PacifiCorp Energy and Cowlitz County PUD No. 1

Aquatic Monitoring and Evaluation Plan for the Lewis River

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Acronyms and Abbreviations

ACC	Aquatics Coordination Committee
AER	Adult equivalent run
AOP	Annual Operating Plan
ATE	Adult trap efficiency
C + E	Catch plus escapement
CE	Collection efficiency
CF	Correction factor
cfs	Cubic feet per second
CI	Confidence Interval
CPE	Catch plus escapement
CS	Collection survival
CWT	Coded-wire tag
DART	Data Access in Real Time
FERC	Federal Energy Regulatory Commission
HOR	Hatchery-origin recruits
HPP	Habitat preparation plan
H&S Plan	Hatchery and Supplementation Plan
M&E	Monitoring and Evaluation
NMFS	National Marine Fisheries Service
NOR	Natural-origin recruits
ODS	Overall downstream survival
PM&E	Protection, mitigation and enhancement
RM	River mile
RMIS	Regional Mark Information System
PIT	Passive Integrated Transponder
SA	Settlement agreement
SAR	Smolt-to-adult survival rate
SASR	Smolt-to-adult survival ratio
SDF	Swift downstream facility
Services	US Fish and Wildlife Service and National Marine Fisheries Service
TCC	Terrestrial Coordination Committee

USFWS	U.S. Fish and Wildlife Service
UPS	Upstream passage survival
USACE	U.S. Army Corps of Engineers
UTF	Upstream transport facility
Utilities	PacifiCorp and Cowlitz County PUD
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
YOY	Young-of-the-year
ZOI	Zone of influence

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1.0 INTRODUCTION

This plan is designed to meet the monitoring and evaluation (M&E) requirements outlined in the Lewis River Settlement Agreement (Settlement) entered into by state, federal and local governments, various resource interest groups and the Lewis River Project hydropower licensees (PacifiCorp and Cowlitz PUD 2004). The Federal Energy Regulatory Commission (FERC) issued new operating licenses for all four Lewis River projects (Merwin, Yale, Swift No. 1 and Swift No. 2) on June 26, 2008 and the requirements of these new licenses are also incorporated in this plan.

The primary focus of the M&E plan is the evaluation of upstream fish collection facilities at Merwin Dam and downstream facilities at Swift Dam. As described in Section 9.1 of the Settlement, the M&E Plan shall provide the approach to:

> *"…monitor and evaluate the effectiveness of aquatic PM&E Measures and to assess achievement of the Reintroduction Outcome Goals. The M&E Plan shall address the tasks, and the methods, frequency and duration of those tasks, necessary to accomplish the monitoring and evaluation items…"*

Anadromous fish reintroduction goals were established in the Settlement for coho, spring Chinook and steelhead for the portion of the Lewis River basin located upstream of Merwin Dam. The measures to be monitored and evaluated are described primarily in sections 4 and 9 of the Settlement. The intent of the M&E Plan is to identify monitoring actions to determine the success of constructed fish passage systems and the overall success of the fish reintroduction effort. The reintroduction outcome goal is to:

> *"…achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations ("Reintroduction Outcome Goal")."*

However, it needs to be noted that the metrics for determining whether the Reintroduction Outcome Goal is being met have yet to be developed[1] by the US Fish and Wildlife Service and National Marine Fisheries Service (the Services). Because these metrics are unavailable, the M&E Plan focuses on those studies needed to determine when the performance standards outlined in Section 4 of the Settlement are achieved. A definition of each performance standard and its benchmark value are presented in Table 1.1.1.

The M&E Plan also provides the methods to be used to monitor and evaluate adult fish spawning escapement, fish passage facility hydraulic performance, flow and ramping rates, resident and anadromous fish interactions, and bull trout and kokanee populations. Monitoring related to Clean Water Act Section 401 certification is identified in the Final Water Quality Management Plan which was submitted for comment to the Washington Department of Ecology (WDOE) in September 2008 and will be finalized in 2009. Also, monitoring needed to implement the Lewis River Hatchery and Supplementation Plan (H&S Plan) (PacifiCorp Energy and Cowlitz PUD 2006) is detailed in that plan. H&S

[1] The time frame for the Services to identify this metric is described in Section 3.1.1 of the Settlement.

monitoring objectives are summarized here (Objective 21) for reader convenience and to demonstrate that all aspects of the reintroduction program are being monitored. PacifiCorp and Cowlitz PUD will provide an annual report to FERC (ACC/TCC Annual Report), the Aquatics Coordination Committee (ACC) and the Terrestrial Coordination Committee (TCC) and WDOE in approximately April of each year. The ACC/TCC Annual Report will contain results of all monitoring activities included in the M&E Plan plus all water quality, hatchery, and terrestrial monitoring results from the previous year.

Table 1.1.1. Reintroduction performance standard definitions and benchmark values.

Performance Standard	Definition[1]	Benchmark Value
Adult Trap Efficiency (ATE)	The percentage of adult Chinook, coho, steelhead, bull trout, and sea-run cutthroat that are actively migrating to a location above the trap and that are collected by the trap.	Determined by the ACC to be 98%
Collection Efficiency (CE)	The percentage of juvenile anadromous fish of each of the species designated in Section 4.1.7[2] that is available for collection and that is actually collected.	95%
Collection Survival (CS)	The percentage of juvenile anadromous fish of each of the species (designated in Section 4.1.7) collected that leave the Release Ponds alive.	Smolts $\geq$ 99.5% Fry $\geq$ 98% Adult Bull Trout $\geq$ 99.5%
Injury	Visible trauma (including, but not limited to hemorrhaging, open wounds without fungus growth, gill damage, bruising greater than 0.5 cm in diameter, etc.), loss of equilibrium, or greater than 20% descaling . "Descaling" is defined as the sum of one area on one side of the fish that shows recent scale loss. This does not include areas where scales have regenerated or fungus has grown.	$\leq$ 2% for smolts
Overall Downstream Survival (ODS)	The percentage of juvenile anadromous fish of each of the species designated in Section 4.1.7 that enter the reservoirs from natal streams and survive to enter the Lewis River below Merwin Dam by collection, transport and release via the juvenile fish passage system, passage via turbines, or some combination thereof (calculated as provided in Schedule 4.1.4. of the Settlement).	Interim $\geq$ 80% $\geq$ 75% after installation of Yale Downstream Collector
Upstream Passage Survival (UPS)	Percentage of adult fish of each species (designated in Section 4.1.7) that are collected that survive the upstream trapping-and-transport process. For sea-run cutthroat and bull trout, "adult" means fish greater than 13 inches in length.	$\geq$ 99.5%

[1] Definitions are taken from Settlement Agreement for the Lewis River Hydropower Projects (PacifiCorp and Cowlitz PUD 2004)
[2] Species designated in Section 4.1.7 of the Settlement Agreement are spring Chinook, winter steelhead, coho, bull trout and sea-run cutthroat trout.

Because the M&E Plan will be updated approximately every five years, this initial plan emphasizes the methods for evaluating the Swift Downstream Facility (SDF) and the Merwin Upstream Transport Facility[2]. The SDF will be used to collect juvenile and adult anadromous salmonids migrating downstream from stream reaches upstream of Swift No. 1 Dam. The Merwin Upstream Transport Facility will collect adults returning to this same portion of the basin or to hatchery facilities.

The performance standards shown in Figure 1.1-1 will be used to determine not only the success of the SDF but also provide the justification for making improvements to this facility over time.

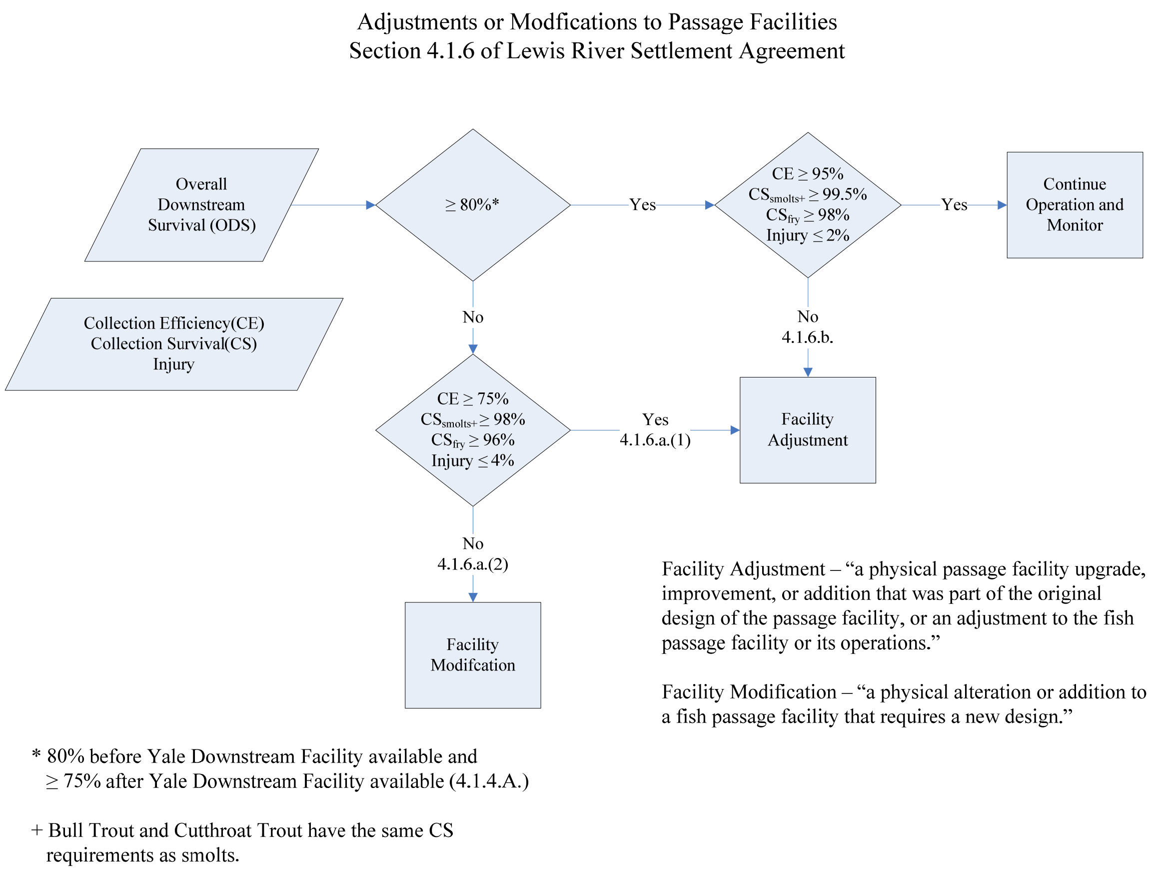


Figure 1.1-1. Swift downstream facility decision flow chart.

The lessons learned from studies undertaken to evaluate these facilities will be applied to new adult and juvenile passage facilities proposed for Yale starting in year 13 (June 2021) and juvenile passage facilities at Merwin starting in year 17 (June 2025) of the new FERC licenses.

Finally, the need for updating the M&E Plan will be determined as part of the comprehensive periodic review as outlined in the Settlement (see Sections 8.2.6 and 9.1

[2] The Settlement states that the licensees shall consult with the ACC as necessary, but not less than every five years (Section 9.1).

of the Settlement). This review will occur at a minimum within 5 years after the reintroduction of anadromous fish above Swift Reservoir, Yale Lake and also Lake Merwin. The periodic review will be repeated every 10 years from that point forward.

2.0 MONITORING AND EVALUATION OBJECTIVES

The M&E Plan has been designed to achieve twenty-one objectives. The objectives are as follows:

Objective 1	Quantify overall juvenile fish downstream survival (ODS) which includes reservoir survival, collection survival, transport survival, and survival at the release ponds
Objective 2	Quantify SDF collection efficiency
Objective 3	Quantify the percentage of juvenile fish available for collection that are not captured by the SDF and that enter the powerhouse intakes
Objective 4	Quantify juvenile and adult collection survival
Objective 5	Quantify juvenile injury and mortality rates during collection at the SDF (includes injury and mortality of adult bull trout, adult sea-run cutthroat, and steelhead kelts)
Objective 6	Quantify the number, by species, of juvenile and adult fish collected at the SDF
Objective 7	Quantify the number of juveniles entering Swift Reservoir
Objective 8	Develop index of juvenile migration timing
Objective 9	Quantify adult upstream passage survival
Objective 10	Quantify adult trap efficiency at each upstream fish transport facility (emphasizes analysis of the Merwin Adult Trapping Facility)
Objective 11	Quantify the number, by species, of adult fish being collected at the projects (emphasizes Merwin Dam)
Objective 12	Quantify ocean recruits
Objective 13	Develop performance measures for index stocks
Objective 14	Document upstream and downstream passage facility compliance with hydraulic design criteria
Objective 15	Determine spawn timing, distribution and abundance of transported anadromous adults

Objective 16 Evaluate lower Lewis River wild fall Chinook and chum populations

Objective 17 Monitor bull trout populations

Objective 18 Determine interactions between reintroduced anadromous salmonids and resident fish

Objective 19 Document Project compliance with flow, ramping rate and flow plateau requirements

Objective 20 Determine when reintroduction outcome goals are achieved

Objective 21 Develop a Hatchery and Supplementation Plan (H&S) to support and protect Lewis River native anadromous fish populations and provide harvest opportunity

For objectives 1-20, the tasks, methods, frequency and duration of sampling, assumptions, results and reporting are discussed in the sections that follow. For objective 21, a brief description of the H&S plan is provided. The reader is referred to the actual plan for detailed description of proposed methods, monitoring and expected outcomes.

Although not explicitly repeated for each objective, the fish handling and facility operations listed in the Incidental Take Statements for the Project will be strictly followed. The Incidental Take Statement can be found in Section 9 of the National Marine Fisheries Service (NMFS) Biological Opinion for the Project (NMFS 2007) and the USFWS Biological Opinion (USFWS 2006). The Post-Season Monitoring and Evaluation Form required by NMFS is attached as Appendix A. This post-season report will be included in the ACC/TCC Annual Report.

2.1 OBJECTIVE 1: QUANTIFY OVERALL JUVENILE DOWNSTREAM SURVIVAL

The Settlement requires that the Utilities achieve an overall downstream survival (ODS) rate of greater than or equal to 80%[3]. ODS is defined in Section 4.1.4 of the Settlement Agreement as:

> *The percentage of juvenile anadromous fish of each of the species designated in Section 4.1.7 that enter the reservoirs from natal streams and survive to enter the Lewis River below Merwin Dam by collection, transport and release via the juvenile fish passage system, passage via turbines, or some combination thereof, calculated as provided in Schedule 4.1.4.*

In other words, ODS is the percentage of the fish entering the Project that migrate, or are transported to the lower Lewis River (i.e., downstream of Merwin Dam) and released successfully (i.e., alive). It should be noted that Schedule 4.1.4 of the Settlement contains

[3] An ODS of greater than or equal to 80% is required until such time as the Yale Downstream Facility is built or the Yale In Lieu Fund becomes available to the Services, after which ODS shall be greater than or equal to 75%. The parties to the Settlement acknowledge that ODS rates of 80% or 75% are aggressive standards and will take some time to achieve.

a caveat that the methodology described in the Schedule needs to be ground-truthed and may not be the best method to use.

2.1.1 Task 1.1- Estimate ODS for Anadromous Fish Species above Swift No. 1 Dam

Initially, ODS will be measured from the head of Swift Reservoir to the exit of the Release Ponds located downstream of Merwin Dam[4] (Figure 2.1-1). Estimates of ODS will be developed for coho, spring Chinook, steelhead and sea-run cutthroat trout. ODS estimates for sea-run cutthroat trout will be delayed until data indicate that this cutthroat life history is present in the upper Lewis River basin and that the number of juveniles produced is sufficient, as determined by the USFWS, for experimental purposes.

Passive Integrated Transponder (PIT) tags and direct enumeration of fish collected and transported from the SDF will be used to develop estimates of ODS.

Consistent with the Settlement, juveniles passing Swift Dam either through the turbines or spill will not be counted toward meeting the ODS standard because they are unlikely to survive passage through multiple dams and reservoirs not equipped with passage facilities. There is however, an allowance to consider turbine survival if it appears to be higher than expected[5].

2.1.1.1 Methods

The methods proposed for developing estimates of ODS are as follows:

- Test fish will be obtained from a screw trap operated at the head of Swift Reservoir or at the SDF[6]. Preference will be to use fish collected at the screw trap as these fish would have not been exposed to the reservoir environment; an exposure that may alter fish behavior, and thus interpretation of study results.

- Fish captured at the traps will be identified to species, measured for length and a subsample tagged with PIT-tags. Only fish greater than, or equal to, 60mm in length will be tagged. This is the minimum size of fish that can be tagged with the PIT-tag[7].

- Fish will be released at the head of Swift Reservoir. Releases will be made weekly throughout the major part of the migration season (April-June). A total of 996 fish of each species will be released over the course of six weeks in proportion to the run-timing of each species. PIT tag releases would be extended

[4] Estimates of ODS will be developed for fish collected at Yale and Merwin dams once downstream passage facilities are constructed.

[5] The Settlement states that fish passing through turbines at Swift Dam can be ignored if they are not expected to contribute substantially to ODS.

[6] According to the Settlement Agreement, the Modular Surface Collector built at Swift No. 1 Dam will be referred to as the Swift Downstream Facility. It is to be operational within 6 months following the 4th anniversary of the issuance of the new license for the Swift No. 1 or 2 Project, whichever is later. That implementation date is December 26, 2012.

[7] Smaller fish may be tagged in the future if technologies become available that allow marking and handling of test specimens with low mortality rates.

if juvenile run-timing data collected during the initial pilot study (see below) indicate that fish migration extends into summer or fall.

- Sample size for the release was based on a reservoir survival rate of 80%, tag detection probability of 95% and a precision of 0.025 (see Appendix B). The test fish will be held for 24 hours prior to release to quantify handling mortality.

- A control group (100 of each species) will be held in small circular raceways throughout the study to determine 1) post-release mortality due to tagging, and 2) tag shedding. The facilities will be located in a secure area.

- PIT-tag detectors will be located on the SDF and at the exit of the release ponds and will generate the tag detection histories necessary to estimate ODS.

- The SDF, transport trucks and release ponds will be examined daily by biologists to determine the number of fish killed during the handling and transport processes. All dead fish will be examined for the presence of a PIT tag. Dead tagged fish found in the SDF and release ponds would be assigned to collection loss (S_{COL}) and transport loss (S_{TRAN}), respectively.

- 50 dead PIT-tagged fish will be released into the SDF over the course of the season as a check on the ability of the biologists to detect and recover dead fish. If tag recoveries are less than 100%, estimates of ODS will be adjusted based on the calculated error rate[8].

The single release-recapture model will be used to estimate the probability of surviving passage to the lower Lewis River (Appendix B).

ODS will be calculated as:

$ODS = S_1 * (S_{COL} * S_{TRAN})$

Where

S_1 = joint survival probability through reservoir (S_{RES}) and collector (P_{COL}),

P_{COL} = proportion of fish arriving at Swift Dam that enter the surface collector,

S_{COL}= survival probability through the collector,

S_{TRAN} = survival probability through the smolt transport system.

A diagram of each of these four parameters (S_{RES}, P_{COL}, S_{COL} and S_{TRAN}) is shown in Figure 2.1-2.

8 PIT tag detectors located at the pond exits will also provide information on whether dead tagged fish are able to leave the ponds.

The seasonal ODS estimate will be based on pooling release–recapture data over the season. Because some proportion of the smaller fish (60mm to 90mm) tagged are likely to overwinter in the reservoir, any fish captured in subsequent years will be added to the ODS estimate for their release year.

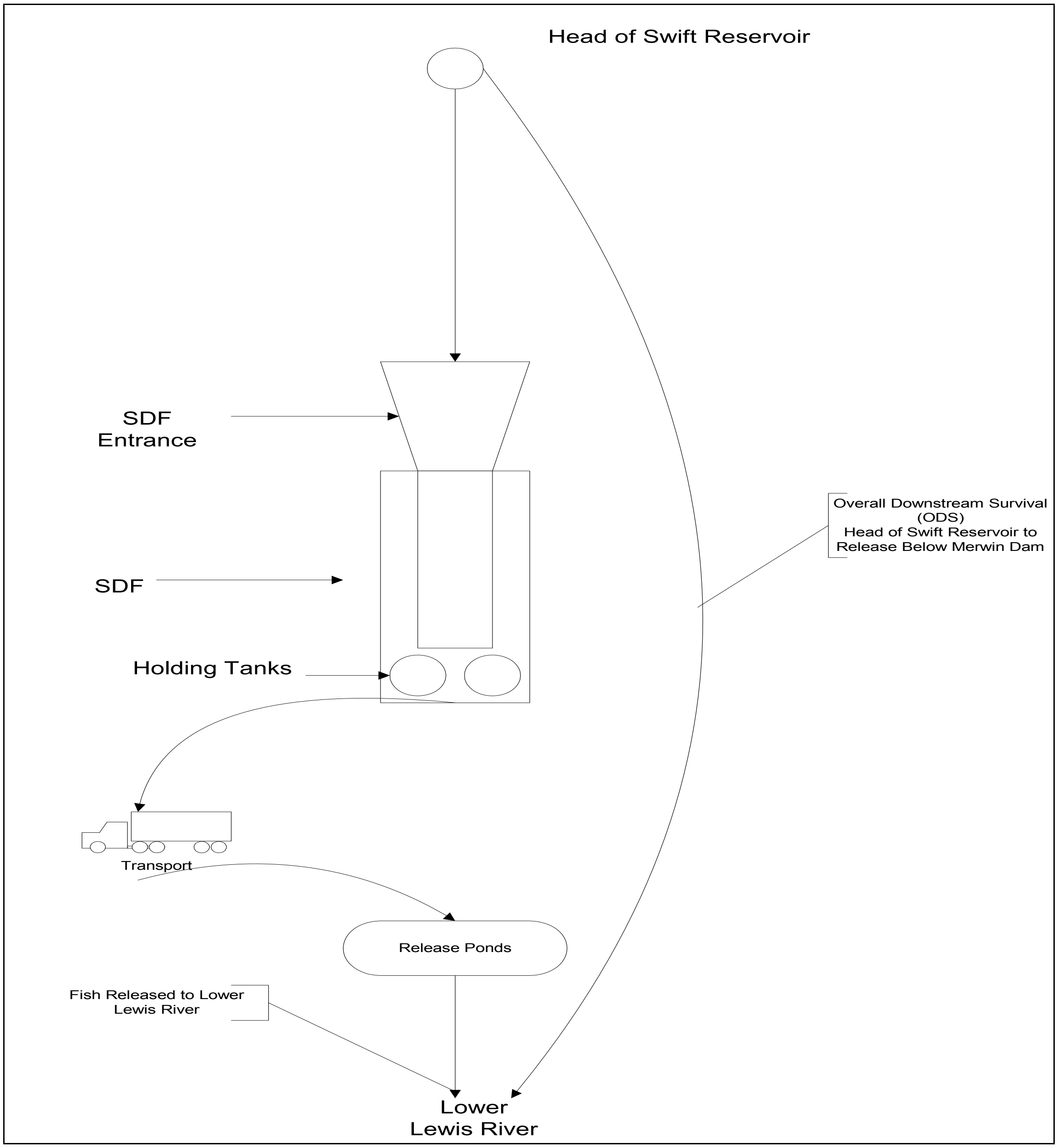


Figure 2.1-1. Schematic showing ODS measurement range and associated facilities.

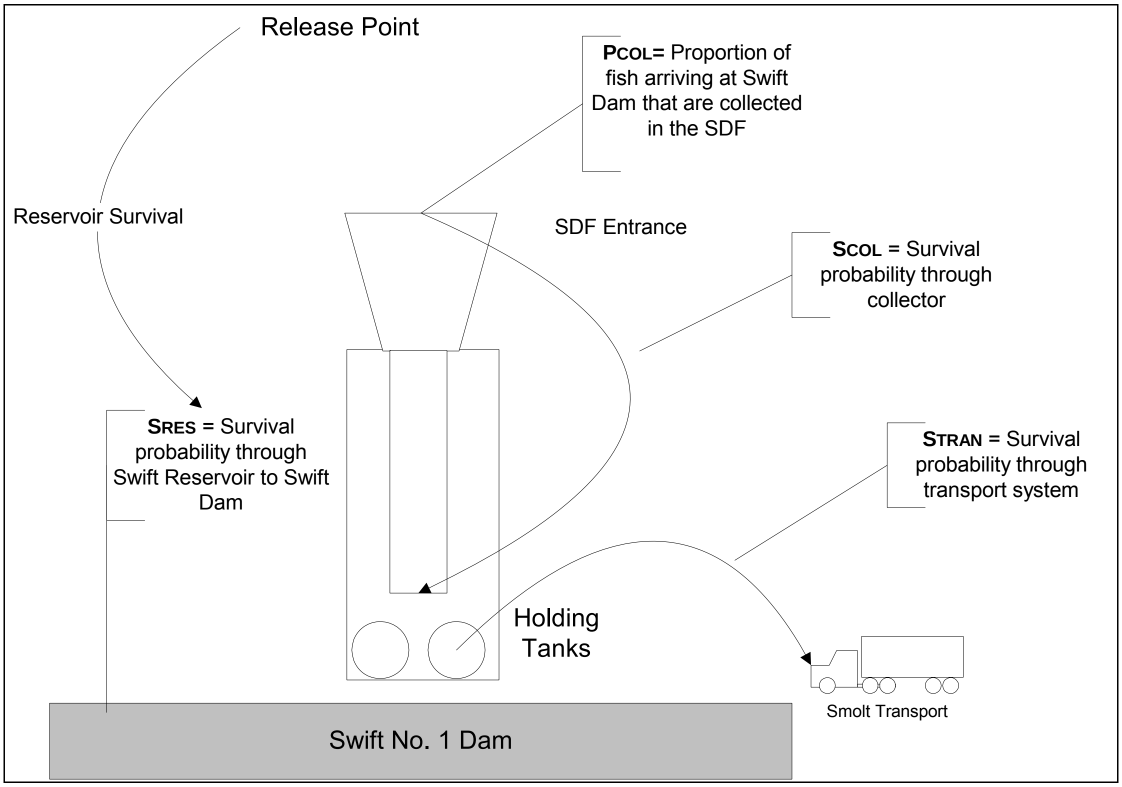


Figure 2.1-2. Schematic showing evaluation parameters for calculating ODS.

2.1.1.2 Frequency and Duration

The study will be conducted over a four year period. The first year will be considered a pilot study designed to test study methods, equipment and assumptions (detection, probability, active migration etc.). Actual estimates of ODS will be developed by species in years 2-4. The study will then be performed yearly until such time as study results show that the 80% ODS standard has been met for each species. The study will be repeated upon completion of the Yale downstream collection facility to determine if the 75% ODS criteria called for in the Settlement is achieved.

2.1.1.3 Assumptions

Assumptions associated with conducting the analysis include:

1. All fish act independently.
2. Release size is known without error.
3. There is no post-release handling mortality, tag failure or loss, or these parameters can be estimated and the survival estimates adjusted accordingly.

4. Downstream detection is conditionally independent of detection upstream.

5. Tagged fish are uniquely identifiable at all detection sites.

6. Fry and parr mortality due to extended reservoir rearing is accepted as a Project impact and does not need to be corrected for.

7. Fish passing through spill and turbine discharge at Swift Dam will not count toward meeting the ODS standard (i.e. these fish will be considered mortalities).

Of the six assumptions listed, number 3 is the most likely to be violated. Tagging and transporting juvenile salmonids can be stressful and result in some mortality both pre- and post-release. To quantify this mortality, a control group will be established as part of the experimental design. These fish will be tagged and handled in an identical fashion as the test fish. However, instead of being released into the reservoir, the fish will be held in small raceways, and then observed over time to determine mortality and tag shedding rates. This information will then be used to adjust survival rates for the test fish, if needed.

2.1.1.4 Results and Reporting

The results of the study will be recorded weekly and reported in text and tabular format in the ACC/TCC Annual Report. The type of table that would be presented is shown in Table 2.1.1.

Table 2.1.1. Example table of weekly estimates of the percent ODS for juvenile coho, Chinook and steelhead released at the head of Swift Reservoir.

Date	Coho	Chinook	Steelhead
Week 1			
Week 2			
Week 3			
Week 4			
Week 5			
Week 6			

A total estimate of ODS for the migration season will also be developed and reported by species. Biologists will investigate and present any information that indicates ODS values vary by fish size class or project operations. This information would be used to adjust study protocols to better estimate ODS and implement corrective actions if ODS is not being achieved.

2.2 OBJECTIVE 2- ESTIMATE SDF COLLECTION EFFICIENCY (P_{CE})

Radio-tagged fish released at the head of Swift Reservoir will be used to measure the juvenile collection efficiency (P_{CE}) of the SDF. Section 4.1.4 of the Settlement defined collection efficiency as:

The percentage of juvenile anadromous fish of each of the species designated in section 4.1.7 that is available for collection and that is actually collected.

In this study, a juvenile that is available for collection is one that is found (detected) within the zone of influence (ZOI) of the SDF entrance[9]. As stated in the Settlement, the performance standard for P_{CE} is 95% or greater for smolts.

Additionally, estimates of the proportion of fish encountering the SDF (P_{ENC}), SDF fish entrance efficiency (P_{ENT}) and SDF retention efficiency (P_{RET}) will also be collected as part of this analysis using radio-tag detections. Collecting this data will give biologists the ability to determine where improvements in the design or configuration of the SDF may be needed to meet the collection efficiency and ODS standards. The importance of each parameter in diagnosing SDF operations are as follows:

- P_{ENC} – A low encounter value indicates that few fish arriving at Swift Dam were detected within the zone of hydraulic influence of the SDF[10].
- P_{ENT} - Fish that have encountered the collector entrance may not actually enter the SDF. This condition would be indicated by a low entrance efficiency value for P_{ENT}. The problem may be caused by poor or confusing hydraulics at the mouth of the collector or a sudden decrease or increase in water velocity just inside the SDF. Such problems may be corrected by altering system hydraulics.
- P_{RET} - Fish that enter the SDF may also swim back out of the system, resulting in low SDF retention efficiency (P_{RET}). Low SDF retention efficiency may be the result of water velocities through the SDF that are too slow to trap the fish. This condition could be alleviated by increasing flow through the collector or changing screen openings to increase water velocities.

2.2.1 Task 2.1- Estimate SDF Collection Efficiency (P_{CE})

2.2.1.1 Methods

A description of the methods to be used in estimating SDF collection efficiency is presented below.

- Radio tags will be used for estimating SDF collection efficiency. A total of 55 radio-tagged juveniles will be released per species to estimate FCE. Sample size was based on achieving a 90% confidence level (CL) at a 0.05 precision level when FCE and tag detection probability is 95%.
- Sample fish will be collected either at the screw trap located at the head of Swift Reservoir or at the SDF. Fish captured at either location will be identified to species, measured for length and tagged with a radio-tag.

[9] The Zone of Influence is the area in front of the SDF entrance where all flow lines within the exclusion nets lead to the collector.

[10] Encounter efficiency is not a performance criteria identified in the Settlement. It is used here to document whether the collector location needs adjustment or that flows into the collector should be increased to better attract juvenile migrants.

- Only fish greater than 90mm will be tagged, as this is currently the minimum sized fish that can be used for radio tag studies. Tagging smaller fish may result in high mortality rates or negatively affect fish behavior.

- A control group will be held in small circular raceways throughout the study to quantify tag failure, tag loss, decay rate and also to determine post-release mortality. The facilities will be located in a secure area.

- Tagged fish will be transported by boat and released 2 miles upstream of the SDF. Releasing fish at this point, instead of the head of the reservoir, will increase survival rates of tagged fish and result in more test fish arriving at the SDF.

- Fish will be released over a 6-week period in proportion to the run at large. Juvenile run-timing will be based on the results of the pilot study proposed in year 1 (see section 2.2.1.2).

- The first antennae array (A in Figure 2-1.3) will be located at or near the entrance of the SDF; the second, (B in Figure 2-1.3), will be near or within the holding tanks, depending on operational constraints of the facility.

- Antennae array (A) will be tuned to detect fish within the ZOI of the surface collector. The ACC agreed that the ZOI extends from the mouth of the SDF 150 feet upstream into the forebay. Field crews will verify the detection zone by trolling radio tags in, through and outside of the ZOI. A map showing detection locations will be developed and presented to the ACC prior to releasing tagged fish to determine SDF collection efficiency.

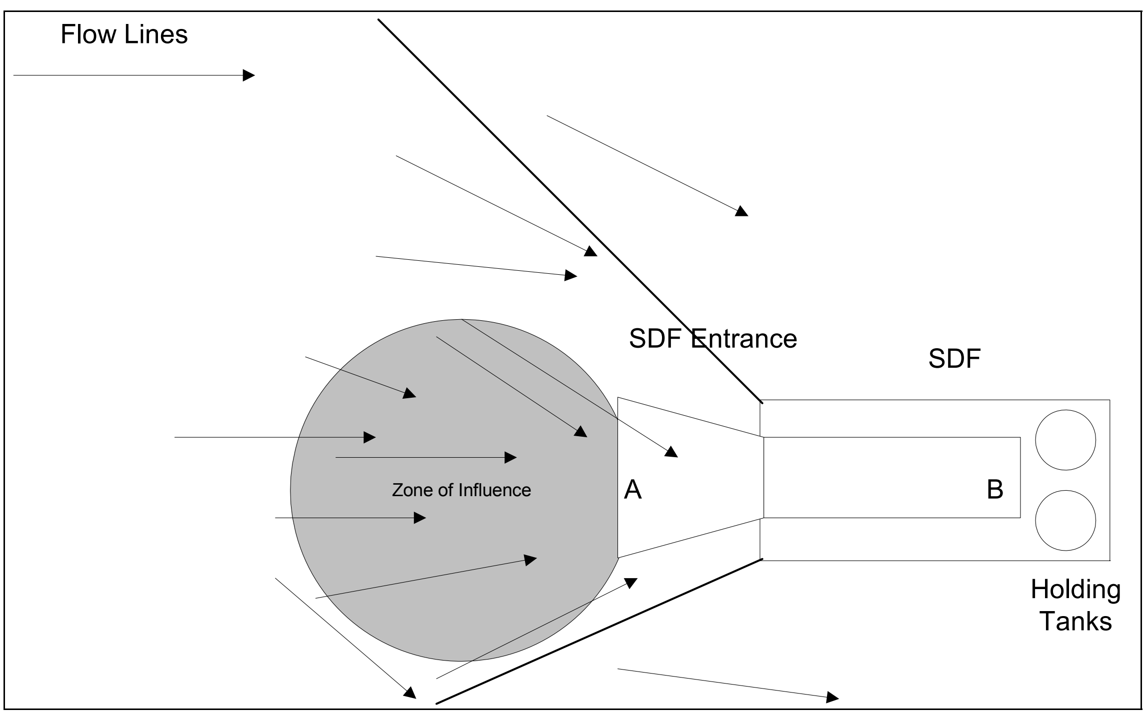


Figure 2.1-3. Schematic of SDF and associated antenna arrays (A and B). The gray circle represents the ZOI (diameter of 150 ft).

The collection efficiency of the SDF (P_{CE}) will be estimated as:

$$\hat{P}_{CE} = \frac{a_2}{a_1}$$

Where

a_1 = number of unique tagged fish identified in the ZOI of the surface collector

a_2 = number of unique tagged fish identified in the fish holding tanks

2.2.1.2 Frequency and Duration

A pilot study will be conducted in year 1 to test study methods and equipment. In years 2-4, SDF collection efficiency will be quantified weekly for approximately 6 weeks around the expected peak migration period for each species. The study would continue annually after year 4 for those species for which collection efficiency was not met. Future studies would not be implemented if it is determined by the ACC and the Services that improvement in SDF collection efficiency is not possible.

2.2.1.3 Assumptions

All of the assumptions associated with the single release-recapture model described in Section 2.1.1.3 apply here as well. In addition, it is assumed that the second antennae array will have 100% detection efficiency[11].

2.2.1.4 Results and Reporting

The results of the study will be reported in tabular format in the ACC/TCC Annual Report. An example is shown below as Table 2.2.1.

Table 2.2.1. Example table for weekly and seasonal estimates of SDF collection efficiency for coho, Chinook and steelhead.

Date	Coho	Chinook	Steelhead
Week 1			
Week 2			
Week 3			
Week 4			
Week 5			
Week 6			
Season			

[11] Antennae detection efficiency will be tested as part of study set-up.

A total estimate of SDf collection efficiency for the migration season will also be developed and reported by species.

2.2.2 Task 2.2- Estimate the Number of Juveniles Encountering the SDF Entrance (P_{ENC})

2.2.2.1 Methods

The number of juveniles (smolts) encountering the SDF will be determined by tracking releases of radio-tagged fish as they arrive at Swift Dam[12]. Antennae arrays will be placed across the face of Swift Dam to detect radio-tagged fish arriving at the dam. Arrays will be located near the spillway and on the earthen embankment both upstream and downstream of the SDF. Actual array locations will be developed once a final design for the SDF has been completed[13].

The proportion of the tagged juveniles encountering the SDF (P_{ENC}) will be calculated as:

$$P_{ENC} = DET_{SDF} / DET_{SWIFT}$$

Where

DET_{SDF} = number of juveniles detected at antenna array A and/or B on the SDF

DET_{SWIFT} = number of juveniles detected at Swift Dam and the SDF

P_{ENC} will provide a simple index to describe the proportion of the tagged fish that were available for collection.

2.2.2.2 Frequency and Duration

P_{ENC} estimates will be developed until the collection efficiency standard is achieved.

2.2.2.3 Assumptions

Antenna array A can be tuned to detect fish only within the zone of influence of the SDF.

2.2.2.4 Results and Reporting

Results will be reported in the ACC/TCC Annual Report. Data will be presented in tabular format similar to that shown in Table 2.2.1.

[12] Release locations would be developed in consultation with the ACC.

[13] Antennae arrays will be tested to determine the detection range of each array. This action will ensure that fish outside of the SDF, for example, are not counted in collection estimates, etc.

2.2.3 Task 2.3- Estimate Juvenile Entrance Efficiency (P_{ENT}) and Retention Efficiency (P_{RET}) for the SDF

2.2.3.1 Methods

Juvenile entrance (P_{ENT}) and retention efficiency (P_{RET}) will be estimated using radio-tag detections at two locations within the SDF (Figure 2.2-1). Two antennas located at D1 (Entrance) and D2 (Retention Zone) will be used to determine P_{ENT} and P_{RET}, respectively.

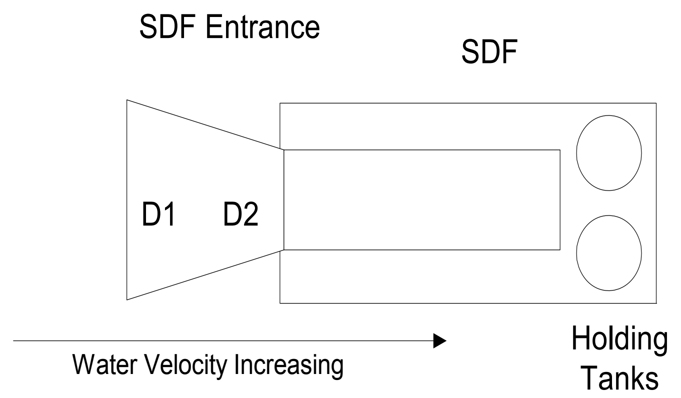


Figure 2.2-1. Location of detection antenna on SDF (D1 and D2).

The antennas will detect radio-tagged fish entering the SDF. Detection history of each tagged fish will be used to determine the pertinent variables as described below.

P_{ENT} will be calculated as:

P_{ENT} = number of radio-tag fish detected at D1/ P_{ENC}

P_{RET} will be calculated as:

P_{RET} = number of radio-tagged fish detected at D2/number of radio-tagged fish detected at D1.

2.2.3.2 Frequency and Duration

Performed at any time SDF collection efficiency estimates are being developed.

2.2.3.3 Assumptions

Key assumptions of the analysis include:

- Antenna power can be adjusted such that detection zones can be estimated.
- Antenna can be placed within the SDF without impacting SDF operations.

2.2.3.4 Results and Reporting

Study results will be provided as a stand-alone report at the conclusion of each evaluation season. A summary of the report will be provided in the ACC/TCC Annual Report.

2.3 OBJECTIVE 3- DETERMINE THE PERCENTAGE OF JUVENILES AVAILABLE FOR COLLECTION THAT ARE NOT CAPTURED BY THE SDF AND THAT ENTER THE TURBINES

The proportion of fish entering the intake of the Swift No. 1 powerhouse will not be quantified until downstream collection systems are installed at Yale and Merwin dams. Once these systems are operational, the M&E Plan will be updated to include study protocols designed to determine turbine entrainment and loss. In the interim, antenna will be located in the Swift No. 2 canal downstream of the Swift No. 1 powerhouse tailrace to detect any radio-tagged fish passing through the Swift No.1 units. This assumes that radio tags remain functional after passing through the Swift No. 1 turbines.

2.4 OBJECTIVE 4- ESTIMATE JUVENILE AND ADULT COLLECTION SURVIVAL

The objective of this task is to quantify survival from the time the fish (Chinook, coho, steelhead, and sea-run cutthroat smolts and fry and adult bull trout and steelhead kelt) enter the SDF to their release downstream of Merwin Dam[14]. This survival rate is defined in the Settlement as collection survival (CS). The CS standard varies by fish size and species as shown below:

- Chinook, coho, steelhead, and sea-run cutthroat smolts = 99.5%
- Chinook, coho, steelhead and sea-run cutthroat fry = 98%
- Bull trout = 99.5%

The CS standard will be considered met if the calculated 95% confidence interval (CI) spans the target survival rate of smolts, fry and adults.

The PIT-tag data collected to estimate ODS can be used to estimate CS for smolts, but not for fry. Fry are too small to tag with a PIT tag and therefore calculating survival for this size fish requires that mortality be measured directly at the subsampler, transport tanks and release ponds. The calculations for estimating smolt collection and transport survival using the PIT tag results are presented in Appendix B.

Because fish mortality may occur both in the collection and/or transport processes, separate estimates of survival through each process will help determine the cause of any observed mortality and will be used to develop appropriate remedial measures. Therefore, CS will be broken into two components, collection survival (S_{COL}) and transport survival (S_{TRAN}).

[14] Bull trout survival estimates will also be made for other release sites identified by the USFWS. Steelhead kelt mortality and injury rates, although not required in the Settlement will be based on visual observation.

Estimates of CS, S_{COL} and S_{TRAN} will be developed for coho, Chinook, steelhead, sea-run cutthroat trout (if a run is established) and bull trout captured in the SDF[15].

2.4.1 Task 4.1- Estimate Fish Collection and Transport Survival Rates

2.4.1.1 Methods

The methods to be used for quantifying S_{COL}, S_{TRAN} and CS are presented below.

Determine Fish Survival through the Collection System (S_{COL})
Survival estimates for juvenile fish collected at the SDF (S_{COL}) will be developed daily by collecting a 10% subsample of captured fish prior to their entry into the transport system. Subsampling will be accomplished through the use of gates located on the SDF that can be programmed to automatically divert fish to the subsample tanks. The diverted fish will be physically examined to determine the proportion of fish that die from collection activities. Consequently, estimates of S_{COL} will be based on binomial sampling with the estimator:

S_{COL} = $Fish_{SUB} / Fish_{EX}$

$Fish_{SUB}$ = number of fish found alive in subsample

$Fish_{EX}$ = number of fish examined in subsample

Determining Survival through the Transport System (S_{TRAN})
Juvenile survival, from the time they enter the transport system until they exit the release ponds downstream of Merwin Dam, is defined as S_{TRAN}[16].

The method used for determining S_{TRAN} is as follows:

- Healthy uninjured smolts and fry will be marked and released directly into the transport tanks located on the SDF on a weekly basis (one test per week)[17]. The test fish used for these releases will be collected from the SDF subsample tanks. A control group will be established to determine mortality associated with handling.

- Test fish releases will be made such that these fish spend a similar amount of time in the holding tanks as the fish that were diverted to the tanks through the SDF.

- Fish in the holding tanks will then be loaded onto trucks, transported and released to the ponds located below Merwin Dam. The current design has three release ponds and one redundant pond. The three ponds are thought to be adequate for

[15] Survival estimates will be developed for both juvenile and adult bull trout. The adult bull trout CS standard is 99.5%. Unless large numbers of bull trout juveniles are collected at the SDF, testing will not be performed.

[16] The USFWS BiOP requires that smolt-sized bull trout be placed in recovery tanks and released to the next reservoir downstream. Bull trout fry are to be released back to Swift Reservoir. Because of this requirement estimates of transport survival to and out of the ponds will not be developed for this species. Visual estimates of fish health for bull trout released at other locations will be used to estimate mortality.

[17] Transport survival tests will be conducted more frequently if CS values drop below 99%.

the anticipated numbers of outmigrants. The fish will be held in these ponds for 24 hours.

- Prior to releasing fish from the ponds, the ponds will be checked for dead fish. Dead or dying fish will be collected, examined for marks and injury, and identified to species. The ponds gates then will be opened and the fish allowed to volitionally exit over a 24-hour period[18].

- To test the ability of biologists to identify and collect dead fish from the release ponds, a known number of marked dead fish will be periodically released into the transport system. The results of this test will be used to develop a correction factor to account for less than 100% detection of dead fish.

- After 24 hours, the ponds will once again be examined for dead fish. Any dead fish will be collected, examined for marks and injury, and identified to species. Live fish remaining in the ponds at this time will be forced out of the ponds.

S_{TRAN} will be calculated using the formula:

S_{TRAN} =	$(Fish_{alive}/Fish_{REL}) * CF$
$Fish_{alive}$ =	number of marked fish found alive in release ponds
$Fish_{REL}$ =	number of marked fish released in transport system
CF =	Correction factor for missed marked fish based on marked dead fish

An estimate of S_{TRAN} will be developed for coho, Chinook, steelhead, sea-run cutthroat trout and bull trout (adults and juveniles) captured in the SDF. It should be noted that S_{TRAN} values for bull trout adults (and steelhead kelts) will be based on observed mortalities during transport and release at all release sites identified by the resource agencies.

Calculating Juvenile Collection Survival (CS)
CS is the combined juvenile mortality observed for collection (S_{COL}) and transport (S_{TRAN}), calculated as:

$$CS = S_{COL} * S_{TRAN}$$

An estimate of CS will be developed daily for coho, Chinook, steelhead, sea-run cutthroat trout and bull trout (adults and juveniles) captured in the SDF. The daily estimates will be pooled to develop an overall estimate of CS for the monitoring season.

18 Note that ponds and transport systems will be examined daily for dead and injured fish even when tests are not being conducted. Daily estimates of each parameter will be presented in the annual report.

2.4.1.2 Frequency and Duration

Collection survival estimates will be developed daily until it is proven that the collection standards have been met. Once met, survival estimates will be developed monthly to document compliance with the collection survival standard.

2.4.1.3 Assumptions

The major assumptions inherent in the proposed methods include:

1. The subsample fish are representative of the population being collected and transported.

2. Diversion of juvenile fish into the subsample system does not bias mortality estimates.

3. Fish handling protocols for determining S_{TRAN} do not bias juvenile mortality estimates.

4. Biologists will be able to identify and collect dead fish from the release ponds.

2.4.1.4 Results and Reporting

Results of the analysis will be presented in tabular format as shown in Table 2.4.1. The CS standard will be considered met if the calculated confidence interval (CI) spans the target survival rate of smolts, fry and adults.

Table 2.4.1. Example table of daily and seasonal estimates of S_{COL}, S_{TRAN} and CS, with associated 95% CI for coho salmon collected and transported from the SDF.

	Collection Survival	**Transport Survival**	**Collection + Transport (CS)**	
Week	S_{COL}	S_{TRAN}	CS	95% CI
Day 1				
Day 2				
Day 3				
Season				

2.5 OBJECTIVE 5- DETERMINE JUVENILE INJURY RATES DURING COLLECTION AT THE SDF

The objective of this analysis is to determine the injury rate for fish collected at the SDF. The Settlement establishes a SDF design performance objective for injury of less than or equal to two percent for all fish examined.

Injury is defined in Settlement Table 4.1.4 as:

> *Visible trauma (including, but not limited to hemorrhaging, open wounds without fungus growth, gill damage, bruising greater than 0.5 cm in diameter, etc.), loss of equilibrium, or greater than 20% descaling. "Descaling" is defined as the sum of one area on one side of the fish that shows recent scale loss. This does not include areas where scales have regenerated or fungus has grown.*

2.5.1 Task 5.1- Determine Collection Injury Rate (P_{CINJ})

The method proposed for estimating the proportion of fish injured (P_{CINJ}) each day from collection activities at the SDF is presented below.

2.5.1.1 Method

Estimates of P_{CINJ} will be determined by closely examining a subsample of the total juvenile population collected each day. Sample fish will be diverted (through the use of automatic gates on the SDF) into small holding tanks where they will be anesthetized and examined for injury[19]. Injured smolt and fry will be classified into the categories shown in Table 2.5.1.

Table 2.5.1. Categories used for documenting visible injury at the SDF collection and transport system.

Hemorrhaging	Open Wound (No Fungus)	Open Wound (Fungus)[1]
Gill Damage	Bruising > 0.5 cm diameter	Bruising $\leq$ 0.5 cm diameter
Loss Of Equilibrium	Descaling > 20%	Descaling < or = 20%

[1]Open wound fish with fungus will not be counted as an injured fish. The presence of fungus indicates the wound likely occurred prior to entry into the SDF.

The proportion of juvenile fish injured (P_{CINJ}) will be calculated using the formula:

P_{CINJ} = # of fish injured / # of fish sampled

2.5.1.2 Frequency and Duration

Injury rates will be determined daily for as long as the SDF is operational.

2.5.1.3 Assumptions

The major assumptions for measuring P_{CINJ} include:

1. The subsample fish are representative of the population being collected.
2. Diversion of juvenile fish into the subsample system does not bias estimates of injury.
3. Fish handling protocols do not result in an increase in fish injury.

[19] These fish will not be used for any additional tests of collector mortality.

2.5.1.4 Results and Reporting

Results of the injury analysis will be summarized in tabular format similar to that shown in Table 2.5.2.

Table 2.5.2. The injury type and number of juvenile coho injured during collection and transport operations of the SDF.

	Date		
Data/Injury	5/22/13	5/23/13	5/24/13
Number Examined			
Number Injured (Visible)			
Hemorrhaging			
Open Wound (No Fungus)			
Open Wound (Fungus)			
Gill Damage			
Bruising ≥ 0.5 cm diameter			
Bruising ≤ 0.5 cm diameter			
Loss Of Equilibrium			
Descaling > 20%			
Descaling ≤ 20%			

2.6 OBJECTIVE 6- QUANTIFY THE NUMBER, BY SPECIES, OF JUVENILE AND ADULT FISH COLLECTED AT THE SDF

The objective of this analysis is to quantify the number of juvenile and adult fish collected at the SDF by species.

The number of juvenile fish entering the SDF will be calculated through subsampling and the use of an AquaScan CSE-1600 (Scanner) that will automatically count all fish passing through the SDF. A combination of these two methods was chosen for estimating this parameter as it is currently unknown how accurate the Scanner will be at enumerating small juvenile salmonids under field conditions[20]. System reliability is especially uncertain during periods of high debris load which may trigger a reading, thereby biasing estimates upwards.

2.6.1 Task 6.1- Calculate Juvenile and Adult Collection Numbers Using SDF Subsampling

The methods proposed for quantifying the number of juveniles and adult collected at the SDF are detailed below.

[20] Lab tests conducted on October 15 and 16, 2009 at the Merwin Hatchery indicated that Scanner accuracy for enumerating smolts and fry was 99% and 97%, respectively. However, these tests were done under ideal conditions (See R2 Resources Technical Memorandum dated November 12, 2008).

2.6.1.1 Methods

A diversion gate on the SDF will be used to subsample fish entering the system. Diverted fish will be anesthetized, enumerated, checked for marks and identified to species. The number of fish collected each day in the SDF (SDF_{COL}) will be calculated as follows:

$$SDF_{COL} = N_{SUB} * (SDF_{OP} / S_{SUB})$$

Where

N_{SUB} = # of fish sub-sampled each day

SDF_{OP} = # of hours the SDF was operated each day

S_{SUB} = # of hours the diversion gate was operated each day

Based on ACC input, diversion gates will be operated six minutes out of each hour to provide a 10% sample rate for all fish entering the facility. Sample rates may be increased if future study protocols require the marking of more test fish.

The total number of fish (by species) entering the SDF each year will be calculated by summing the daily totals for each sample year.

2.6.1.2 Frequency and Duration

Daily counts of the number of fish entering the SDF will continue for as long as the facility is operational. Subsampling rates will be developed over time as more is learned about facility effectiveness and total basin fish production.

2.6.1.3 Assumptions

The major assumption inherent in the methodology is that the subsampled fish are representative of the general population.

2.6.1.4 Results and Reporting

The results of the analysis will be presented in tabular format and included in the ACC/TCC Annual Report.

2.6.2 Task 6.2- Calculate Juvenile and Adult Collection Numbers Using Scanner

2.6.2.1 Methodology

Scanners will be located at both the subsample and adult holding tanks on the SDF.

To test the accuracy of the scanner, physical counts of fish collected in the fry and smolt subsample tanks and adult holding tanks will be compared to the fish counts produced from the scanners. Testing will be conducted weekly throughout the migration season to determine if system accuracy varies by species, size and environmental condition present at the SDF.

For each system test, fish will be subsampled hourly over a single 24-hour period. All fish diverted will be counted by hand, identified to species, and measured for length. The number of fish enumerated through the hand count will be compared to the count produced from the scanner for each sample taken.

2.6.2.2 Frequency and Duration

Daily counts of the number of fish entering the SDF will continue for as long as the facility is operational.

2.6.2.3 Assumptions

A key assumption is that the scanner juvenile counts are not biased due to species composition, fish size or environmental condition present at the SDF; or that the bias can be accounted for statistically.

2.6.2.4 Results and Reporting

The results of the analysis will be presented in tabular format by day and included in the ACC/TCC Annual Report.

2.7 OBJECTIVE 7- ESTIMATE THE NUMBER OF JUVENILES ENTERING SWIFT RESERVOIR

Estimating the total number of juvenile salmonids entering Swift Reservoir is required under Section 9.2.1 of the Settlement. Methods for collecting this data are provided below.

2.7.1 Task 7.1– Estimate the Number of Juveniles Entering Swift Reservoir using the Screw Trap at Eagle Cliff

The proposed method for estimating the number of juveniles entering Swift Reservoir from data collected at the SDF is presented below.

2.7.1.1 Methods

A screw trap will be operated at the head of Swift Reservoir at Eagle Cliff to estimate the total number of juvenile salmonids entering the system. The trap will be operated daily from early April through the end of the juvenile migration season.

A subset of the juveniles collected will be marked either with PIT tags or an external mark and released (daily) either downstream of the trap or upstream to estimate trap efficiency. Trap efficiency tests will be conducted weekly throughout the juvenile migration season. Sample size for the releases will be based on achieving a coefficient of variation (CV) of 15% for coho and Chinook, and 30% for steelhead (NMFS 2009). Because trapping efficiency is not currently known for each species, sample sizes required to achieve required precision will be developed over time as biologists gain experience with the system.

Fish released from the trap will be identified to species and measured for length. Fish smoltification status as indicated by physical appearance will also be recorded.

Weekly total juvenile production would be calculated using the following formula:

$$N_{JUV} = SCT_{COLW} / Trap_{eff}$$

Where

N_{JUV} = number of fish entering Swift Reservoir

SCT_{COLW} = number of juveniles collected weekly in the screw trap

$Trap_{eff}$ = estimated recapture efficiency of the screw trap.

These weekly estimates of juvenile production will be combined to calculate the total number of juveniles entering the reservoir each migration season by species.

The M&E subgroup agreed that fish down to 60mm would be marked and assessed. Fry would be included later once a suitable marking methodology is found that will not compromise fry survival.

2.7.1.2 Frequency and Duration

Estimates of the number of juveniles entering the reservoir will be conducted weekly for five years.

2.7.1.3 Assumptions

Key assumptions inherent in the analysis are:

1. Juvenile survival rate from small tributaries in the reservoir to the SDF are similar to those for tributaries upstream of Swift Reservoir.

2. Survival rate for tagged fish is the same as for un-tagged fish.

3. Tagged fish do not show trapping tendency or trap avoidance that differs from untagged fish.

2.7.1.4 Results and Reporting

Trapping results will be summarized in the ACC/TCC Annual Report. An example of a table that may be used to present juvenile production estimates developed from fish captured at the SCT is shown in Table 2.7.1. Tables would be developed for each species.

Table 2.7.1. Example table of SCT estimates of the number of juvenile (fry, subyearlings, smolts etc.) coho entering Swift Reservoir

	Swift Downstream Facility	
Sample Period	**Number of Coho**	**95% CI (+/-)**
Week 1		
Week 2		
Week 3		
Week 4		
Season Summary		

2.8 OBJECTIVE 8- DETERMINE JUVENILE MIGRATION TIMING

Natural juvenile migration timing will be determined by tracking juvenile abundance at the SDF each migration season[21].

2.8.1 Task 8.1- Operate SDF to Develop Juvenile Migration Timing Index

The methods, analysis and assumptions required for using the SDF to develop a juvenile migration timing index are presented in the following sections.

2.8.1.1 Methods

An index of juvenile migration timing will be developed by tracking the number of fish captured each day at the SDF and then plotting this information over time.

The number of fish collected each day at the SDF (SDF_{COL}) will be calculated as follows:

$$SDF_{COL} = N_{SUB} * (SDF_{OP} / S_{SUB})$$

Where

N_{SUB} = Number of fish sub-sampled each day

SDF_{OP} = Number of hours the SDF was operated each day

S_{SUB} = Number of hours the diversion gate was operated each day

Fish counts from the scanner also will be used to generate a run-timing index for juvenile fish.

2.8.1.2 Frequency and Duration

Juvenile migration timing will be collected each year that the SDF is operational.

[21] A subset (100) of the spring Chinook released from acclimation ponds will also be PIT-tagged to determine their migration timing through the system.

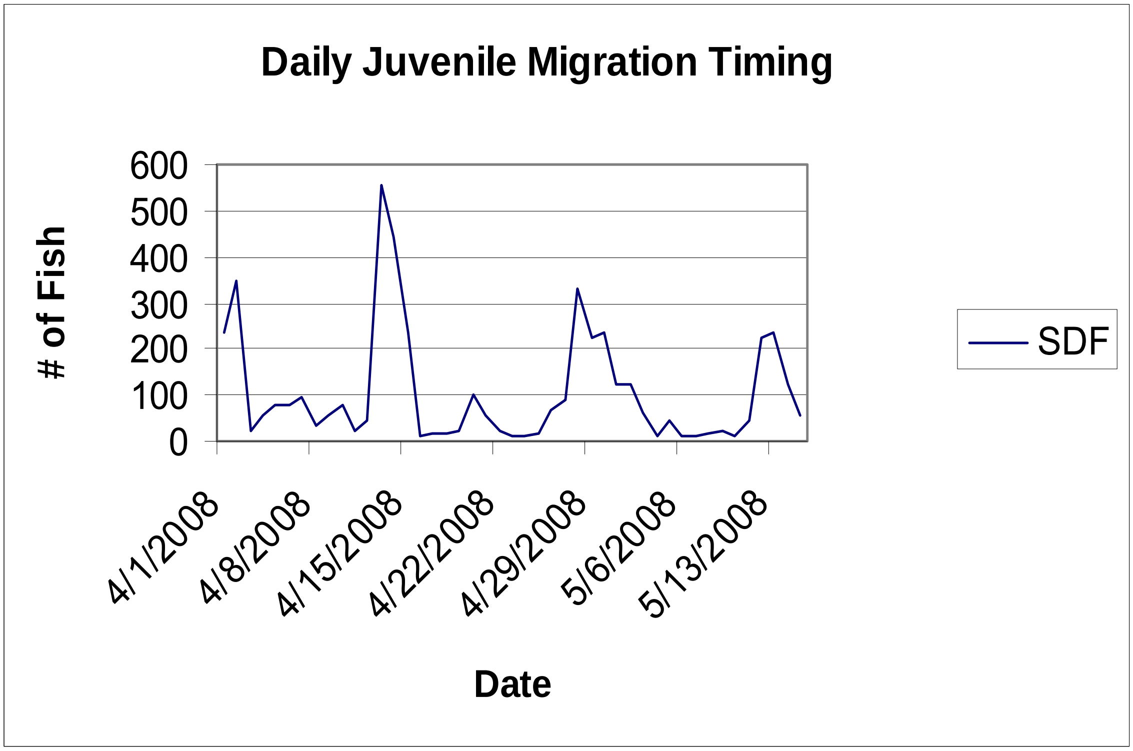
2.8.1.3 Assumptions

The major assumption inherent in this analysis is:

- The run-timing estimate is an index that applies to fish arriving at the SDF.

2.8.1.4 Results and Reporting

Migration timing results will be presented as shown in example Figure 2.8-1. Trapping results will be summarized in the annual fish monitoring and evaluation report.



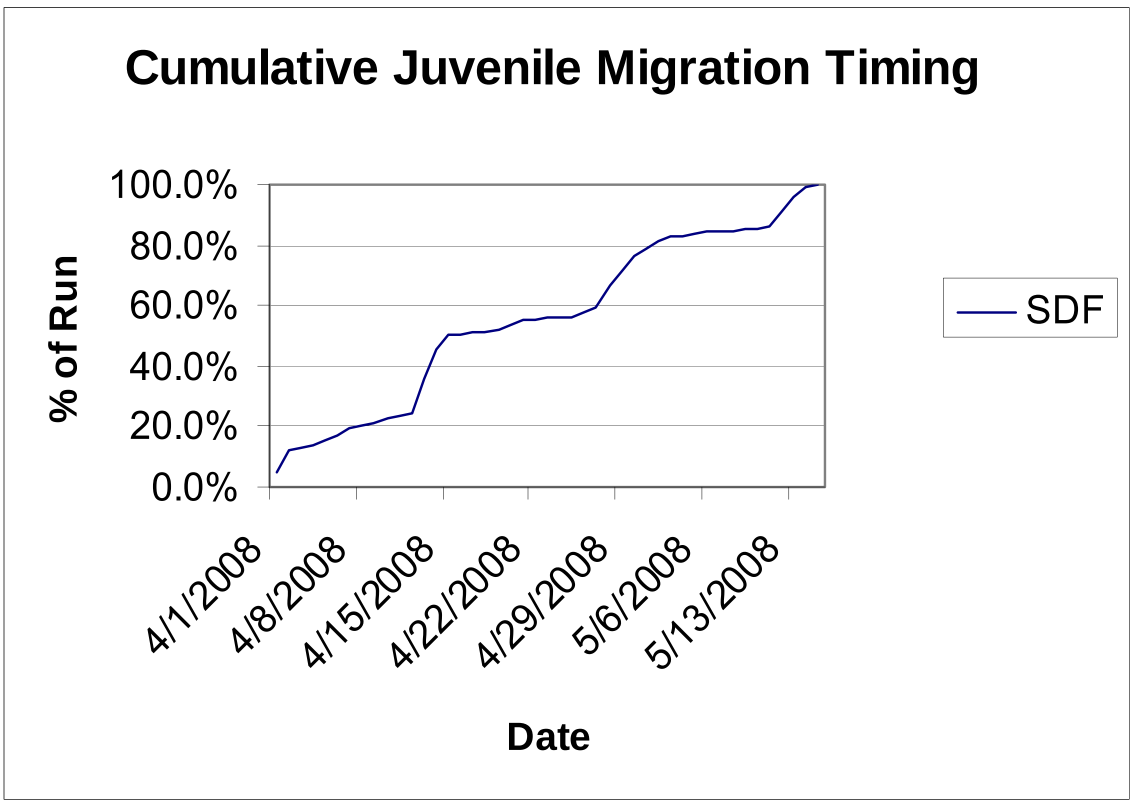


Figure 2.8-1. Example of juvenile migration timing graphs.

2.9 OBJECTIVE 9- QUANTIFY ADULT UPSTREAM PASSAGE SURVIVAL

The adult upstream passage survival (UPS) performance standard is defined in the Settlement as:

> *Percentage of adult fish of each species designated in Section 4.1.7 that are collected that survive the upstream trapping-and-transport process. For sea-run cutthroat and bull trout, "adult" means fish greater than 13 inches in length.*

The Settlement requires the Utilities to achieve a UPS rate for all species of 99.5%. Given the UPS definition, it is assumed survival is measured from the point of collection to the point of release. The CS standard will be considered met if the calculated 95% confidence interval (CI) spans the target survival rate of transported fish.

2.9.1 Task 9.1- Quantify Upstream Passage Survival

Methods proposed for measuring UPS for adult fish captured at Merwin Dam are presented below.

2.9.1.1 Methods

The UPS will be measured through the direct enumeration of adult fish at the Merwin Upstream Transport Facility (UTF) and at transport release sites. Any dead fish recovered at trapping or release sites will be identified to species and examined for signs of physical injury, to the extent possible.

UPS will be calculated as follows:

$$UPS = 1-((AD_{TRAP}+AD_{REL}) / N)$$

Where

$N =$	Number of total adults collected
$AD_{TRAP} =$	Number of dead adults in trap
$AD_{REL} =$	Number of dead adults at release site

An estimate of UPS will be calculated for each day fish are collected and/or transported from the Merwin UTF. The daily estimates will be summarized to produce a single estimate of UPS for the year.

In order to determine possible causes of any adult mortality observed in the collection and transport process, the following environmental data will also be collected:

Temperature- Water temperatures at the Merwin UTF, in the transport truck and release site will be collected each day. Transport truck water temperature will be collected during fish loading and at the time of release. Stream temperature will be recorded for each release group. Stream temperature difference between transport and receiving water will not exceed 10°F. If the difference is greater than 10°F then truck water will be tempered with stream water before releasing adults.

Dissolved Oxygen- Measurements of dissolved oxygen will be collected and monitored in the transport truck from initial loading to release.

Transport Time and Distance- Transport time and distance will be recorded for each load of fish.

Species Mix- The number of fish by species will be recorded for each load of fish.

These data will be reviewed throughout the transport season to determine possible cause and effect relationships between transport conditions and fish loss.

2.9.1.2 Frequency and Duration

An estimate of UPS will be calculated for each day fish are collected and/or transported from the Merwin UTF.

2.9.1.3 Assumptions

A major assumption in the proposed method is that staff operating the adult trapping facility, and transporting and releasing adult fish to the river, will be able to accurately count the number of dead and live adults.

2.9.1.4 Results and Reporting

Results will be presented in tabular format by species. An example for coho is presented in Table 2.9.1.

Table 2.9.1. Estimated adult UPS for coho captured and transported from Merwin Dam.

Date	Number Loaded Alive	No. Dead Release Site	% Survival
4/01/12			
4/02/12			
4/03/12			
4/04/12			
4/05/12			
4/06/12			
4/07/12			
Season Total			

2.10 OBJECTIVE 10- ESTIMATE ADULT TRAP EFFICIENCY AT EACH UPSTREAM FISH TRANSPORT FACILITY

Adult trap efficiency (ATE) is defined in Table 4.1.4 of the Settlement as:

> *The percentage of adult Chinook, coho, steelhead, bull trout and sea-run cutthroat that are actively migrating to a location above the trap and that are collected by the trap.*

The Settlement calls for the licensees to consult with the resource agencies and the ACC to develop such a standard as soon as practicable. This effort was completed in 2008 and the ACC selected 98% as the target ATE value for each species.

2.10.1 Task 10.1- Develop Estimate of ATE for Adult Fish Originating Above Swift No. 1 Dam.

The methods, metrics, and definitions developed by the ACC for this study are included as Appendix C.

2.10.1.1 Methods

Methods are described in Appendix C.

2.10.1.2 Frequency and Duration

Until ATE performance standards are achieved, the Merwin Trap will be adjusted or modified per Settlement Agreement Section 4.1.6. As long as ATE performance standards are achieved, no further adjustments or modifications to the Merwin upstream passage facility will be required.

2.10.1.3 Assumptions

Key assumptions inherent in the analysis include:

1. Test fish are captured either at the new Merwin trap or some point downstream of the tailrace;
2. All radio-tagged test fish are released at the Merwin boat ramp regardless of their original capture location; and,
3. The tailrace is that entire area of river upstream of the powerhouse access bridge.

2.10.1.4 Results and Reporting

Study results will be provided in the ACC/TCC Annual Report.

2.11 OBJECTIVE 11- QUANTIFY THE NUMBER, BY SPECIES, OF ADULT FISH COLLECTED AT THE PROJECTS

The accurate enumeration of adults arriving at Merwin Dam is important not only to determine the success of the anadromous reintroduction program, but is also needed to make changes to the program as defined in the Settlement. For example, when natural-origin adult production exceeds the abundance targets shown in Table 2.11.1, hatchery production levels may be decreased on a fish-for-fish basis (1:1)[22].

Table 2.11.1. Natural-origin adult abundance numbers governing modifications to hatchery production targets.

	Spring Chinook	Steelhead	Coho	Total
Natural Production Threshold for Hatchery Reduction	2,977	3,070	13,953	20,000

2.11.1 Task 11.1- Quantify the Number, by Species, of Adult Fish Collected at Merwin Dam

The methods proposed for determining the number of adult fish being collected at Merwin Dam each year is presented below.

2.11.1.1 Methods

All fish (adults, juveniles and jacks) arriving at Merwin Adult Trapping Facility will be anesthetized, enumerated and identified to species. The definition of adult for each species of interest is as follows[23] :

Bull trout: $\geq$ 13 inches

Chinook: $\geq$ 22 inches

Coho: $\geq$ 18 inches

Sea-run cutthroat trout: $\geq$ 13 inches

Steelhead: $\geq$ 20 inches

The number of live and dead fish captured at Merwin Dam will be summarized on a daily basis. The daily counts will be combined to quantify total adults, jacks and juveniles captured by species for the year.

2.11.1.2 Frequency and Duration

The number of fish entering the facility will be calculated for each day the facility is operated.

[22] The surplus abundance of one species cannot be used to reduce the number of hatchery fish of another species.
[23] Note that in some years, jack lengths may actually exceed the values identified for adults.

2.11.1.3 Assumptions

The primary assumption of this analysis is that biologists working the adult trap will be able to accurately count and identify to species all captured fish.

2.11.1.4 Results and Reporting

Results of this analysis will be reported in tabular format similar to that shown in Table 2.11.2 in the ACC/TCC Annual Report.

Table 2.11.2. Example table for reporting the number of adult coho, Chinook, steelhead, bull trout and sea-run cutthroat trout captured at the Merwin Adult Trapping Facility.

Date	Coho	Chinook	Steelhead	Bull Trout	Sea-run Cutthroat	Daily Total
4/01/12						
4/02/12						
4/03/12						
4/04/12						
Season Total						

2.12 OBJECTIVE 12- DEVELOP ESTIMATES OF OCEAN RECRUITS

According to the Settlement, a juvenile tagging program is needed to determine when the hatchery and natural adult production targets identified in Table 2.12.1 are achieved.

Table 2.12.1. Hatchery and naturally produced adult threshold levels (ocean recruits) for spring Chinook, steelhead and coho.

	Spring Chinook	Steelhead	Coho (Type S and Type N)	Total
Hatchery	12,800	13,200	60,000	86,000
Natural Production Threshold	2,977	3,070	13,953	20,000
Grand Total	**15,777**	**16,270**	**73,953**	**106,000**

These targets are referred to in the Settlement as Ocean Recruits[24]. This parameter is defined in Section 8.1 of the Settlement as:

> *"… total escapement (fish that naturally spawned above Merwin and hatchery fish) plus harvest (including ocean, Columbia River, and Lewis River Harvest)."*

[24] The ACC agreed to change the ocean recruits definition so that jacks are not included or counted as part of the ocean recruits analysis (March 9, 2005 ACC meeting).

The Settlement does not however, define (1) if the species-specific values are averages, or (2) the time frame over which they must be observed to invoke a possible change in hatchery production.

For this analysis, the average number of ocean recruits for five consecutive brood years will be used to determine if and when hatchery production levels should be altered.

2.12.1 Task 12.1- Calculate Ocean Recruits

2.12.1.1 Methods

The Lewis River Hatchery and Supplementation Plan (H&S Plan) identified three indices that could be used to measure ocean recruits (PacifiCorp Energy and Cowlitz PUD 2006):

1. **Age 2 Recruits (Age 2)**: Number of fish alive at the time of first recruitment into a fishery (typically at age 2). Represents the maximum number of fish available to be managed.

2. **Adult Equivalent Run (AER)**: The total number of fish that would have returned to the spawning grounds at all ages in the absence of fisheries. In other words, AER is the best estimate of adult run-size absent human harvest.

3. **Catch Plus Escapement (C+E)**: Total catch of all ages plus total escapement of all ages. This method is in reality the outcome of harvest management activities affecting the species.

The formulas used to calculate each of the three ocean recruit estimates are presented in Appendix D. The indices that will be used to calculate this parameter by species is shown in Table 2.12.2.

Table 2.12.2. Methods used for estimating ocean recruits by species.

Stock	Age 2	AER	C+E[1]
Spring Chinook Hatchery	✓	✓	✓
Spring Chinook Natural	✓	✓	✓
Coho Hatchery	✓	✓	✓
Coho Natural	✓	✓	✓
Steelhead Hatchery			✓
Steelhead Natural			✓

[1] Because steelhead are not harvested in large numbers in ocean fisheries, the H&S Plan recommended that only C+E be used for estimating ocean recruits for this species.

Calculating ocean recruits requires that Lewis River-origin fish be marked such that they are distinguishable in fisheries, traps and on the spawning grounds. Test fish will be marked using a combination of coded-wire tags (CWTs) and fin-clips (AD-clip). The mark used for each index group will be consistent with the marking designations presented in Table 2.12.3. However, the marking program would be reviewed prior to initiation to confirm that protocols conform to other research activities undertaken in the basin or nearby basins. This review will be conducted as part of developing the annual report for the hatcheries.

Table 2.12.3. Juvenile marking program for supplementation, hatchery, and natural-origin spring Chinook, coho and steelhead.

Location	Fish Origin	Spring Chinook	Steelhead*	Coho
Swift	Natural	None	None	AD intact, 21,000 CWT (right cheek)
	Supplementation	AD intact, (100% CWT located in adipose fin)	None	None
Yale	Natural	None	None	AD intact, 21,000 CWT (left cheek)
	Supplementation	AD intact, 100% CWT	None	None
Merwin	Natural	None	None	None
	Supplementation	AD intact, 100% CWT	AD intact, 50,000 blank wire (nose)	None

* CWTs may be coded or blank dependent on the harvest sampling program in net fisheries. In addition, the decision to use CWTs or another tag type for upper basin wild production will be coordinated with the resource agencies.
Note: AD =adipose fin clip

The number of fish to be tagged by species and stock is also shown in Table 2.12.3. Sample sizes for fish released from Lewis River hatcheries are based on historical practices. Sample sizes for natural-origin fish are based on the smolt-to-adult survival ratio (SAR) presented in the H&S Plan (PacifiCorp and Cowlitz PUD 2006). The release size for each group was designed to produce 1,000 marked adults, on average, for each brood year (Table 2.12.4). Sample sizes would be adjusted in the future as data become available on SARs for each species.

Table 2.12.4. Release size, Smolt-to-Adult Survival Ratio (SASR) and expected adult production for marked natural-origin spring Chinook, coho and steelhead.

Species	Release Size	SASR	Number of Adults
Spring Chinook	34,000	3%	1,000
Coho	21,000	4.8%	1,000
Steelhead	16,700	6%	1,000

SASR- Includes fish caught in all fisheries, at the hatchery and spawning grounds. This value is reported in the CWT database for the west coast for Chinook and coho (http://www.rmpc.org/).

Calculating Sample Sizes

A portion (10%) of the natural-origin fish entering the SDF will be diverted to the subsample tanks for marking. Here the fish will be anesthetized, tagged, allowed to recover and then transported to the release ponds downstream of Merwin Dam. The formula for calculating the number of tagged natural-origin fish released downstream of the dam is:

N = number of fish tagged at SDF - number lost due to tagging and transport

Hatchery-origin fish will be tagged at basin hatcheries and then released according to protocols in place at each hatchery. Sample size (N) for these groups equals:

N= number of total fish tagged - number of fish found dead before release

Supplementation fish destined for release upstream of Swift No. 1 Dam will be tagged at the Lewis River hatcheries, transported and released into the upper watershed (either to streams or acclimation ponds).

The number of tagged supplementation fish caught in the SDF will be determined using the protocols described in Section 2.6. The formula for calculating the number of supplementation fish released downstream of Merwin Dam is:

N= number of tagged fish collected in SDF - number lost due to collection and transport

Tagged Lewis River-origin fish captured in ocean and freshwater fisheries, as well as on the spawning grounds and at hatcheries will be collected by those agencies responsible for monitoring these areas. PacifiCorp will also recover tagged fish during any spawning surveys they conduct in the Lewis River basin both downstream and upstream of Merwin Dam. CWT recoveries will be reported to the Regional Mark Information System (RMIS) where the data will be stored (http://www.rmpc.org/).

Adjusting Hatchery Production

The Settlement allows the Utilities to reduce hatchery production on a 1:1 basis after the natural production target for each species shown in Table 2.12.1 is achieved. The calculations used for adjusting spring Chinook, coho and steelhead hatchery production is as follows:

$$H_{JUV} = N_{OR} - (N_{PTH} / H_{SUR})$$

Where:

H_{JUV} =	Number of hatchery juveniles eliminated
N_{OR} =	Natural ocean recruits (five brood year running average)
N_{PTH} =	Natural production threshold
H_{SUR} =	Hatchery survival rate (five brood year running average)

The hatchery survival rate (H_{SUR}) is calculated:

$H_{SUR} = (H_{OR} / H_{REL})$

Where:

H_{OR} = Hatchery ocean recruits (five year running average)

H_{REL} = Number of hatchery fish released (five year running average)

The need for hatchery production adjustment will be determined every five brood years. An example hatchery production adjustment for spring Chinook is shown in Table 2.12.5. In this example, hatchery spring Chinook production would be reduced by 55,471 fish.

Table 2.12.5. Spring Chinook hatchery production adjustment example.

Brood Year	N_{OR}	N_{PTH}	Difference	H_{SUR}
1	3,500	2,977	523	1.0%
2	4,500	2,977	1,523	2.0%
3	6,900	2,977	3,923	4.0%
4	1,500	2,977	-1,477	0.5%
5	3,200	2,977	223	1.0%
Average	3,920	2,977	943	1.7%
Adjustment (H_{JUV}) (Calculated: 943 / 1.7%)	55,471			

2.12.1.2 Frequency and Duration

Estimates of ocean recruits will be developed for each brood year and species throughout the term of the licenses.

2.12.1.3 Assumptions

Key assumptions inherent in completing the analysis include:

1. Sample sizes provide sufficient precision for making management decisions.
2. Tagged fish can be readily and reliably identified in ocean and freshwater fisheries, on the spawning grounds and at trapping facilities.
3. Recovered CWT data will be reported to RMIS in a timely manner.

2.12.1.4 Results and Reporting

The results of the ocean recruits analysis will be documented in the ACC/TCC Annual Report. The data will be presented in tabular format similar to that shown in Table 2.12.6.

Table 2.12.6. Estimates of ocean recruits for coho, Chinook and steelhead using three different indices.

		Age 2	AER	C+E
Species	**Stock**	**Ocean Recruits**	**Ocean Recruits**	**Ocean Recruits**
Spring Chinook	Natural			
	Hatchery			
	Supplementation			
Coho	Natural			
	Hatchery			
	Supplementation			
Winter Steelhead	Natural			
	Hatchery			
	Supplementation			

2.13 OBJECTIVE 13- DETERMINE PERFORMANCE MEASURES FOR INDEX STOCKS

The H&S Plan (PacifiCorp and Cowlitz PUD 2006) recommends that other Lower Columbia River stocks be used as index groups to determine whether the success or failure of the Lewis River reintroduction program is the result of in-basin or out-of-basin factors. This would be determined by comparing the survival rates of hatchery and natural-origin fish produced in other basins (such as the Cowlitz River) with releases made in the Lewis River. The methods that will be used to calculate juvenile-to-adult survival rates are presented below.

2.13.1 Task 13.1- Develop Estimates of Survival for Lower Columbia River Fish Stocks

2.13.1.1 Methods

Two different juvenile to adult survival estimates will be developed for marked test groups. These are:

- Smolt-to-adult Survival Ratio (SASR): Represents the total number of fish caught in fisheries, on the spawning grounds and at hatcheries. The SASR is equivalent to C+E described in Section 2.12.1.1.

- Smolt-to-adult Survival Rate (SAR): Measures the number of adults that return to the basin at a pre-defined point. For this analysis, SAR will be measured at the Merwin Dam upstream trap and/or Lewis River Hatchery ladder.

For almost all hatchery stocks, SASR is tracked on the Data Access in Real Time (DART) web site (http://www.cbr.washington.edu/cwtSAR/)[25]. DART uses data from RMIS to calculate both SASR and a standard error for CWT fish released in the Columbia River Basin.

The DART system will be used to develop and contrast survival rates for index stocks and fish released in the Lewis River. All hatchery and natural stocks located below Bonneville Dam will be used as index stocks as recommended in the H&S Plan as long as data are available for comparison. This M&E plan does not propose to initiate a tagging program for those lower river fish stocks that are not currently marked.

The SAR for each tagged group of fish originating from upper basin-origin juveniles will be determined by sampling fish at Merwin Dam[26]. Hatchery SARs will be based on tag recoveries at both Merwin and Lewis River hatcheries. SAR will be calculated as:

SAR = number of tagged fish recovered / number tagged fish released

Scale samples will be collected on upper basin-origin tagged fish to determine age and assign tags to the correct brood year[27]. Results from this analysis will be checked against scales recovered on the spawning grounds for untagged. The additional step of reading scales is needed because it is currently unknown what proportion of the upper basin spawners will be sampled as part of the spawning surveys described in Section 2.14. The inability of biologists to access some spawning areas may result in few CWT fish being recovered during survey work, making it difficult to accurately assign adult returns to the correct release year based on CWTs alone[28].

Finally, SAR estimates will also be developed for unmarked natural-origin adults returning to Merwin Dam. The SAR for this group of fish will be calculated as follows:

SAR= number of unmarked adults/ number of unmarked juveniles released below Merwin Dam

The estimated number of unmarked juveniles released below Merwin comes from the analysis described in Section 2.6 of this report.

2.13.1.2 Frequency and Duration

Survival estimates will be developed for each brood year throughout the term of the licenses.

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[25] Note: this web site uses the abbreviation SAR in presenting data for what they refer to as the smolt-to-adult ratio. The abbreviation was changed to SASR in this report to eliminate confusion with the more well known smolt-to-adult survival rate (SAR) used in the fisheries literature.

[26] Upper basin-origin fish collected at the Lewis River hatcheries would also be included in SAR calculations.

[27] Although the vast majority of coho are three-year old fish, scale samples will be collected on this species until such time as data indicate that no or few 4+ fish return to the basin.

[28] Scale sampling will be eliminated if sufficient numbers of CWT are recovered during spawning surveys.

2.13.1.3 Assumptions

Key assumptions inherent in completing the analysis include:

1. Sample sizes provide sufficient precision for making management decisions.
2. Tagged fish can be readily identified in ocean and freshwater fisheries, on the spawning grounds, hatcheries and at trapping facilities.
3. Scale samples accurately identify fish age.
4. Recovered CWT data will be reported to RMIS in a timely manner.

2.13.1.4 Results and Reporting

The results of the SAR analysis will be documented in the ACC/TCC Annual Report. The data will be presented in tabular format similar to that shown in Table 2.13.1. Results of SAR analysis for index stocks developed by others will be provided in a similar table (if available).

Table 2.13.1. Estimated SAR for hatchery and natural origin Lewis River coho, Chinook and steelhead.

Species	Stock	Brood Year	SAR	Standard Error

Results of the SASR analysis will be downloaded from the DART site and presented in a similar manner.

2.14 OBJECTIVE 14- DETERMINE COMPLIANCE OF UPSTREAM AND DOWNSTREAM PASSAGE FACILITIES WITH HYDRAULIC DESIGN CRITERIA

As new fish passage facilities are implemented, they will be tested to determine if they are operating as designed. For the SDF, the key design variables are total attraction flow and water velocities passing through and past the screens. At the Merwin UTF, adult attraction flows, water drop in elevation over weirs, and uniformity of flow across attraction flow diffusers are the indicators of facility performance that will be tested.

2.14.1 Task 14.1- Confirm SDF System Compliance with Hydraulic Design Criteria

The method used for determining the hydraulic performance of the SDF is discussed below.

2.14.1.1 Methods

Both acoustic Doppler and hand-held water velocity meters will be used to determine the hydraulic performance of the SDF. The two systems will collect data on flow velocity and direction at the following locations (see Figure 2.14-1 for SDF schematic):

- Collection entrance
- Collection enhancement structure
- Primary and secondary dewatering screens (including floor screens)

Water velocity and directional measurements will be collected over the full range of SDF operational conditions. The results will be compared to the SDF design criteria to document system compliance.

2.14.1.2 Frequency and Duration

Flow measurements required to document compliance with design criteria will be conducted until it is proven that these criteria have been achieved. After that time, flow measurements within the SDF will be made once yearly to ensure that the system continues to perform as designed.

2.14.1.3 Assumptions

Key assumptions inherent in completing the analysis include:

- Measurement points are readily accessible to staff.

2.14.1.4 Results and Reporting

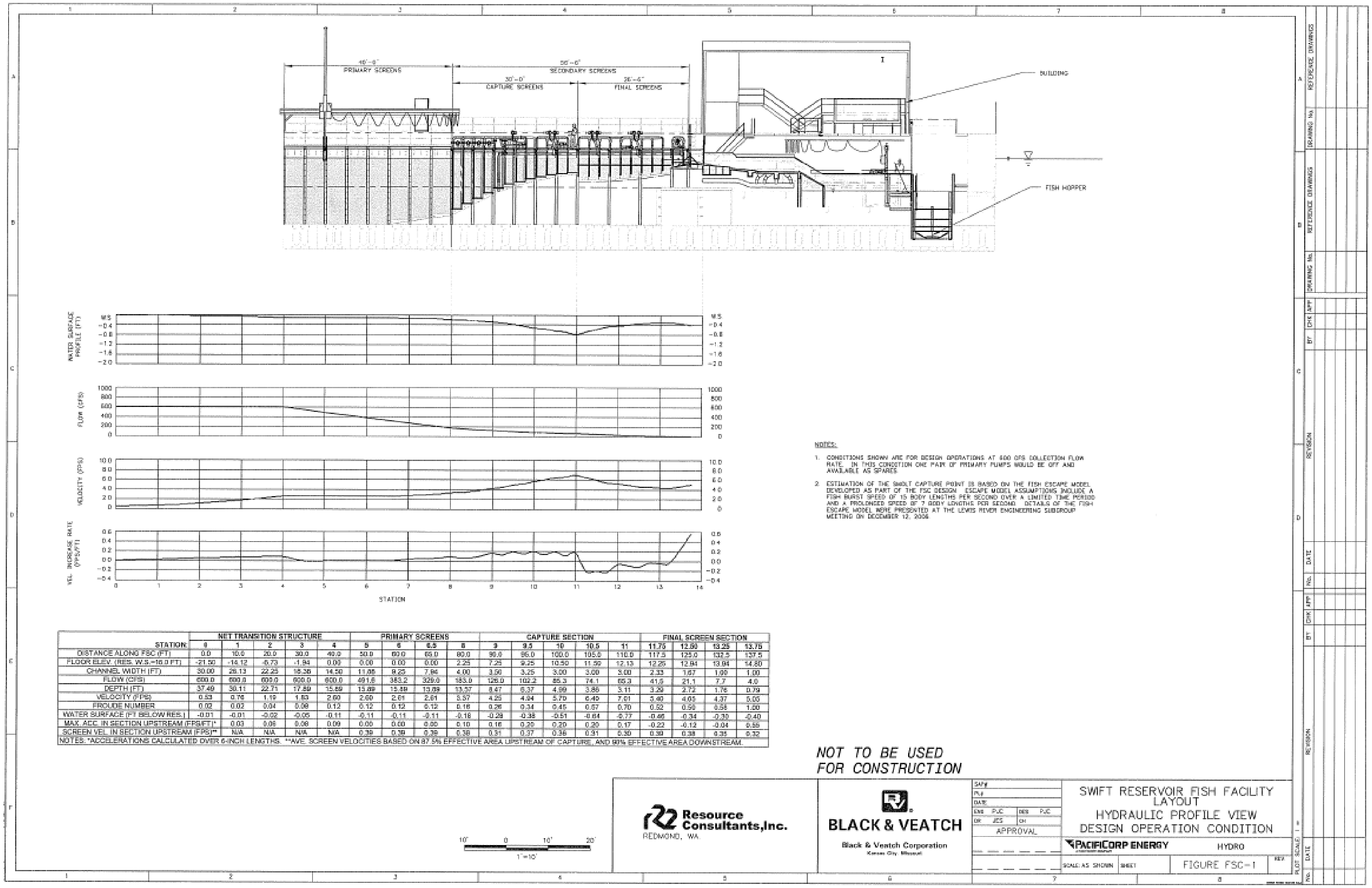
Yearly monitoring results will be reported in the ACC/TCC Annual Report.

2.14.2 Task 14.2- Confirm Compliance of Merwin Upstream Transport System with Design Criteria

The method used for determining that the Merwin upstream transport system is operating as designed is presented below.

2.14.2.1 Methods

To be determined after facility is designed and operational.



	NET TRANSITION STRUCTURE					PRIMARY SCREENS				CAPTURE SECTION					FINAL SCREEN SECTION			
STATION:	0	1	2	3	4	5	6	6.5	8	9	9.5	10	10.5	11	11.75	12.50	13.25	13.75
DISTANCE ALONG FSC (FT)	0.0	10.0	20.0	30.0	40.0	50.0	60.0	65.0	80.0	90.0	95.0	100.0	105.0	110.0	117.5	125.0	132.5	137.5
FLOOR ELEV. (RES. W.S.=16.0 FT)	-21.50	-14.12	-6.73	-1.94	0.00	0.00	0.00	0.00	2.25	7.25	9.25	10.50	11.50	12.13	12.25	12.94	13.94	14.80
CHANNEL WIDTH (FT)	30.00	26.13	22.25	18.38	14.50	11.68	9.25	7.84	4.00	3.50	3.25	3.00	3.00	3.00	2.33	1.67	1.00	1.00
FLOW (CFS)	600.0	600.0	600.0	600.0	600.0	491.6	383.2	329.0	183.0	126.0	102.2	85.3	74.1	65.3	41.5	21.1	7.7	4.0
DEPTH (FT)	37.49	30.11	22.71	17.89	15.89	15.89	15.89	15.89	13.57	8.47	6.37	4.99	3.86	3.11	3.29	2.72	1.76	0.79
VELOCITY (FPS)	0.53	0.76	1.19	1.83	2.60	2.60	2.61	2.61	3.57	4.25	4.94	5.70	6.40	7.01	5.40	4.05	4.37	5.05
FROUDE NUMBER	0.02	0.02	0.04	0.08	0.12	0.12	0.12	0.12	0.18	0.26	0.34	0.45	0.57	0.70	0.52	0.50	0.58	1.00
WATER SURFACE (FT BELOW RES.)	-0.01	-0.01	-0.02	-0.05	-0.11	-0.11	-0.11	-0.11	-0.18	-0.28	-0.38	-0.51	-0.64	-0.77	-0.46	-0.34	-0.30	-0.40
MAX. ACC. IN SECTION UPSTREAM (FPS/FT)*		0.03	0.06	0.08	0.09	0.00	0.00	0.00	0.10	0.16	0.20	0.20	0.20	0.17	-0.22	-0.12	-0.04	0.55
SCREEN VEL. IN SECTION UPSTREAM (FPS)**		N/A	N/A	N/A	N/A	0.39	0.39	0.39	0.38	0.31	0.37	0.36	0.31	0.30	0.39	0.38	0.35	0.32

NOTES: *ACCELERATIONS CALCULATED OVER 6-INCH LENGTHS. **AVE. SCREEN VELOCITIES BASED ON 87.5% EFFECTIVE AREA UPSTREAM OF CAPTURE, AND 90% EFFECTIVE AREA DOWNSTREAM.

Figure 2.14-1. 60% draft Swift Dam downstream facility schematic.

2.14.2.2 Frequency and Duration

Compliance activities will be conducted yearly.

2.14.2.3 Assumptions

Assumptions will be determined after facility design is complete.

2.14.2.4 Results and Reporting

Yearly evaluations to document that the facility continues to operate as designed will be reported in the ACC/TCC Annual Report.

2.15 OBJECTIVE 15- DETERMINE SPAWN TIMING, DISTRIBUTION AND ABUNDANCE OF TRANSPORTED ANADROMOUS ADULTS

Article 9.2.2 of the Settlement Agreement requires the licensees to identify the spawn timing, distribution, and abundance for transported anadromous species that are passed upstream of Merwin Dam. This is to be achieved by monitoring a statistically valid sample of each stock. According to the Settlement Agreement, the primary objective of this task is to identify preferred spawning areas in order to: (1) inform revisions to the H&S Plan and the Upstream Transport Plan; and, (2) guide the ACC in determining how to direct restoration efforts with the Aquatics Fund. To fulfill this requirement, the licensees will conduct comprehensive spawning ground surveys for spring Chinook and coho in the potentially accessible river and stream reaches upstream of Swift Dam to determine their spawn timing, distribution, and abundance in the upper basin. Winter steelhead spawn timing, distribution and abundance will not be determined by on-the-ground spawning surveys (due to poor access and anticipated heavy snow accumulations during the spawning season), but will be determined through a combination of aerial radio telemetry surveys, aerial redd counts (conducted during the radio telemetry surveys when visibility allows), and single pass electrofishing surveys for young-of-the year steelhead (conducted during the following summer).

2.15.1 Task 15.1- Chinook and Coho Spawning Surveys

2.15.1.1 Sampling Design

The spawn timing, distribution, and abundance of spring Chinook and coho adults that migrate into the tributaries after being released into Swift Reservoir will be determined using a spatially balanced probabilistic sampling design framework. The sampling area will include all potentially accessible river and stream reaches upstream of Swift Dam, as determined by AQU 4, *Assessment of Potential Anadromous Fish Habitat Upstream of Merwin Dam* (PacifiCorp and Cowlitz PUD 2004) and listed in Table 2.15.1. The spawn timing of each species (duration) will be measured by starting the surveys just prior to the expected onset of spawning and continuing the surveys until no new adults, jacks, or redds are observed on the spawning grounds. The overall sampling design will follow the U.S. Environmental Protection Agency (EPA) – Environmental Monitoring and

Assessment Program – Generalized Random Tessellation Stratified (GRTS)[29] sampling method to select a spatially balanced random sample of river and stream reaches to survey each year. This method is recommended by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009) and by the American Fisheries Society (AFS) in their *Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations* (Johnson et al. 2007).

According to PacifiCorp and Cowlitz PUD (2004), there are approximately 74 miles of stream habitat that is potentially accessible to anadromous fish upstream of Swift Dam. These 74 miles of potentially accessible habitat will be the spawning survey sample universe from which the sample reaches will be drawn. However, it should be noted that the GRTS method allows refinement of the sample universe over time. The GRTS statistical framework allows elimination of reaches with no spawning habitat (i.e., bedrock dominated, always dry during the spawning period, etc.), without having to re-define the spatially balanced sample. Any elimination of sample reaches (if needed) would be done in consultation with the ACC. The GRTS statistical framework also allows for some expansion of the sample universe after the spatially balanced sample reaches have been established; however, this expansion should be limited to no more than about 15 percent of the initial sample universe size.

Table 2.15.1. Spawning survey sample frame organization within the sample universe upstream of Swift Dam.

Sample Frame	Stream Name	Accessible Reach Length (miles)
NF Lewis River and Minor Tributaries	Mainstem NF Lewis River	13.1
	U8	0.3
	Spencer Creek	0.6
	Pepper Creek	0.4
	Rush Creek	1.7
	Little Creek	0.3
	Big Creek	0.3
	Cussed Hollow	0.3
	Chickoon Creek	0.3
	Total Miles	**17.3**
Muddy River Watershed	Muddy River	13.8
	Clear Creek	12.3
	Clearwater Creek	5.2
	Smith Creek	5.7
	Total Miles	**37.0**
Pine Creek Watershed	Lower Pine Creek	8.0
	P1	0.9
	P3	1.0
	P7	1.1
	P8	4.2
	P10	0.3
	Total Miles	**15.5**

29 http://www.epa.gov/NHEERL/arm/analysispages/software.htm.

Sample Frame	Stream Name	Accessible Reach Length (miles)
Swift Creek Reservoir Tributaries	Swift Creek	0.3
	Diamond Creek	0.1
	Range Creek	0.7
	S10	0.4
	Drift Creek	1.6
	S15	1.3
	Total Miles	**4.4**
Total Miles in the Sample Universe		**74.2**

Within the sample universe, four independent sample frames will be used to meet survey objectives. Each sample frame will consist of a discrete geographic zone that generally corresponds to hydrologic boundaries and major differences in reach-scale habitat attributes. The sample frames will include all potentially accessible anadromous fish habitat in the 1) Pine Creek watershed, 2) Muddy River watershed, 3) North Fork Lewis River upstream of Swift Creek Reservoir, and 4) Swift Creek Reservoir independent tributaries (Table 2.15.1). The GRTS method for sample reach selection ensures that the samples are spatially balanced at the sample frame scale as well as the sample universe scale.

Statistical estimates of the total number of spring Chinook and coho spawners and redds will be calculated for each sample frame. All sampled reaches will also be pooled to generate estimates of total spawners and redds at the entire sample universe spatial scale (i.e., all accessible habitat upstream of Swift Dam). Total spawner abundance will be primarily determined by counts of fish (live and dead) and by employing the “area under the curve” method (Jacobs, et al. 2002) to generate statistical estimates. Redd counts will also be used to generate a second statistical estimate of total spawner abundance (based on regionally-used fish per redd expansion factors), although estimates based on redd count expansion are expected to be less precise.

The GRTS method will be used to establish three separate survey panels, each being a spatially balanced subsample of the four sample frames encompassing 33 percent of all potentially accessible habitats in each sample frame. Panel 1 will be surveyed in year one, panel 2 will be surveyed in year two, and panel 3 will be surveyed in year three. In year four, the survey rotation begins again with panel 1. In this way, all potentially accessible reaches will receive one survey every three years. In each year, the same sample panel will be surveyed during the full coho and Chinook spawning periods. Following this method over time, the sampling design will allow measurement of the total spawning distribution for Chinook and coho as they expand their distribution over the reintroduction period. This level of sampling effort is statistically rigorous[30]. It is expected to meet or exceed the precision recommended by NMFS (2009) for a coefficient of variation (CV) on average of 15 percent at a 95 percent confidence level for total spawner estimates of the sample universe based on fish counts and for estimates of total redds. This method is especially useful as levels of variation and sources of error in the

[30] The AFS protocol recommends a target draw of 10% of the sample universe, with an over sample of 25% to account for access issues, while this study will draw a larger sample (33%) (Johnson et al. 2007).

underlying assumptions are better understood in the sample universe over time (see Section 2.15.1.4 for a discussion of these assumptions).

The EMAP – GRTS program suite (Software for R) will be used to draw spatially balanced sample reaches and conduct subsequent statistical analyses of data. This is described in detail at http://www.epa.gov/NHEERL/arm/analysispages/software.htm.

It should be noted that the estimates of spawner abundance developed following the methods outlined in this M&E Plan will differ in one significant respect from the typical spawner abundance estimates developed in un-dammed river systems where the total number of adults entering the system are unknown. In this monitoring program, the maximum number of potential spawners upstream of Swift Dam will be known, equaling the number of adults collected, transported and released alive into Swift Creek Reservoir. Therefore, the upper bounds of any statistical estimate of adult salmon abundance on the spawning grounds will be bracketed by a known abundance, which may result in increased precision and confidence in the upper abundance estimate. With respect to spawner abundance, this study is more concerned with determining the proportion of transported fish that successfully reach the spawning grounds and where they go to spawn than determining the absolute abundance in the upper basin.

2.15.1.2 Field Survey Methods

Two crews of two surveyors working in pairs will conduct the annual spawning ground surveys. The following methods will be employed for surveying each individual sample reach. In general, these methods will follow those recommended in Johnson et al. (2007) and ODFW (2009)[31]. Surveyors will be trained in field survey methods and fish identification prior to the start of data collection each year. Project leaders will conduct periodic field assessments of survey crews to ensure proper data collection during the survey season. The start and end points of each sample reach will be located by GPS and clearly marked in the field during the first survey of each year.

Biologists will work in pairs, walking in an upstream direction on opposite sides of the stream bank, at a pace adapted to weather and viewing conditions. It is anticipated that crews will be able to survey two to three miles during each survey day; however, some of the more remote sites may require more time to survey (due to difficult access conditions). Surveyors may also elect to float selected mainstem reaches in rafts or kayaks as logistics and safety dictate. To minimize stress on pre-spawning salmonids, surveyors will move carefully and quietly through holding and spawning areas and avoid stepping on redds.

Stream visibility in each sample reach will be scored following ODFW (2009) codes:

- Code 1: Can see bottom of riffles and pools
- Code 2: Can see bottom of riffles only
- Code 3: Cannot see bottom of riffles or pools (survey crews will check several areas before making this determination).

[31] The ODFW coastal salmon spawning inventory survey methodology is given as an example extensively in the AFS redd survey and carcass survey protocol (Johnson et al. 2007).

Surveys will not be conducted in a given sample reach if the visibility is determined to be code 3 or if the sample reach is inaccessible (e.g., unsafe conditions, snow accumulation, or where the distance is such that a survey could not be reasonably conducted within one day). However, a data sheet will be filled out to document the survey attempt and reason why the survey was not completed.

The following data will be recorded during surveys of each sample reach.

1) Surveyor names

2) Survey sample reach identification code (each sample reach will be uniquely identified)

3) Survey date

4) Stream visibility code (as defined above)

5) All live salmon (by species and sex as possible) will be enumerated and counts of jacks will be made separate from adults. The adult and jack counts will include both "holders" and "spawners". A holder is a salmon identified in an area not considered spawning habitat such as pools, large cobble, and boulder riffles and glides. A spawner is identified in an area considered spawning habitat such as pool tail outs, spawning riffles, and glides with appropriate velocity and substrate for spawning (i.e., cobble and gravel).

6) All salmon carcasses will be counted by species, examined for marks (i.e., fin clip or coded-wire tag), scale sampled, sexed (if possible), and examined to determine egg retention for females. Counts of jacks will be made separate from adults. After examination, tails will be excised to prevent recounting.

7) All carcasses will be enumerated on subsequent repeat surveys with separate tallies of new carcasses and previously counted carcasses (i.e., those with tails already removed), which will be use to estimate average carcass life for the "area under the curve calculation".

8) Surveyors will count all unflagged redds or groups of redds, and flag such after counting. Number and species of fish on the redd will be recorded. Redd locations will be documented by GPS.

9) Each redd counted will be marked with a flag hung on the most permanent feature on the stream bank upstream, as close to the redd as possible. Each flag will be marked with the date, sample reach identification code, redd number for the survey, location (i.e., left bank, right bank, mid-channel, etc.), and indication of redd type (single or redd cluster)[32].

[32] All flagging used to mark redds will be counted and removed at the conclusion of each field season. The final count and removal of all flags will facilitate identification of flag loss and associated counting errors.

10) Each redd will be recorded as a possible test dig, single redd (i.e., one pocket and one mound), or redd cluster, with estimate of the number of pocket/mounds present for each cluster.

11) Redds recorded as test digs will be re-examined upon each re-survey to determine if the redd was actually completed at a later time. If the test dig becomes a completed redd, it will be recorded to revise the final database of total redd counts.

12) Any relevant notes regarding survey attributes or difficulties

Surveyors will also document and record the location of any adult or juvenile bull trout observed during the spawning surveys.

2.15.1.3 Frequency and Duration

The spawning surveys for Chinook and coho will begin after the first reintroduction groups are transported to the upper basin. For some stocks this may not be until 2012 or 2013. Following the initial adult reintroduction and will continue for a minimum of 6 years. At that time, all potential habitat in the sample universe upstream of Swift Dam will have been surveyed in two different years for both species. After 6 years of surveys, the need for changes in the protocol or survey frequency will be evaluated by the ACC. Any changes will require the approval of the Services. The proposed timing and frequency of surveys for each sample year is given below.

The spring Chinook spawning period in the lower Columbia River Chinook ESU in Washington generally occurs from late August through early October (WDFW 2003), but they return to the river much earlier than this and hold for an extended period of time prior to spawning. To more narrowly focus the spring Chinook spawning survey timing, surveys will be scheduled to commence within one week after the first release of adults into Swift Creek Reservoir, or start on August 15, whichever is later.

Coho generally spawn shortly after arriving on the spawning grounds. Therefore, coho spawning surveys will begin within one week after the first release of coho adults into Swift Creek Reservoir (probably around October 1). Spawning surveys for both species will continue until no new fish or redds are observed in the sample reaches.

All sample reaches will be surveyed within 10 days or less after starting the first survey (Jacobs et al. 2002). Subsequent re-surveys of all sample reaches will also be conducted within 10-days or less from the previous sample reach survey date. This 10-day rotation is based on experiments that suggest the average lifespan of adult coho and Chinook on spawning grounds is slightly more than ten days (Willis 1954, Perrin and Irvine 1990). This 10-day survey rotation will be maintained throughout the entire spring Chinook and coho spawning periods until no new fish or are found in all sample reaches in the survey panel. At the level of subsampling indicated above, the two survey crews will need to survey an average of 2.5 miles of stream each day to complete the 10-day rotation (assuming a 4 day work week).

Each sample reach will be re-surveyed within ten days of the previous valid survey (those with a visibility code of 2 or 1). For reaches with a visibility code of 3, surveyors will revisit the sample reach within the 10-day rotation period to conduct a survey when the visibility improves to code 1 or 2. If the visibility remains code 3 for an extended period of time (surpassing the 10-day rotation period), surveyors will revisit the sample reach as often as practical to survey the reach when the visibility improves to code 1 or 2. After a successful survey, the 10-day rotation will begin again for the individual sample reach. Careful planning of site rotations and scheduling will aid in keeping the surveys within the 10-day rotation limit.

2.15.1.4 Assumptions and Discussion of Bias and Error

The sampling design method outlined in Section 2.15.1.1 (GRTS) minimizes the overall survey bias through the use of a spatially balanced random sample and a high subsampling rate (i.e., 33 percent), and provides a rigorous statistically valid means of estimating the total number of redds and spawners in each sample frame and in the total sample universe. However, it is important to note that natural variability in fish spawning behavior and surveyor error can add additional bias, contributing to increased error. In general, estimates of total spawner abundance based on the expansion of redd counts have a greater inherent risk of introducing survey bias than estimates based on adult fish counts (i.e., because there are more assumptions associated with the estimates based on redd counts than for those derived from adult fish counts). This is the primary reason that the estimates of total spawner abundance in the upper Lewis River basin will rely primarily on adult fish counts. Estimates of total spawner abundance will be calculated based on redd counts, but we recommend that they be viewed only as a secondary estimate to gage the overall “reasonableness” of the primary adult fish estimate. Presented below is a list of major survey assumptions and a brief discussion of how this monitoring plan addresses each assumption. The major assumptions associated with the Chinook and coho spawning surveys are consistent with those identified in Johnson et al. (2007).

Assumptions applicable to adult fish counts and redd counts:

1. All possible spawning areas are surveyed.

The survey universe encompasses all potentially accessible stream reaches in the upper Lewis River basin (below migration barriers), not just areas with potential spawning habitat. Over time, if spawners are observed up to the current expected limit of accessible habitat and are found to be able to migrate even farther upstream (unlikely as most identified barriers are large waterfalls), these additional areas will be incorporated into the sample universe.

2. Spawning occurs during the time frames identified in Sections 2.15.1.3 and 2.15.2.3.

The annual surveys are closely linked to fish transport timing and will continue until no new fish or redds are observed in the sample frame. Unlike an undammed river, the arrival of fish into the North Fork Lewis River will be known as a result of collection at Merwin Dam. Therefore, this assumption factors little into this study.

3. Identified stream reaches are and remain accessible to surveyors during the sampling period.

If a large number of survey reaches cannot be accessed, there is a risk that sampling will not achieve the desired level of precision. This study minimizes this risk by drawing a large subsample for surveying each year (i.e., 33 percent), which provides a substantial buffer if some reaches are not accessible. Furthermore, summer juvenile surveys will be used to assess spawning in reaches that could not be accessed during adult surveys.

4. Surveyors are competent and conduct surveys as designed.

Surveyors will be thoroughly trained prior to the field season each year, and project leaders will conduct periodic field assessments of survey crews to ensure proper data collection during the survey season

Assumptions applicable to adult fish counts:

1. Surveyors are able to accurately count adult fish by species.

Surveyors will be trained in fish identification prior to the field season each year, and project leaders will conduct periodic field assessments of surveys crews. However, there will be errors when counting live fish by species, especially when they are in schools. Surveys will be conducted in teams of two; therefore, fish counts can be made by consensus and not just by one surveyor. Areas with poor visibility will also reduce the ability to accurately count adult fish. Over and under counting will both likely occur and tend to cancel each other out. There is no methodology that could reasonably measure this type of counting error.

2. Average adult fish life on the spawning grounds is greater than 10 days

Time between each re-survey should be less than the average fish life on the spawning grounds, generally measured and assumed to be slightly more than 10 days for coho and Chinook (Willis 1954, Perrin and Ervine 1990). If average fish life on the spawning grounds is significantly less than 10 days, the estimate of total spawners based on fish counts would be underestimated. To quantify the average adult fish life on the spawning grounds, a fine-scale radio telemetry study of spawner movement by species could be conducted.

Assumptions applicable to redd counts:

1. Surveyors are able to accurately count the number of redds.

Several studies have shown that over and under counting errors of large salmonid redds occur due to several factors such as identifying natural scour patterns as redds, discerning the number of individual redds in a redd "cluster", missing actual redds, etc., and that there is a difference between the magnitude of such error between "experienced" and less experienced surveyors. This study will thoroughly train surveyors in redd identification prior to the field season. Although counting errors will still occur, some result in over- or under-estimation and tend to cancel each other out (Muhlfeld et al. 2006). A multi-year study to quantify the observer (surveyor) error structure could be conducted similar to the methods employed by Muhlfeld et al. (2006).

2. Surveyors are able to discriminate redds between species

Chinook and coho spawning distribution can overlap in time and space. Often no fish are present on redds when they are counted to aid in species origin. A multi-year study to quantify attributes of redds by species could be conducted similar to the methods employed by Gallagher and Gallagher (2005).

3. The assumption of the number of redds per female is valid and remains constant over time.

Several studies have quantified the average number of redds constructed per female by species. This study proposes to use the regionally accepted values used by WDFW. A multi-year study to determine the average number of redds per female of each species within the upper North Fork Lewis River basin could be conducted similar to Murdoch et al. 2009.

4. Redd life is greater than 10 days for each species.

If average redd life is significantly less than 10 days for each species, redd counts would result in underestimation of total redds. Underestimation of total redds would result in underestimation of total spawners. Redd visibility could be determined similar to the methods employed by Hemmingsen et al. (1997).

2.15.1.5 Results and Reporting

Survey results will be provided in the Utilities' ACC/TCC Annual Report. The report format will follow the standard AFS format. At a minimum, results will summarize the number of live and dead fish, and redds counted by species by reach, and provide a GIS map of sample reaches and redd locations. Sex ratios by sample frame and sample universe, any identified marks, and egg retention in carcasses will also be reported.

For each sample frame and sample universe, the estimate of total spawners and redds by species will be reported along with the calculated coefficient of variance (CV) at a 95% confidence level. Total number of spawners will also be calculated based on an expansion of redd counts using regionally applied fish-per-redd expansion factors.

If the confidence interval encompasses the maximum potential number of spawners (i.e., the number released into Swift Creek Reservoir), then a statistical test will be performed to determine if the estimate of total spawners (based on fish counts) is statistically different from the total number of transported adults by species. Also in this case, the probability distribution of the estimate will be recalculated to account for the known potential maximum spawner number.

2.15.2 Task 15.2-Winter Steelhead Surveys

2.15.2.1 Sampling Design

As described above, winter steelhead spawn timing, distribution and abundance not determined by on-the-ground spawning surveys (due to challenges associated with poor access and anticipated heavy snow accumulations during the spawning season), will be determined through a combination of aerial radio telemetry surveys; aerial redd counts (conducted during the radio telemetry surveys when visibility allows); and single pass electrofishing surveys for young-of-the year steelhead conducted during the following summer. After 6 years of surveys, the need for yearly aerial surveys will be re-evaluated by the ACC and require approval of the Services. The winter steelhead spawning period in the lower Columbia River steelhead DPS generally occurs from early March through early June (WDFW 2003). The aerial surveys will be scheduled to commence within one week after the first group of radio-tagged adults are released into Swift Creek Reservoir (likely in early March) and will continue weekly through mid- to late-June or until spawning behavior of radio-tagged steelhead ceases.

2.15.2.4 Assumptions and Discussion of Bias and Error

The radio telemetry study serves two primary purposes; (1) to estimate the survival of transported steelhead (which would be applied to the total number of transported steelhead to estimate total spawner abundance), and (2) to determine the distribution of spawners. Radio telemetry to determine distribution is descriptive in nature and is not a statistical design. Error in determining the actual position of each radio-tagged fish observation will be minimized by using helicopter surveys rather than fixed-wing surveys, and by using experienced personnel to conduct the tracking. Precision could be further measured by placing "dummy" tags in various known locations and having a naive surveyor locate them. Assessment of the full tag detection histories for each fish will be conducted to determine if the fish was actually alive or if a predator may have caused some movement.

Using radio-tagged fish to estimate survival of transported fish and to ultimately estimate total spawner abundance is statistical in nature. This study would tag 100 adult steelhead each year (20 percent of the target number for transport). This sample rate is robust and should provide a high level of confidence in the survival estimate. A primary assumption is that the survival and spawning of radio-tagged fish is not influenced by tagging (i.e., no tag effect). Tagged fish could be held as a control group for a long period of time to assess the tagging effect; however, holding the control group in an unnatural environment likewise does not reflect the survival of tagged fish in the wild, nor un-tagged fish in the wild. Therefore, such a study would yield spurious results. This study will minimize tag effects by following the most current method for surgical tag implantation, using experienced surgeons, and following current guidelines on appropriate tag size.

Counting steelhead redds by air has all of the fundamental assumptions listed previously for Chinook and coho ground surveys, except that quantification of survey bias is not possible in this case. The reason that aerial surveys are proposed is that the survey reaches would not be practically accessible by foot. On-the-ground surveys would be needed to assess the survey bias. Steelhead aerial redd counts will be descriptive in nature and will not be used to make statistical expansions.

2.15.2.3 Results and Reporting

Study results will be provided in the ACC/TCC Annual Report. At a minimum, study results will summarize the detection histories of radio-tagged steelhead and associated redds in tables and maps; estimate survival of radio-tagged steelhead based on movement patterns; estimate total steelhead spawner abundance by applying the survival factor to the total number of transported steelhead; estimate spawn timing based on radio-tagged steelhead movement patterns; summarize data from attempts at conducting aerial redd and fish counts of the survey reaches.

Task 15.3 Young-of-the-year Sampling where Adult and Redd Counts are Problematic

In addition to the surveys described above, juvenile fish surveys will be conducted in each GRTS survey panel reach that could not be surveyed for spring Chinook, coho, or steelhead adults due to difficult access or poor survey conditions. Surveys will be conducted during the summer low flow period. The focus will be to document young-of-the-year fish of these species, the life stage that has the greatest chance of being associated with the actual spawning reaches. Observations of older fish of each species will also be documented as older age classes become present as reintroduction progresses after year-1.[33]

2.16 OBJECTIVE 16- EVALUATE LOWER LEWIS RIVER WILD FALL CHINOOK AND CHUM POPULATIONS

Section 9.3 of Lewis River Settlement Agreement calls for the continued monitoring of wild fall Chinook and to begin monitoring chum populations in the Lewis River below Merwin Dam (including juvenile tagging). To meet this obligation, juvenile Chinook monitoring activities and spawning surveys for adult fall Chinook and chum.

2.16.1 Task 16.1- Tag Lower Lewis River Wild Fall Chinook Juveniles

2.16.1.1 Methods

In late May through early June of each year, fall Chinook young-of-the-year (YOY) from rearing areas in the Lewis River will be collected using stick seines. YOY fish will be collected from just above Colvin Creek (RM 16.5) to a point upstream of the county road bridge in Woodland (RM 6.6). The goal will be to collect and CWT tag approximately 100,000 YOY fall Chinook each year. Fish less than 47 mm in length will not be tagged. All tagged fish will also have their adipose fin removed.

2.16.1.2 Frequency and Duration

Wild YOY fall Chinook will be tagged each year throughout the term of the new license.

[33] The presence of YOY *O. Mykiss* could be from resident rainbow trout and does not necessarily demonstrate steelhead spawning.

2.16.1.3 Assumptions

Key assumptions of the analysis include:

1. Chinook captured in the lower river are fall Chinook and not juvenile spring Chinook.

2. Fish handling and tagging does not bias study results.

3. Failing to tag fish less than 47 mm does not bias study results or interpretation.

4. Tagging up to 100,000 juveniles provides an adequate sample size

2.16.1.4 Results and Reporting

The results of this work will be summarized in the ACC/TCC Annual Report. Data on the number of fish tagged by species, mortality rates, recapture numbers in fisheries and spawning grounds will also be reported.

2.16.2 Task 16.2- Conduct Fall Chinook and Chum Spawning Surveys in Lower Lewis River

2.16.2.1 Methods

Starting in September and continuing through January, weekly spawning and carcass recovery surveys for fall Chinook and chum will be conducted in the lower Lewis River. Surveys will include all reaches extending from just downstream of Merwin Dam to just downstream of Eagle Island.

To better accommodate redd counts and fish carcass data collection, PacifiCorp will reduce river flows when feasible at Merwin Dam during scheduled survey days. The magnitude of each drawdown will be prescheduled and subject to change based on inflow conditions. PacifiCorp will coordinate with crews conducting this survey work to the best of their ability depending on runoff conditions.

Field crews will count carcasses and collect length and sex data on a subset of the carcasses found. The snout of any carcass missing an adipose fin will be sampled with a wire detector wand to determine if it has a CWT. Snouts with CWTs will be sent to a lab for tag removal and submittal to RMIS. The tails of sampled carcasses will be removed so they will not be counted in future surveys.

Counts of live fish and redds will be made for all reaches where spawning is observed. A mark-recapture study using tagged carcasses will be conducted every five years to verify sample rates and escapement estimates.

Fall Chinook and Chum Objectives:

- Determine adult composition (hatchery versus wild) on spawning grounds downstream of Merwin dam;

- Determine spatial and temporal distribution of fall Chinook and chum spawning downstream of Merwin dam with the ability to detect a change in distribution of ± 15% with 80% certainty;

- Provide an "unbiased" estimate of adult fall Chinook and chum abundance downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;

- Estimate juvenile abundance (reproductive success) downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less.

Monitoring of viable salmonid population (VSP) parameters will be designed to meet objectives and precision goals outlined by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009).

2.16.2.2 Frequency and Duration

Fall Chinook and chum spawning and carcass surveys will be conducted yearly throughout the term of the new license.

An annual report that estimates run size and population demographics for the Lewis River will be developed. The tagging information is provided to the Pacific States Marine Fisheries Commission.

2.16.2.3 Assumptions

The key assumptions of the analysis include:

1. Surveyors can identify fall Chinook and chum carcasses and redds.

2. Historic areas sampled are representative of the spawning area downstream of Merwin Dam for each species.

3. Fall Chinook carcasses and redds can be distinguished from spring Chinook (applies to bright stock fall Chinook but not to Tule stock fall Chinook or late returning bright fall Chinook).

4. Recovery of tagged adult returns is adequate and representative of the fall Chinook population

2.16.2.4 Results and Reporting

Study results will be provided in the ACC/TCC Annual Report.

2.17 OBJECTIVE 17- OBJECTIVES FOR WILD WINTER STEELHEAD, SPRING CHINOOK, AND COHO

These wild winter steelhead, spring Chinook, and coho objectives represent the mutual obligations of PacifiCorp, Cowlitz PUD and the agencies. Monitoring of viable salmonid population (VSP) parameters will be designed to meet objectives and precision goals outlined by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009).

<u>Wild Winter Steelhead</u>

The Utilities believe the following objectives are consistent with the recommendations of the Hatchery and Scientific Review Group (February 2009) and goals of associated Hatchery and Genetic Management Plans for wild winter steelhead. These objectives will be represented in the Annual Operation Plan (H&S Plan) for wild winter steelhead to guide monitoring plans related to winter steelhead reintroduction efforts and hatchery effects downstream of Merwin dam.

Wild Winter Steelhead Objectives:

- Determine adult composition (hatchery versus wild) on spawning grounds downstream of Merwin dam;
- Determine spatial and temporal distribution of wild winter steelhead spawning downstream and upstream of Merwin dam with the ability to detect a change in distribution of ± 15% with 80% certainty;
- Provide an "unbiased" estimate of adult wild winter steelhead abundance downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;
- Estimate juvenile abundance (reproductive success) downstream of Merwin dam with a coefficient of variation (CV) on average of 30% or less;
- Estimate juvenile migration and residualism of hatchery releases downstream of Merwin dam;
- Hatchery juvenile monitoring for ecological interactions with wild smolts;
- Complete actions of the Monitoring and Evaluation Program identified in the Lewis River Hatchery and Supplementation Plan; and,
- Provide annual operating plans and reports.

A full description of how the Utilities will complete actions towards these objectives is provided each year in the Lewis River Wild Winter Steelhead Annual Operation Plan. This plan is developed in consultation with the Lewis River Aquatic Coordination Committee. Results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.

<u>Spring Chinook</u>

The Utilities believe the following objectives are consistent with the recommendations of the Hatchery and Scientific Review Group (February 2009) and goals of associated Hatchery and Genetic Management Plans for spring Chinook. These objectives will be represented in the Annual Operation Plan (H&S Plan) for spring Chinook to guide monitoring plans related to spring Chinook reintroduction efforts and hatchery effects downstream of Merwin dam.

Spring Chinook Objectives:

- Determine adult composition (hatchery versus wild) on spawning grounds downstream of Merwin dam;
- Determine spatial and temporal distribution of spring Chinook spawning downstream and upstream of Merwin dam with the ability to detect a change in distribution of ± 15% with 80% certainty;
- Provide an "unbiased" estimate of adult spring Chinook abundance downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;
- Estimate juvenile abundance (reproductive success) downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;
- Estimate juvenile migration and residualism of hatchery releases downstream of Merwin dam;
- Hatchery juvenile monitoring for ecological interactions with wild smolts;
- Complete actions of the Monitoring and Evaluation Program identified in the Lewis River Hatchery and Supplementation Plan; and,
- Provide annual operating plans and reports.

A full description of how the Utilities will complete actions towards these objectives is provided each year in the Lewis River Spring Chinook Annual Operation Plan. This plan is developed in consultation with the Lewis River Aquatic Coordination Committee. Results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.

<u>Coho</u>

The Utilities believe the following objectives are consistent with the recommendations of the Hatchery and Scientific Review Group (February 2009) and goals of associated Hatchery and Genetic Management Plans for coho. These objectives will be represented in the Annual Operation Plan (H&S Plan) for coho to guide monitoring plans related to coho reintroduction efforts and hatchery effects downstream of Merwin dam.

Coho Objectives:

- Determine adult composition (hatchery versus wild) on spawning grounds downstream of Merwin dam;

- Determine spatial and temporal distribution of coho spawning downstream and upstream of Merwin dam with the ability to detect a change in distribution of ± 15% with 80% certainty;

- Provide an "unbiased" estimate of adult coho abundance downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;

- Estimate juvenile abundance (reproductive success) downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less;

- Estimate juvenile migration and residualism of hatchery releases downstream of Merwin dam;

- Hatchery juvenile monitoring for ecological interactions with wild smolts;

- Complete actions of the Monitoring and Evaluation Program identified in the Lewis River Hatchery and Supplementation Plan; and,

- Provide annual operating plans and reports.

A full description of how the Utilities will complete actions towards these objectives is provided each year in the Lewis River Coho Annual Operation Plan. This plan is developed in consultation with the Lewis River Aquatic Coordination Committee. Results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.

2.18 OBJECTIVE 18- OBJECTIVES FOR BULL TROUT

These bull trout objectives represent the mutual obligations of PacifiCorp, Cowlitz PUD and the agencies. Methods to achieve these objectives will be provided in the Annual Operating Plans for each species.

Bull Trout

The purpose of monitoring bull trout on the Lewis River Hydroelectric Project is to help inform management decisions and changes in methodology pursuant to the goals and objectives of the United States Fish and Wildlife Service's (USFWS) 2002 Draft Bull Trout Recovery Plan which specifically seeks to reverse declining trends and promote bull trout recovery.

The overarching goal of the draft recovery plan states, "to ensure the long term persistence of self sustaining, complex, interacting groups of bull trout distributed throughout the species native range so that the species can be delisted". The Recovery Plan identifies four objectives for the Lower Columbia Recovery Unit; 1) maintain current distribution and restore distribution in previously occupied areas; 2) maintain stable or increasing trends in abundance of bull trout; 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and 4) conserve genetic diversity and provide opportunity for genetic exchange.

Bull Trout Objectives:

The Utilities developed the following objectives to be consistent with the bull trout draft recovery plan:

- Provide an "unbiased" estimate of adult bull trout spawner abundance in Swift Reservoir.
- Collect and transport bull trout from within the Yale tailrace, Swift Power Canal or the Swift bypass reach and transport to an area as directed by the USFWS, to promote spawning availability and success of these fish within the Lewis River local populations.
- Monitor bull trout abundance or presence-absence in key Lewis River tributaries as identified during AOP development.
- Meet acceptable precision levels as established by the United States Fish and Wildlife Service for recovery of bull trout as identified during AOP development.
- Provide annual operating plans and reports.

A full description of how the Utilities will complete actions towards these objectives is provided in the Lewis River Bull Trout Annual Operating Plan. This plan is developed each year in consultation with the USFWS and may adaptively change per their direction or as new scientific information becomes available. The results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.

The USFWS sees the development of the Bull Trout Annual Operating Plan as an opportunity for a bull trout sub group of the ACC (including, but not limited to, PacifiCorp, USFWS, and WDFW) to meet, at a minimum, annually. The primary purpose would be to discuss progress in meeting Settlement Agreement/license requirements for bull trout in the past year, and to develop a plan for the next years' activities.

The USFWS also recommends that as part of developing the yearly Bull Trout Annual Operating Plans, PacifiCorp should take the lead in hosting "Annual Bull Trout Operations" meetings. These would be separate from, and in addition to, the existing field coordination meetings. With respect to timing, the USFWS recommends that the Annual Operating Plan be completed and provided to the ACC for discussion before holding the field coordination meeting. This way, the field coordination meeting can be used to identify gaps in activities that need to be addressed.

2.19 OBJECTIVE 19- DETERMINE INTERACTIONS BETWEEN REINTRODUCED ANADROMOUS SALMONIDS AND RESIDENT FISH

As called for in Section 9.7 of the Settlement, PacifiCorp will monitor the interaction between reintroduced anadromous salmonids and resident fish species. Of specific interest to the Settlement parties was the possible effect resident trout released in Swift

Reservoir may have on reintroduced salmonids and the effect of anadromous fish introductions on the kokanee populations in Yale Lake. Additionally, concern was expressed that anadromous fish may impact the health of ESA listed bull trout populations. The methods proposed for addressing these concerns are presented separately below.

2.19.1 Task 19.1- Develop and Implement a North Fork Lewis River Baseline Assessment Plan

During preparation of this M&E Plan, the ACC expressed their desire to conduct an aquatic baseline assessment prior to implementing the full anadromous fish reintroduction program. In response to this request, PacifiCorp Energy, along with a Baseline Monitoring subgroup of the ACC, prepared the North Fork Lewis River Baseline Assessment Plan (PacifiCorp Energy 2009). The objective of this assessment plan is to monitor specific tributary and reservoir aquatic index sites within the Lewis River watershed upstream of Merwin Dam to gather baseline information on the aquatic biological community, in order to compare and document conditions and changes over time within the watershed. Specifically, data collected during monitoring would be used to document changes in species assemblage, species relative abundance, tropic interactions, and nutrient availability resulting from anadromous fish reintroduction efforts.

2.19.1.1 Methods

As outlined in the North Fork Lewis River Baseline Assessment Plan, baseline monitoring was conducted in June, August, and October of 2009 at a total of 28 index sites located upstream of Merwin Dam (Table 2.19.1). The 100 meter stream index sites were chosen in coordination with USFWS bull trout Patch Model sampling activities which are an ongoing effort in the Lewis River basin. The baseline monitoring that occurred in 2009 addressed species diversity and relative abundance prior to anadromous reintroduction. Follow-up duplication of baseline efforts after reintroduction is established will address the two-way effects between anadromous fish and resident fish.

Table 2.19.1. Reservoir and tributary index site locations associated with the North Fork Lewis River Baseline Assessment Plan.

Reservoir Index Site Locations:	100 Meter-long Tributary Index Site Locations:
Lake Merwin (a site across from Speelyai Bay Park and a site near Merwin Dam)	Jim Creek (two sites) Brooks Creek (two sites)
Yale Lake (a site across from the mouth of Cougar Creek and a site near Yale Dam)	Siouxon Creek (two sites) Cougar Creek (two sites) Lewis River Bypass Reach (two sites)
Swift Reservoir (a site across from the mouth of Drift Creek and a site near Swift No. 1 Dam)	Swift Creek (two sites) Drift Creek (two sites) P8, an unnamed tributary to Pine Creek (two sites) Rush Creek (two sites) Cussed Hollow Creek (two sites) Mainstem North Fork Lewis River above Lower Falls (two control sites)

The six reservoir index sites were sampled for fish species composition and relative abundance using 150-to 250 foot variable mesh experimental tangle nets (0.25- to 2.5-inch stretch mesh) deployed perpendicular to the shoreline. At the tributary index sites, field personnel will use single-pass electrofishing techniques to determine fish species composition, fish species relative abundance, and forage fish nutrient availability. For fish, tissue samples will be taken from individuals in each of three size categories for each species encountered. For resident salmonids, the size-class distinctions will be <200mm, 200-300mm, and >300mm. For other resident fish species, the size-class distinctions will be <50mm, 50-100mm, and >100mm. The collection goal is 5 individual samples per size-class strata per species.

Two locations within each reservoir and tributary index site will also be sampled for macroinvertebrates (using a Serber Sampler or benthic dredge). To address concerns about the effects of reintroduced anadromous fish on kokanee in Yale Lake, pelagic plankton tows will also be performed near the Yale Park index area. These 28 reservoir and tributary sites will then be re-sampled following the same method after full anadromous fish reintroduction to record changes from the 2009 baseline data.

Trophic relationships in the reservoirs and identified tributaries will be evaluated using stable isotope analysis. Tissue samples will be taken from captured organisms (fish, macroinvertebrate, and for Yale Lake, plankton) at each index site, and when funding allows, samples will be sent to a lab and analyzed for distinct nitrogen (δ15N) and carbon (δ13C) isotopic signatures as needed to identify trophic interactions within and between individual organisms of each identified species.

2.19.1.2 Frequency and Duration

The initial baseline assessment was conducted in June, August, and October of 2009. The timeline and duration of subsequent sampling will be described in PacifiCorp and Cowlitz PUD's Monitoring and Evaluation Plan, scheduled to be completed in June 2010.

2.19.1.3 Assumptions

Major assumptions associated with this task include:

1. Fish sampling efforts in the tributary and reservoir index sites result in the collection of at least 5 fish per size-class strata per species.
2. Adequate funding will be available to process tissue samples.
3. A single year baseline is indicative of pre-reintroduction conditions.

2.19.1.4 Results and Reporting

All sampling activities will be a conducted in collaboration with representatives of the Parties to the Settlement Agreement. Data will be compiled at the end of each scheduled sampling period and the cumulative findings presented to the Aquatic Coordination Committee in a single report.

2.19.2 Task 19.2- Determine Spawning Competition in Rush, Pine and Cougar Creeks

Reintroduced coho salmon have the potential to compete with bull trout for limited spawning habitats in the upper Lewis River basin as a result of their similar spawning period and generally comparable spawning habitat preferences. Steelhead and Chinook salmon spawn prior to bull trout in the Lewis River and therefore do not pose a risk of competition for spawning sites (USFWS 2006). Potential negative effects on bull trout can include redd superimposition and associated increases in egg and alevin mortality. The objective of this task therefore is to determine if coho spawners compete with bull trout for spawning areas in the identified streams.

2.19.2.1 Methods

Following implementation of the formal reintroduction effort upstream of Swift Dam (i.e., the completion of the upstream and downstream fish passage facilities), PacifiCorp will work in coordination with the USFWS and WDFW to evaluate potential bull trout redd superimposition by coho salmon in Pine Creek. An evaluation in Cougar Creek will begin as soon as the Habitat Preparation Plan is implemented in the Yale Lake reach (fall of 2016).

During the bull trout spawning surveys described in the Utilities' Bull Trout Monitoring Plan, survey crews will mark each clearly defined bull trout redd with a piece of rebar or a wooden dowel driven into the streambed so that bull trout redds can continue to be identified after the coho spawning period (ODFW 2005)[34].

If it is found that some percentage of coho spawn before bull trout, both coho and bull trout redds will be differentially marked throughout the monitoring period to determine any impacts on the bull trout population. The results of the baseline spawning surveys in Cougar Creek (GIS maps) will serve as a tool indicating primary bull trout spawning locations in this study.

For each bull trout redd, the combined length of the pocket and mound, maximum depth of the pocket, and maximum width of the mound will be measured and recorded. Spawning substrate size will also be determined by counting gravel along a 0.5 meter length of each pocket and mound of selected redds.

After each bull redd is located and marked, they will be revisited twice per month during the coho spawning period to determine whether spawning coho superimpose on bull trout redds. Superimposition of redds will be defined as overlapping redd pits or tailspills resulting from construction of multiple redds in the same area. Estimates of the percent of each bull trout redd affected by coho spawning and the total number of redds superimposed will be determined for each tributary for each sample period.

[34] Because of access, turbulence, and water clarity issues it may be difficult to find many bull trout redds. Thus impacts of coho spawning on top of bull trout redds may be difficult to ascertain.

2.19.2.2 Frequency and Duration

Surveys will be performed every 10 days starting in September and continuing until January, weather and access permitting. The study will likely be repeated for several years. Study termination would be determined in consultation with the ACC and with the approval of the Services.

2.19.2.3 Assumptions

- Biologists are able to correctly assign redds to species.

2.19.2.4 Results and Reporting

Study results will be summarized in the ACC/TCC Annual Report.

2.19.3 Task 19.3 – Determine Anadromous Fish Effects on the Kokanee Spawner Abundance in Yale Lake.

Kokanee and bull trout spawning surveys will be conducted yearly in Cougar Creek throughout the spawning period of each species. The entire 1.5 miles of Cougar Creek will be surveyed for adult fish. Information such as redd superimposition and displacement of kokanee redds will be identified following reintroduction of anadromous fish into Yale Lake. Annual abundance information for both kokanee and adult anadromous fish will be reviewed by and in consultation with the ACC to inform adaptive management of the reintroduction program and to help guide the operation of the passage facilities.

2.19.3.1 Assumptions

The key assumption of the study is:

- Biologists can accurately identify and enumerate kokanee spawners.

2.19.3.2 Results and Reporting

Study results will be presented in the ACC/TCC Annual Report.

2.20 OBJECTIVE 20- DOCUMENT PROJECT COMPLIANCE WITH WATER MANAGEMENT REQUIREMENTS

PacifiCorp has agreed to document project flow, ramping rate, flow plateau, and flood storage requirements of the new Licenses for the Project. Pending approval of the High Run-Off Procedures, PacifiCorp has also agreed to document flood storage. The monitoring locations for stream flow-related requirements will be at the Ariel Gage located in the lower Lewis River, and at two sites in the Lewis River bypass reach below Swift No. 1 Dam. Flood storage requirements will be monitored at each of the project dams.

2.20.1 Task 20.1 – Monitor River Flow, Ramping Rate and Flow Plateau for the Lewis River Projects

2.20.1.1 Monitoring Locations

Minimum stream flow values for the Lewis River are measured in real-time at the USGS Gage No. 14220500 (Ariel Gage) located downstream of the Merwin Dam. This gage is the official compliance point for minimum stream flow releases, ramping rates and plateau operations downstream of Merwin Dam.

Flow into the Swift bypass reach will be measured in two locations in accordance with Section 6.1 of the Settlement Agreement. These locations are the "Upper Release Point" in the upper end of the bypass reach, and at the "Canal Drain", located approximately one-third the length of the canal downstream of the Swift No. 1 tailrace. [35]

The methods used for determining Project compliance with all flow and ramping rate license requirements at these monitoring locations are presented below.

2.20.1.2 Rating Tables and Gage Station Maintenance

Where used, rating tables will be maintained by PacifiCorp or a qualified contractor. Maintenance of relevant monitoring instrumentation will meet PacifiCorp's need for real time access to flow data. Instruments will be maintained by PacifiCorp or other qualified contractors.

2.20.1.3 Data Management and Publication

Data will be managed by PacifiCorp. Any data deficiencies discovered during the review and publication process (e.g., rating table shifts, stage offsets) will be edited to produce an accurate record.

Ariel Gage

Real-time 15-minute provisional data from the Ariel gage will be logged by PacifiCorp to monitor hourly average flow and hourly ramping rates downstream of Merwin Dam. Minimum stream flow, ramp rate and plateau operations reporting will occur on an excursion basis only as provided in Section 2.20.1.4.

Swift Bypass Reach: Upper Release Point

Real-time 15-minute data from the Swift bypass reach and Upper Release Point will be logged by PacifiCorp and/or a qualified contractor to monitor hourly average flow. Minimum flow at these locations will be reported on an excursion only basis in the annual report. All reviewed records will be stored by PacifiCorp in a permanent repository.

In the event of an extended unplanned interruption to flow from the upper release point, PacifiCorp will provide flow via the spill gates (or other means) to allow at least the

[35] PacifiCorp will pay for the maintenance, operation and replacement, if necessary, of both gages.

required minimum flow into the upper bypass reach. During this particular scenario, flow will be calibrated by PacifiCorp at the most suitable point downstream of the spillway to verify that the temporary flow release is equal to the flow required by the 401 Certification. The spill gates will be adjusted until such time as the appropriate minimum flow is achieved and the spill gates fixed to this opening. In addition, PacifiCorp will send a notice by electronic mail (email) to the ACC members within 48 hours after each adjustment or change to the flows in the bypass reach (unless the Parties agree upon an alternate method of notification). In the case of planned interruptions (e.g., for canal maintenance) flow will be provided to the Upper Release channel using a pump or siphon until the flows can be restored.

Swift Bypass Reach: Canal Drain

Flow into the lower Swift bypass reach from the canal drain will be monitored by logging 15-minute stage data in the Swift canal. This data will be used to calculate hourly average flow into the lower Swift bypass reach. Since the required flow release from the canal drain remains constant throughout the year (14 cfs), the canal drain opening will be fixed to release required flows at the lowest possible stage in the canal. Most of the time, flow from this release point will likely exceed the required minimum since the stage in the canal generally is operated higher than this minimum elevation, thereby increasing the head at the release point. Mean hourly stream flow values measured at the canal drain will be published in the ACC/TCC Annual Report. All reviewed records will be stored by PacifiCorp in a permanent repository.

In the event of a planned or unplanned interruption of flow release from the canal drain, PacifiCorp will place a pump siphon or use other means to allow at least the minimum flow into the bypass reach from this location. During this particular scenario, flow will be calibrated by PacifiCorp or a qualified contractor at the most suitable point downstream of the canal drain to verify that the temporary flow release is equal to the flow required by the 401 Certification. Flow will be adjusted until such time as the appropriate minimum flow is achieved and set at this level. As is the case for the Upper Release Point, PacifiCorp will send a notice by email to the ACC members and WDOE within 48 hours after each adjustment or change to the flows in the bypass reach via the canal drain (unless the Parties agree upon an alternate method of notification).

2.20.1.4 Flow and Ramp Rate Monitoring and Excursion Reporting

Flow Monitoring and Excursion Reporting

If flows at gage sites are discovered to be less than the required minimum flows, or ramping occurs that exceeds the compliance limits, PacifiCorp will correct these conditions as rapidly and prudently as possible. Any excursions from the flow requirements will be clearly documented by date, time and duration and reported as discussed below.

Ariel Gage

PacifiCorp will review hourly average flow data for compliance with the minimum stream flow requirements in the new license (Table 2.20.1). Excursions from hourly minimum stream flow requirements will be reported to FERC, WDOE, and the ACC within 24 hours of verifying the excursion. Notification will include a detailed explanation of why the event occurred and corrective actions implemented.

These initial notifications will be distributed via email, and will describe the location, time, duration, magnitude, and cause of the event; what immediate corrective actions were taken; and any long-term plans to prevent repetition. Comprehensive reports may be requested by the agencies for individual circumstances.

Minimum flow excursions measured at the Ariel Gage site will be described in the ACC/TCC Annual Report.

Swift Bypass Reach Upper Release

PacifiCorp will review hourly average flow data for compliance with the minimum stream flow requirements in the new license (Table 2.20.1). Excursions from minimum stream flow requirements will be reported to FERC, WDOE, and the ACC within 24 hours of verifying the excursion. Notification will include a detailed explanation of why the event occurred and corrective actions implemented.

These initial notifications will be distributed via email, and will describe the location, time, duration, magnitude, and cause of the event; what immediate corrective actions were taken; and any long-term plans to prevent repetition. Comprehensive reports may be requested by the agencies for individual circumstances. Minimum flow excursions measured at the Upper Release site will be described in the ACC/TCC Annual Report.

Swift Bypass Reach Canal Drain

Flow in the lower Swift bypass reach from the canal drain will be monitored by logging 15-minute stage data in the Swift canal. PacifiCorp will review mean hourly average stage data for compliance with the minimum stream flow requirements in the new license (Table 2.20.1). Excursions from minimum (stage) stream flow requirements will be reported to FERC, WDOE and the ACC within 24 hours of verifying the excursion. Notification will include a detailed explanation of why the event occurred and corrective actions implemented.

These initial notifications will be distributed via email, and will describe the location, time, duration, magnitude, and cause of the event; what immediate corrective actions were taken; and any long-term plans to prevent repetition. Comprehensive reports may be requested by the agencies for individual circumstances.

Minimum flow excursions measured at the canal drain will be described in the ACC/TCC Annual Report.

Table 2.20.1. Minimum flow releases in the Lewis River from Merwin Dam and the Swift bypass reach from the Swift canal as required by the FERC licenses and Section 401 Certifications.

Lewis River Downstream of Merwin Dam	
Date	**Minimum Flow (cfs)**
October 16 through October 31	2,500
November 1 through December 15	4,200
December 16 through March 1	2,000
March 2 through March 15	2,200
March 16 through March 30	2,500
March 31 through June 30	2,700
July 1 through July 10	2,300
July 11, through July 20	1,900
July 21 through July 30	1,500
July 31 through October 15	1,200
Swift Bypass Reach*	
Date	**Minimum Flow (cfs)**
January	65
February	89**
March	90
April	90
May	90
June	68
July	68
August	68
September 1-23	68
September 24-30	69
October	75
November 1-15	90
November 16-30	70
December	65

* Flow levels were taken from the WDOE 401 Certification for the Swift No. 1 Hydroelectric Project (WDOE 2006) and are the "Combined Flow Schedule" for the required stream flow releases from the "Upper Release Point" and the "Canal Drain."
** During leap years, 88 cfs shall be released for the first 7 days in February and 89 cfs for the rest of the month.

<u>Ariel Gage Ramp Rate and Plateau Operations Monitoring and Excursion Reporting</u>

When ramping occurs that exceeds compliance limits, PacifiCorp will correct these conditions as rapidly and prudently as possible. If plateau operations are violated, PacifiCorp will not attempt to correct the action by returning to the flow level preceding the event since plateau operations seek to limit flow changes.

PacifiCorp will review hourly Ariel gage stage data to ensure compliance with Project ramping rate restrictions and plateau changes downstream of Merwin Dam[36]. Stage will be measured in tenths of feet per hour, and will be calculated using available 15-minute Ariel gage flow data to calculate an hourly average. The ramping rates will then be compared with the Settlement required ramping rate and flow plateau requirements on an hourly basis.

The requirements are as follows:

1. PacifiCorp will limit the up-ramping rate as observed at the Ariel gage (downstream of Merwin Dam) to 1.5 feet per hour for all periods when flows below Merwin Dam are at or less than the hydraulic capacity of the Merwin Project turbines (currently 11,400 cfs).

2. PacifiCorp will limit the down-ramping rate to 0.17 feet per hour for all periods when flows are at or less than 8,000 cfs. From February 16 through June 15, no down-ramping shall occur (1) commencing one hour before sunrise until one hour after sunrise and (2) commencing one hour before sunset until one hour after sunset.

3. PacifiCorp will further restrict daily flow fluctuation from February 16 through August 15 of each year by maintaining flow plateaus (periods of near-steady discharge) as described in Section 6.2.2 of the Settlement Agreement.

Excursions from hourly ramp rate requirements or plateau changes will be reported to FERC, WDOE, and the ACC within 24 hours of verifying the excursion. Notification will include a detailed explanation for why the event occurred and corrective actions implemented.

These initial reports will be distributed via email, and will describe the location, time, duration, magnitude, and cause of the event; what immediate corrective actions were taken; and any long-term plans to prevent repetition. Comprehensive reports may be requested by the agencies for individual circumstances.

PacifiCorp will describe ramping rate and plateau operation excursions as measured at the Ariel gage in the ACC/TCC Annual Report.

High Run-Off Procedure Monitoring and Reporting

The reporting requirements described here are pending approval of PacifiCorp's Lewis River High Run-Off Procedures by FERC and the U.S. Army Corps of Engineers

[36] "Ramping" means those Project-induced increases ("up-ramping") and decreases ("down-ramping") in river discharge and associated changes in river surface elevation over time below Merwin Dam caused by Project operations or maintenance (Section 6.2.1 of the Settlement).

(USACE)). Documentation of compliance with the High Run-Off Procedures will be reported directly to FERC at the end of each flood season.

The High Run-Off Procedures define vacant storage requirements for flood control purposes throughout the flood control season extending from September 20 through April 30 or April 15 in years of low snowpack (Table 2.20.2). Generally, vacant storage is a function of reservoir elevation relative to the normal full operating level in the reservoir[37]. PacifiCorp will report daily average vacant storage to the nearest tenth of a foot for the flood control season to the FERC by July 31, annually. In the event that the average daily storage requirement is encroached upon for flood control purposes or other reasons, this will be reported to the FERC within 24 hours of verifying the reservoir storage encroachment. Notification will be provided via email and will include an explanation for the need/use of the vacant storage. Notification will occur when the vacant storage requirement (as measured to the nearest tenth of a foot) is encroached upon by more than 0.2 feet for 6 hours or more. PacifiCorp will report daily average reservoir elevation for each project, to the nearest tenth of a foot for the flood control season to the FERC by July 31, annually.

Table 2.20.2. Vacant storage requirements for the Lewis River Project reservoirs (Merwin, Yale and Swift reservoirs)

Date	Vacant Storage (feet)
Normal Vacant Storage	
Sept. 20	0
Oct. 10	8.5
Nov. 1 thru Apr. 1	17.0
Apr. 15	8.5
Apr. 30	0
Vacant Storage in Low Snowpack Years	
Sept. 20	0
Oct. 10	8.5
Nov. 1 thru Mar. 15	17.0
Apr. 1	8.5
Apr. 15	0

The high runoff procedure also defines elevations at which the reservoirs are considered “full” under normal operating conditions. However, during some high flow events, it may be necessary to surcharge the reservoirs beyond these normal operating limits. When this occurs in any of the three project reservoirs, PacifiCorp will notify the FERC of this occurrence within 24 hours of verifying the reservoir surcharge. Notification will be provided via email and will include an explanation for the need to surcharge. Notification will occur when the normal maximum elevation in each reservoir is exceeded by more than 0.2 feet (measured to the nearest tenth of a foot) for 6 hours or more.

[37] Vacant storage is measured in feet of depth between the current reservoir water levels and elevation 1,000 feet-msl at Swift, elevation 490 feet-msl at Yale, and elevation 239.6 feet-msl at Merwin. Because the average storage space in the top foot of the three Lewis River reservoirs is approximately the same, depth can be summed over multiple reservoirs.

Reservoir elevation monitoring devices are located at the Project dams and are operated and maintained by PacifiCorp. Data from these devices will be archived in PacifiCorp's operations databases.

2.21 OBJECTIVE 21 - DETERMINE WHEN REINTRODUCTION GOALS ARE ACHIEVED

The Settlement Agreement notes:

> *…the Services, after discussion with the ACC, shall determine how they will assess whether Reintroduction Outcome Goals have been met, e.g., metric, model, qualitative factors ("Evaluation Methodology"). The determination shall take into account the variability of the factors influencing the success of the comprehensive aquatics program over time such as cycles of ocean conditions and will include an appropriate temporal component in developing and applying the Evaluation Methodology.*

Although the responsibility of the Services, the Utilities are interested in playing a significant role in putting forth viable approaches for the Services to consider in establishing the reintroduction Evaluation Methodology. The H&S Plan (PacifiCorp Energy and Cowlitz PUD 2006) provides some ideas as to what type of information should be considered in determining program success. In general the H&S Plan suggests:

1. Using other lower Columbia River spring Chinook, coho and steelhead as index stocks to track out-of-basin effects on the success of the Lewis River program.

2. Tracking similar reintroduction efforts on the Cowlitz River and other lower Columbia River tributaries.

3. Calculating yearly harvest rates, smolt-to-adult survival rates, juvenile production etc., to estimate when runs are self-sustaining.

<u>Methods</u>

Methods for conducting each of the three analyses are presented in different sections of this M&E Plan. Yet to be defined is a numeric adult goal that dictates when run-size is sufficient for achieving both recovery and harvest goals. Until the Services develop numeric goals, the natural adult abundance targets presented under Objective 12 (Ocean Recruits) will be used as the benchmarks for determining the success of the reintroduction effort.

2.22 OBJECTIVE 22 - DEVELOP A HATCHERY AND SUPPLEMENTATION PLAN (H&S PLAN) TO SUPPORT AND PROTECT LEWIS RIVER NATIVE ANADROMOUS FISH POPULATIONS AND PROVIDE HARVEST OPPORTUNITY

The H&S Plan is required under Section 8 of the Lewis River Hydroelectric Projects Settlement Agreement. The goals identified by the parties to the Settlement Agreement formed the basis for actions proposed in this plan. The complete plan can be found at:

http://www.pacificorp.com/es/hydro/hl/lr.html# (See tab for ACC)

A brief overview of the H&S Plan is provided below.

Overview of H&S Plan

The Settlement Agreement states that the goals of the H&S Plan are to support:

1. Self-sustaining, naturally producing, harvestable native anadromous salmonids species throughout their historical range in the North Fork Lewis River, and
2. The continued harvest of resident and native anadromous fish species.

The H&S Plan is designed to be consistent with the priority objective of recovering wild fish stocks in the basin to viable and harvestable levels. When selecting between actions, deference will be given to those that provide the greatest protection to wild fish populations.

The H&S Plan addresses six topics:

- Hatchery Programs and Operations
- Supplementation Program
- Monitoring and Evaluation (M&E)
- Adaptive Management
- Expected Outcomes
- Annual Operating Plan

The combined actions proposed in the H&S Plan are designed to achieve the hatchery and natural production targets shown in Table 2.22.1. The values in the table are referred to as adult ocean recruits, which include escapement to the habitat plus the number of fish caught in ocean and freshwater fisheries. It should be noted that most representatives of the Lewis River Aquatic Coordination Committee (ACC) favor not including jacks in the ocean recruits calculation.

Table 2.22.1. Hatchery targets and natural production adult threshold levels (adult ocean recruits) for spring Chinook, steelhead and coho.

	Spring Chinook	Steelhead	Coho	Total
Hatchery Targets	12,800	13,200	60,000	86,000
Natural Production Threshold	2,977	3,070	13,953	20,000
Grand Total	**15,777**	**16,270**	**73,953**	**106,000**

As natural production for each species exceeds the threshold level identified in Table 2.22.1, hatchery production levels for that species would be reduced on a 1:1 (one wild fish for one hatchery fish) basis. However, as called for in the Settlement Agreement, hatchery production targets would not be reduced below the "Hatchery Target Floor" levels shown in Table 2.22.2.

Table 2.22.2. Hatchery target floor levels for spring Chinook, steelhead and coho.

	Spring Chinook	Steelhead	Coho	Total
Hatchery Target Floor	2,679	2,763	12,558	18,000

The following data will be collected to determine if adult production goals are being achieved:

- Ocean Recruits
- Smolt-to-adult survival rates (SAR)
- Juvenile recruits-per-spawner (JRS)
- Adult recruits-per-spawner (ARS)
- Total juveniles entering reservoirs and collected at bypass facilities
- Adult returns to the spawning grounds

Hatchery facilities and operations to be monitored include:

- Environmental rearing conditions by life stage
- Track consistency of programs with HSRG guidelines
- Disease presence and loss by life stage
- Survival by life stage
- Growth rate by month from fry ponding to release as smolts
- Number of fish tagged, tag type and purpose (experimental, production)
- Number of adults collected, spawned, recycled, and their disposition
- Number of wild fish collected, origin and disposition
- Number of hatchery fish collected that originated from outside of the Lewis River basin (based on CWT tag data)
- General hatchery operations data required for regulatory/permitting

The Annual Operating Plan (AOP) is designed to implement the H&S Plan. The AOP will provide the following information to guide yearly activities:

- <u>Production Plan</u>: Specifies the species to be reared and broodstock source
- <u>Hatchery and Juvenile Production Targets</u>: Identifies adult and juvenile targets by species for each hatchery program
- <u>Fish Release Schedule</u>: Identifies by species the rearing schedule and planned distribution of fish and the schedules and locations of release.
- <u>List of Hatchery Facility Upgrades</u>: Identifies upgrades to be implemented at each hatchery facility

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Appendix A

Incidental Take Statement

Appendix A- Incidental Take Statement

Post-Season Monitoring and Evaluation Form
Scientific Research Plan
Annual Report

Date: ___________

Plan Name: _____________ **Evaluator's Name:** ____

Contact Name: ___________________ **Contact Email:** __________________________ **Contact Phone #:** __________________
(Contact = person submitting report)

Study Number and Title (if applicable): ____
Provide separate tables for each study.

Part I: This is an example of how to fill out the table. **Replace all red text with the information in the plan. Replace all blue text with the actual results of your activities.**

ESU/Species and population group if specified in your permit	Life Stage	Origin	Take Activity	Number of Fish Authorized for Take	Actual Number of Listed Fish Taken	Authorized Unintentional Mortality	Actual Unintentional Mortality	Evaluation Location	Evaluation Period
Lower Columbia River (LCR) Chinook	Juvenile	Naturally Produced	Capture, mark, release	100	90	5/100	4/90	Columbia River, Oregon	January – February
LCR Chinook	Adult	Artificially Propagated	Capture, handle, release	10	9	1/10	0/9	Bonneville Dam	June
LCR Chinook	Adult	Naturally Produced	Intentional mortality	20	15	N/A	N/A	Bonneville Dam	June
Oregon Coast Coho	Juvenile	Naturally Produced	Observe / Harass	500	400	N/A	N/ A	Nehalem River	October

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Appendix B

Radio-Tag Recapture Design

APPENDIX B - TAG RELEASE-RECAPTURE DESIGN AT SWIFT DAM

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11 JULY 2007

APPENDIX B

TABLE OF CONTENTS

1.0 INTRODUCTION

This report describes the design and analysis of the 2008 tag release-recapture study at Swift Dam No. 1. Mark-recapture models will be used to estimate survival through the Swift Reservoir and Project. This report describes the release and detection locations used in the proposed study along with the recommended data analyses. Specific objectives of the tagging study include the following:

1. Estimate the joint probability of smolt surviving through the reservoir and entering the surface collector.
2. Estimate entrance efficiency and retention efficiency of the surface collector.
3. Estimate smolt survival through the transport system.

These goals will be accomplished using one or more groups of tagged fish.

2.0 RELEASE-RECAPTURE DESIGN

Releases of the tagged fish at the top of the Swift Reservoir will be used to estimate passage survival through the project. Survival through the Swift No. 1 Project can currently be conceptualized by the equation

$$S_{PROJ} = S_{RES}\left[P_{COL} \cdot S_{COL} \cdot S_{TRAN} + P_{TIT} \cdot S_{TIT} + \left(1 - P_{COL} - P_{TIT}\right) S_{SP}\right] \quad (1)$$

where

S_{RES} = survival probability through reservoir,
S_{PROJ} = total Project passage survival,
P_{COL} = proportion of fish arriving at Swift Dam that enter the surface collector,
P_{TIT} = proportion of fish arriving at Swift Dam that enter the turbine intake tower,
S_{COL} = survival probability through the collector,
S_{TIT} = survival probability through the turbine intake tower,
S_{SP} = survival probability through the spillway,
S_{TRAN} = survival probability through the smolt transport system.

Currently it is assumed that $S_{TIT} = S_{SP} = 0$, in which case

$$S_{PROJ} = S_{RES} \cdot P_{COL} \cdot S_{COL} \cdot S_{TRAN}. \quad (2)$$

A single release-recapture model will be used to estimate joint probability

$$S_{RES} \cdot P_{COL} = S_1 \quad (3)$$

Independent sampling of fish known to have entered the collector in will be used to estimate the probability of surviving through the collector and the transport system, i.e.,

$S_{COL} \cdot S_{TRAN} = S_2$. The product $\hat{S}_1 \cdot \hat{S}_2$ will therefore provide an estimate of overall Project passage survival with associated variance

$$\text{Var}\left(\hat{S}_1 \cdot \hat{S}_2\right) = S_1^2 \cdot \text{Var}\left(\hat{S}_2\right) + S_2^2 \cdot \text{Var}\left(\hat{S}_1\right) + \text{Var}\left(\hat{S}_1\right) \cdot \widehat{\text{Var}}\left(\hat{S}_2\right)$$

and estimated variance

$$\widehat{\text{Var}}\left(\hat{S}_1 \cdot \hat{S}_2\right) = \hat{S}_1^2 \cdot \widehat{\text{Var}}\left(\hat{S}_2\right) + \hat{S}_2^2 \cdot \widehat{\text{Var}}\left(\hat{S}_1\right) - \widehat{\text{Var}}\left(\hat{S}_1\right) \cdot \widehat{\text{Var}}\left(\hat{S}_2\right).$$

2.1 Estimating Survival through the Reservoir to the Surface Collector

Fish known to be active migrants will be collected in the surface collector and subsequently used in estimating project passage survival. Fish gathered from the surface collector, tagged, and transported back to the top of the Swift Reservoir will be released to estimate reservoir survival and entry into the surface collector (S_1, Fig. B-1).

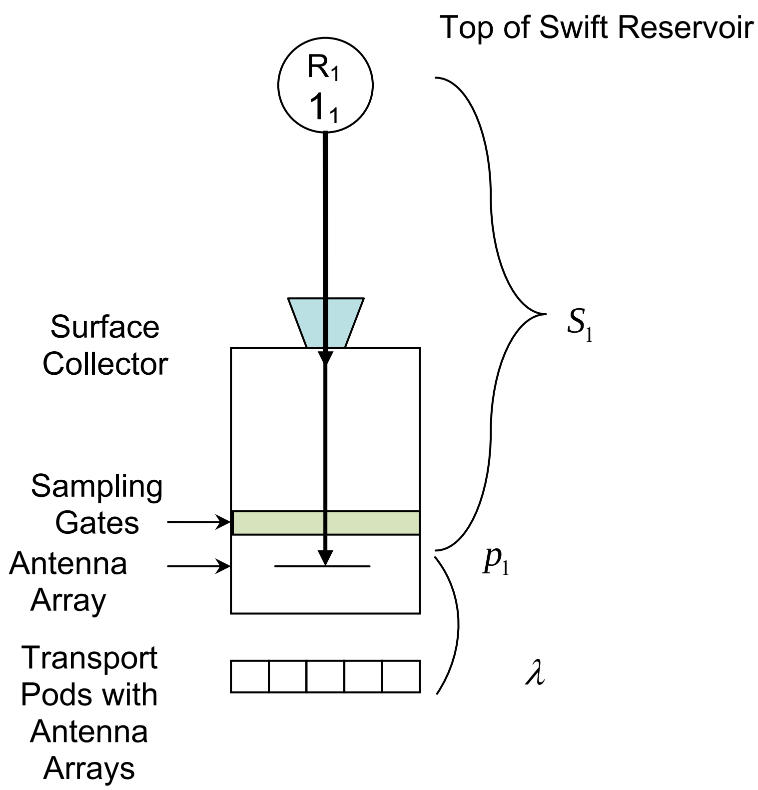

Figure B-1. Schematic of release-recapture design used in estimating survival through the reservoir and into the surface collector (S_1).

The single release-recapture model will be used to estimate the joint probability of surviving the reservoir and entering the surface collector to the point of the sampling gates. Two detection arrays, one in the collector just below the "point of no return" and another set in the collection pods will be used to generate the capture histories necessary to estimate the survival parameter S_1.

With 2 detection arrays, there are $2^2 = 4$ possible capture histories, and the following likelihood model:

$$L = \binom{R_1}{\underset{\sim}{n}} \left(S_1 p_1 \lambda_1\right)^{n_{11}} \left(S_1 p_1 \left(1-\lambda_1\right)\right)^{n_{10}} \left(S_1 \left(1-p_1\right)\lambda_1\right)^{n_{01}} \cdot \left(\left(1-S_1\right) + S_1\left(1-p_1\right)\left(1-\lambda_1\right)\right)^{R-n_{11}-n_{10}-n_{01}}, \quad (4)$$

where

R_1 = number of tagged fish released above Swift Reservoir;
n_{ij} = number of fish with capture history *i* (0,1 detected or not at first array) and *j* (0,1 detected or not at second array);
S_1 = joint probability $S_{RES} \cdot P_{COL}$;
p_1 = probability of being detected at first collection array;
λ = joint probability of surviving between arrays 1 and 2 and being detected at second array.

Survival is then estimated by the quantity

$$\hat{S}_1 = \frac{\left(n_{10}+n_{11}\right)\left(n_{01}+n_{11}\right)}{R_1 n_{11}} \quad (5)$$

with associated variance

$$\text{Var}\left(\hat{S}_1\right) = S_1^2 \left[\frac{(1-\lambda)(1-p_1)^2}{R_1 \lambda S_1 p_1} + \frac{(1-\lambda)^2 p_1 (1-p_1)}{R_1 \lambda (1-\chi_1)} + \frac{\chi_1}{R_1(1-\chi_1)}\right] \quad (6)$$

where

$$\chi_1 = \left(1-S_1\right) + S_1\left(1-p_1\right)\left(1-\lambda\right).$$

The other model parameters are estimated by

$$\hat{p}_1 = \frac{n_{11}}{n_{01}+n_{11}}, \quad (7)$$

$$\hat{\lambda} = \frac{n_{11}}{n_{10} + n_{11}}. \qquad (8)$$

Assumptions associated with the single release-recapture model include the following:

1. All fish act independently.

2. Release size is known without error.

3. There is no post-release handling mortality or tag loss.

4. Downstream detection is conditionally independent of detection upstream.

5. Tagged fish are uniquely identifiable at all detection sites.

6. Fish that residualize are considered mortalities.

2.2 Estimating Collector and Transport Survival

Survival through the surface collector and subsequent transport process to re-release will be estimated using a conceptual release group of fish that were known to have entered and were retained in the collector. Antenna at the sampling gate (Figure B-1) will identify fish known to have entered the collector (i.e., both alive and dead). These collected fish will then enter the transport system and eventually be transported to the recovery ponds prior to re-release. Two antenna arrays in the release channel will monitor fish as they exit the holding facilities. All visual mortalities in the recovery pond will be collected to compare against known fish entering the transport system. A single release-recapture model analogous to Equation (1) will be used to estimate smolt survival from the vicinity of the sampling gate to the release channel (Figure B-2).

To assure all dead tagged fish are properly identified and adjusted for in the statistical model, a known release of 50 dead tagged fish will be monitored through the system from the sampling gate to the antenna array in the release channel. If all known tagged fish are identified and recovered before the release channel, no adjustments to the release-recapture model would be necessary. If, on the other hand, some of the known dead tagged fish are detected at the recovery channel antenna, the likelihood model will need to be adjusted for the observed rate of false positives. In which case, the likelihood can be rewritten as follows:

$$L = \binom{R_2}{\underset{\sim}{m}} \left[\left(S_2 + (1-S_2)(1-p_d) \right) p_2 \lambda_2 \right]^{m_{11}}$$

$$\cdot \left[\left(S_2 + (1-S_2)(1-p_d) \right) p_2 (1-\lambda_2) \right]^{m_{10}}$$

$$\cdot \left[\left(S_2 + (1-S_2)(1-p_d) \right) (1-p_2) \lambda_2 \right]^{m_{01}}$$

$$\cdot \left[\left(S_2 + (1-S_2)(1-p_d) \right) \left(\lambda_2 + p_2 (1-\lambda_2) \right) \right]^{R_2 - m_{11} - m_{10} - m_{01}}$$

$$\cdot \binom{D}{d} (p_d)^d (1-p_d)^{D-d}, \qquad (9)$$

where

D = number of dead tagged fish released into collector system,
d_2 = number of dead tagged fish retrieved before exiting recovery ponds,
p_d = probability a dead fish is recovered in the transport/handling facilities.

In a similar vein, a tag-life study will be performed to construct a tag-failure curve to adjust perceived survival rates (S_1 and S_2) for rates of tag failure during outmigration. This adjustment will be based on the methods in Townsend et al. (2006) to account for any negative bias due to tag failure during the course of the release-recapture study.

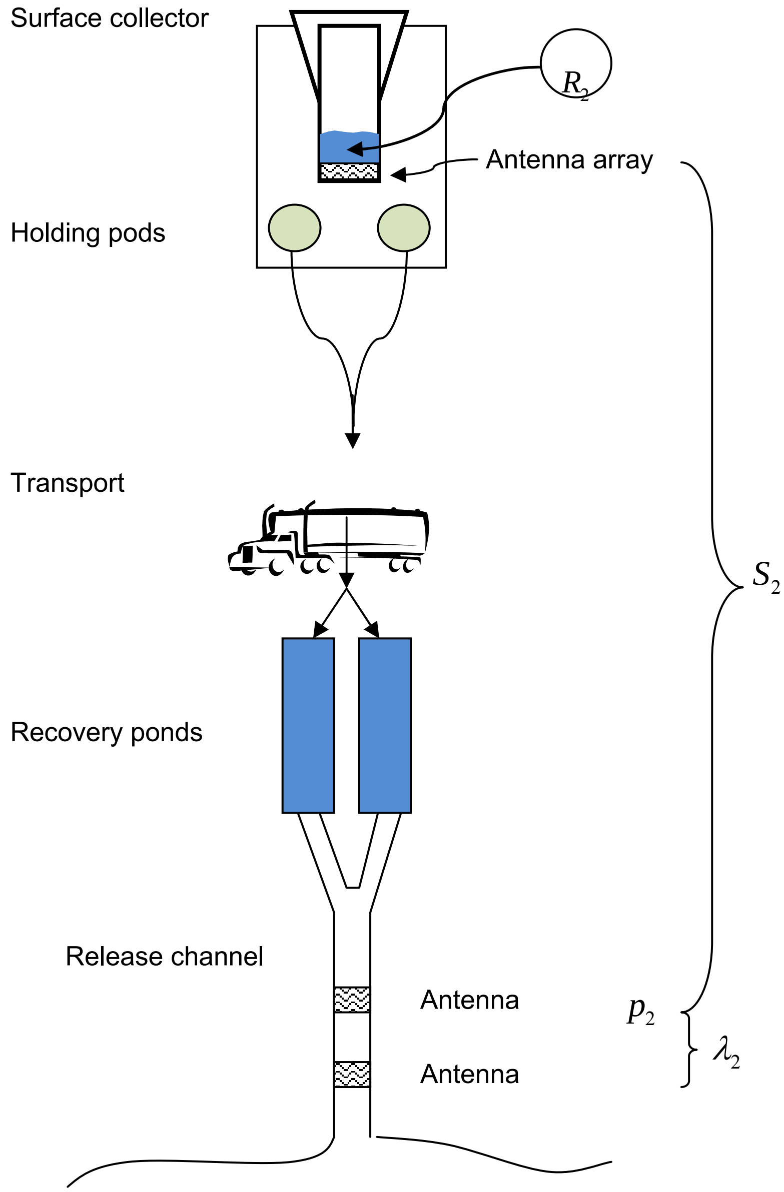

Figure B-2. Schematic of release-recapture design used in estimating survival through collector, transport system, and recovery ponds (S_2). Release group (R_2) composed to tagged fish known to have arrived at the sampling gates in the surface collector.

2.3 Test of Seasonal Performance

Overall dam survival $\left(S_1 \cdot S_2\right)$ will be compared to a desired project goal of 0.80 or greater using an asymptotic Z-test of the form

$$Z = \frac{\hat{S}_1 \cdot \hat{S}_2 - 0.80}{\sqrt{\widehat{\text{Var}}\left(\hat{S}_1 \cdot \hat{S}_2\right)}},$$

testing the null hypotheses

$$\text{H}_\text{o}: S_1 S_2 \geq 0.80$$

vs.

$$\text{H}_\text{a}: S_1 S_2 < 0.80$$

(at an $\alpha = 0.10$)

Should the estimate of $S_1 S_2$ be significantly less than 0.80, H_o will be rejected, and it will be concluded survival goals have not been achieved. The estimate of $\hat{S}_1 \hat{S}_2$ will be based on pooling the release-recapture data over the season. Should weekly estimates of $\hat{S}_1 \hat{S}_2$ prove to be heterogeneous, then a weighted average, weighted by an index of smolt migration, will be used to construct an annual estimate.

2.4 Estimating Collector Efficiency

Two sets of antennas will be used to estimate collector efficiency $\left(P_{CE}\right)$ at the surface collector (Figure B-3).

The first antenna array will be in front of the collector, identifying tagged fish within the vicinity of the entrance. The second antenna array will be in the holding pods, assumed to have a 100 % detection efficiency. Then the overall collector will be estimated by the fraction

$$\hat{P}_{CE} = \frac{a_2}{a_1} \qquad (10)$$

with associated variance estimator

$$\widehat{\text{Var}}\left(\hat{P}_{CE}\right) = \frac{\hat{P}_{CE}\left(1 - \hat{P}_{CE}\right)}{a_1}, \quad (11)$$

where

a_1 = number of unique tagged fish identified in the vicinity of the surface collector,
a_2 = number of unique tagged fish identified in the fish collection pods.

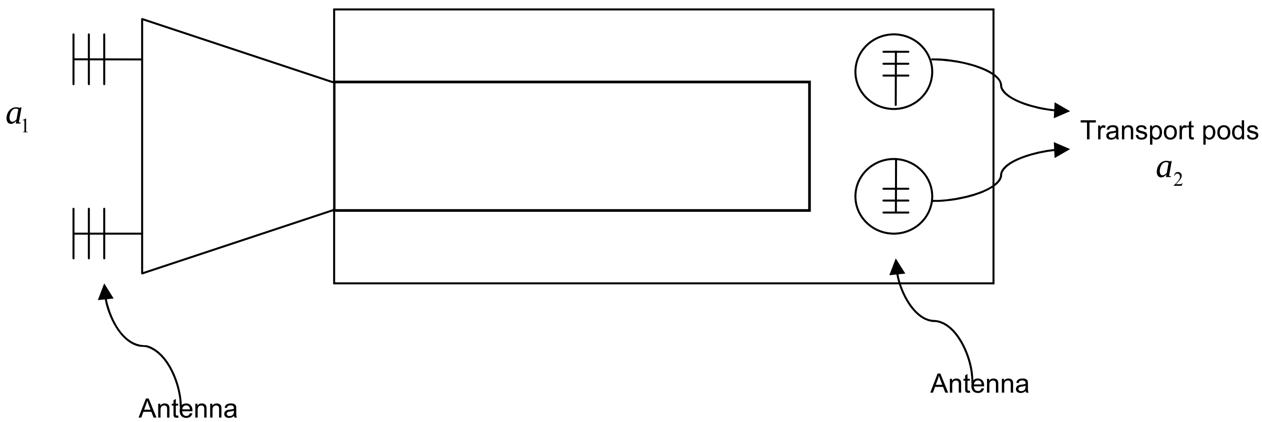

Figure B-2. Schematic of detection data used in estimating collector efficiency.

2.5 Release Schedule

Values of overall Project survival and transport mortality might be expected to vary over the outmigration season due to changes in smoltification and ambient conditions. For these reasons, tag releases need to be distributed across the season in order to more accurately reflect intra-annual trends. Releases will be conducted weekly in order to represent average migrational conditions. Efforts will be coordinated to assure estimates of S_1 and S_2 will be paired over the same time frames in order to estimate overall project survival (i.e., $S_1 \cdot S_2$).

2.6 Sample Size Calculations

Using the single release-recapture model, sample size calculations were performed for precision defined as

$$P\left(\left|\hat{S}_1 - S_1\right| < \varepsilon\right) = 1 - \alpha \, ;$$

In other words, the absolute error in estimation $\left(\text{i.e.}\left|\hat{S}_1 - S_1\right|\right)$ is less than $\varepsilon, \left(1-\alpha\right)100\%$ of the time. For example,

$$P\left(\left|\hat{S}_1 - S_1\right| < 0.05\right) = 0.90 \, .$$

specifies that the absolute error in estimating *S* should be less than .05, 95% of the time. Here ε is equivalent to the half-width of a 90% confidence interval.

Required release sizes were calculated under alternative combinations of:

a. S_1 = 0.50, 0.60, 0.70, 0.80, 0.90

b. p_1 = 0.85, 0.90, 0.95, 0.98

c. $\lambda = 1$

d. $\varepsilon = 0.025$

e. $1-\alpha = 0.95$

Required release sizes are summarized in Table B-1. For example, to be within 0.025 of the true survival value (S_1), 95% of the time when S_1 = 0.80, p_1 = 0.95, a total of 996 tagged fish need to be released.

Table B-1. Release sizes to estimate $S_1 = S_{RES}*P_{COL}$ at the Swift Reservoir for alternative values of survival and collection S_1, and detection probability (p_1) at the slide gates for a precision of $\varepsilon = 0.025$, $1 - \alpha = 0.95$ when $\lambda = 1$ at the holding pods.

S_1	P_1	$\varepsilon = 0.025$	S_1	P_1	$\varepsilon = 0.025$
0.50	**0.85**	**1618**	**0.80**	**0.85**	**1114**
	0.90	**1571**		**0.90**	**1038**
	0.95	**1545**		**0.95**	**996**
	0.98	**1538**		**0.98**	**986**
0.60	**0.85**	**1573**	**0.90**	**0.85**	**700**
	0.90	**1516**		**0.90**	**615**
	0.95	**1485**		**0.95**	**568**
	0.98	**1477**		**0.98**	**556**
0.70	**0.85**	**1405**	**0.95**	**0.85**	**447**
	0.90	**1339**		**0.90**	**357**
	0.95	**1302**		**0.95**	**308**
	0.98	**1293**		**0.98**	**295**

Required release sizes are summarized in Table B-2 for precision values of 0.05 and 0.10, when $1-\alpha$ = 0.90. For example, to be within ± 0.05 of the true survival value (S_1), 90% of the time when S_1 = 0.95, p_1 = 0.95, a total of 55 tagged fish need to be released.

Table B-2. Release sizes to estimate $S_1 = S_{RES} \cdot P_{COL}$ at the Swift Reservoir for alternative values of survival and collection S_1, and detection probability (p_1) at the slide gates for a precision of ε = 0.05 or 0.10, $1-\alpha$ = 0.90 when λ = 1 at the holding pods.

		ε				ε	
S_1	p_1	0.05	0.10	S_1	p_1	0.05	0.10
0.50	0.85	285	72	0.80	0.85	197	51
	0.90	277	70		0.90	183	46
	0.95	272	69		0.95	176	44
	0.98	271	69		0.98	174	44
0.60	0.85	277	70	0.90	0.85	124	31
	0.90	267	67		0.90	109	28
	0.95	262	66		0.95	100	25
	0.98	261	65		0.98	98	25
0.70	0.85	248	62	0.95	0.85	79	20
	0.90	236	59		0.90	63	16
	0.95	230	58		0.95	55	14
	0.98	228	57		0.98	52	13

3.0 REFERENCES

Townsend, R.L., Skalski, J.R., Dillingham, P., and Steig, T.W. 2006. Correcting bias in survival estimation resulting from tag failure in acoustic and radiotelemetry studies. Journal of Agricultural Biology and Environmental Statistics **11**(2): 183-196.

Appendix C

Adult Trap Efficiency

Appendix C - Merwin Upstream Trap Draft Study Plan
February 2010

INTRODUCTION

Section 4.3 of the Final Settlement Agreement (SA) for the Lewis River Hydroelectric Projects called for the construction and future operation of an adult trap and transport facility at the Merwin Project. Table 4.1.4 of the SA defines Adult Trap Efficiency (ATE) as "The percentage of adult Chinook, coho, steelhead, bull trout, and sea-run cutthroat that are actively migrating to a location above the trap and that are collected by the trap." Section 4.1.1 of the Agreement called for studies to inform design decisions regarding upstream and downstream fish passage facilities and stated that the studies should include an evaluation of the movement of fish.

A study conducted in 2005 provided initial baseline information on the performance of the existing trap in attracting and capturing four distinct salmonid stocks migrating upstream in the Lewis River: summer steelhead, coho salmon, winter steelhead, and spring Chinook salmon. A new trap, currently in design, will be implemented with a phased approach as follows.

- Phase I includes a new trap constructed in the eastern upstream corner of the tailrace (the pump room entrance) with an attraction flow of 400 cfs. Phase I will also include a biological evaluation of the trap's performance that would help to determine whether the Phase I trap meets the program goals, or if improvements considered for Phase II would be necessary to improve the trap's performance.
- Phase II, if implemented, includes the potential to expand the attraction flow to 600 cfs
- Phase III would add a second trap entrance.
- Phase IV would add a second penstock tap with 200 cfs pressure reducing valve increasing fishway flow capacity to 800 cfs.
- If ATE standards are not achieved with Phases I through IV, the additional fishway adjustments will be required.

Performance standards for the new trap were determined by the ACC. These standards are included in Attachment A.

Construction of the Phase I trap is expected to be completed 4.5 years after issuance of license. The license date for the projects is June 26, 2008, which would indicate a trap on-line date of December 26, 2012.

The proposed monitoring and evaluation study described herein has been designed to evaluate performance of the new trap once the Phase I facilities are operational. If the Phase I facilities do not meet ATE goals, the study would also inform PacifiCorp and the Aquatics Coordination Committee(ACC) regarding fish behavior in the tailrace as it pertains to adjustments that would occur during Phases 2 through 4 of trap development.

GOALS AND OBJECTIVES

The primary goal of the study plan is to evaluate the performance of the Phase 1 trap location, design, and adequacy of attraction flow for coho and Chinook salmon, and winter steelhead. In addition, the study will provide: 1) information on fish behavior in the tailrace including areas both around and away from the trap entrance, 2) information on downstream movements of adult fish that leave Merwin tailrace, 3) information useful for assessing the need for future trap improvements, and 4) the initial data for SA trap monitoring needs. Specific study objectives follow.

1) Determine trap effectiveness based on Adult Trap Efficiency (ATE) and compare that to the ATE performance standard for efficient passage.
2) Determine if fish show directed movement to the trap entrance. If some fish do not, what behavior patterns do we see for these fish in the tailrace?
3) Determine if fish in the tailrace spend the majority of their time in the area in front of trap. If some fish do not, are they holding in another zone within the tailrace?
4) Determine the total time fish are present in Merwin tailrace and compare that to ATE performance standard for timely passage.
5) Describe the movement of tagged fish that do not enter, or choose to leave, the tailrace and move downstream, past fixed telemetry stations.
6) Determine the injury and mortality rate of fish collected in the trap and compare to ATE performance standard for safe passage.

METHODS

This study involves monitoring the migratory behavior of adult coho salmon, Chinook salmon and winter steelhead via radio telemetry as they move through the Merwin Tailrace. A fixed telemetry array is proposed with coverage in the tailrace that will facilitate obtaining information on the fish attraction to the trap, coverage in the trap that will provide information to assess trap effectiveness, and coverage at selected locations downstream in the Lewis River to document fish leaving the tailrace and inform us of where these fish may be headed. The data from tagged fish will be assumed to be representative of the corresponding fish populations and will inform us of fish behavior as they enter the tailrace, locate the fish trap and are captured.

Fish Collection and Tagging

Approximately 150 adult fish from each of three species/stocks (coho salmon, winter steelhead, spring Chinook salmon) will be collected out of the Merwin Dam fish trap. We will attempt to tag fish on location at the Merwin sorting facility and immediately haul them for release at the Merwin boat ramp. Our goal would be to tag three groups of up to 50 fish on at least three separate days across each run. If we are unable to tag fifty fish during each tagging episode we will increase the number of tagging events to result in a total of 150 fish tagged. We intend to use the electro-anesthesia system incorporated into the trap to anesthetize fish prior to tagging. Tags will be gastrically implanted and tagged fish immediately placed into a transport truck. Based on the 2005 study, the time from net capture in the pond to release in the truck is anticipated to take less than one minute per fish.

Fish will be implanted with a tag similar to Lotek MCFT-3A digitally coded transmitters. These tags are 16 mm in diameter, 46 mm in length and weigh 16 g in air and 6.7 g in water. With burst rates of 2.5 seconds these tags should last as long as 394 days. After all fish from a release group are tagged, they will be transported to the Lewis River for release at the Merwin Boat ramp. Tagged fish will be released via the transport truck pipe directly into the water. Tagging personnel will monitor each release; both regurgitated tags and tag mortalities will be collected.

Telemetry Array

The radiotelemetry array has been designed to provide coverage around the perimeter of the tailrace, within the new fish ladder and trap, as well as five distinct locations downstream in the Lewis River. Approximately 26 fixed antennae will be used in this study to create 16 distinct detection zones. The actual number of antennae set up in the field may vary slightly as more, or fewer, antennae are needed to achieve adequate coverage of the 16 zones. Seventeen antennas, including 2 aerial and 15 underwater antennas will be located within the tailrace proper (Figure 1). Six underwater dipole antennas (Grant Engineering Systems) will be used to create six distinct detection zones along the powerhouse and control room walls (Figure 1, Zones 1-6). One underwater antenna, comprised of stripped coaxial cable will be used to monitor the gallery behind the powerhouse (Zone 7). Two aerial antennas will be located on the access bridge and will cover the right and left edges of the tailrace (Zones 8-9). In addition, approximately eight underwater antennas, comprised of striped coaxial cable, will be used to create a grid below the access road bridge (Zone 10) that provides coverage across the tailrace and from the water's surface to the bottom (or to 20m, as depth is unknown at this time). This array was designed to provide coverage of the perimeter of the tailrace and to inform us regarding time fish spend in the tailrace proper as well as about fish swimming and holding patterns along the right and left banks and the powerhouse wall.

To evaluate successful trap capture an underwater dipole antenna (#18) will be placed within fish trap. The antenna should be placed upstream of the v-trap as once fish pass this location they cannot move freely back into the ladder or out of the trap. Based on design drawings, the best location for the antenna appears to be attached to the downstream wall behind the moving sorting screen. The data collected in his detection zone (Zone 11) will be used for calculating the ATE of the collection facility for both timely and efficient passage.

Five fixed detection zones will be established downstream of the Merwin tailrace (Figures 2, 3). Zone 12 will be generated by two parallel fixed aerial antennas (# 19 and 20) located just downstream of the large pool immediately below the tailrace (Figure 2). The water in this area is relatively shallow and we can obtain complete coverage of the water column using aerial antennae. Two antennas are paired at this location to provide information on direction of movement and thus should allow us to determine when a tagged fish has entered or exited the tailrace.

To describe the disposition of tagged fish that leave the tailrace we will collect data from three aerial antennas located downstream (Figure 3). An aerial antenna (#21) will be placed downstream of the release location at the Merwin Boat ramp near the Aerial gage (Zone 13) to detect fish moving downstream after release. To monitor fish that are aggregating at the hatchery, two fixed antennas will be located there (Zone 14). One aerial antenna (#22) will be located near the entrance of the Lewis River hatchery ladder, while an underwater antenna (#23) will be placed in the hatchery ladder to detect any fish moving into the hatchery holding ponds. An aerial antenna (#24) will be placed across lower Cedar Creek (Zone 15) to detect and fish moving upstream in Cedar Creek to spawn. Finally as part of a separate study an aerial antenna (Zone 16) will be operating in the vicinity of Woodland (Figure 4) at the time this study is conducted. We will obtain and analyze the data from the Woodland receiver (#25) to document any adult fish moving downstream to that extent.

The proposed fixed telemetry array provides radio telemetry coverage from Merwin Tailrace to Woodland, WA (Figure 5). The exact locations of each antenna will be modified to obtain the best coverage given the width of the river and water depth at each location. Dummy tags will be dragged through the detections zones during installation of the array to define the boundaries of distinct detection zones and calibrate the telemetry equipment. The associated receiver's gain and blank levels will be adjusted at the time of installation to ensure adequate coverage and within the tailrace proper to prevent overlap between detection zones. If a number of fish leave the array and are unaccounted for, periodic mobile surveys will be conducted within the Lewis River to try and determine the disposition of these fish.

Table 1. Location of detection zones and corresponding antenna array(s).

Location	Antenna	Detection Zone
Tailrace: trap entrance	1	1
Tailrace: downstream of trap	2	2
Tailrace: downstream of trap	3	3
Tailrace: along powerhouse wall	4	4
Tailrace: along powerhouse wall	5	5
Tailrace: along powerhouse wall	6	6
Tailrace: gallery behind dam	7	7
Tailrace: right bank	8	8
Tailrace: left bank	9	9
Tailrace: below bridge	10-17	10
Trap: upstream of ladder	18	11
Lewis River Downstream: holding pool	19& 20	12
Lewis River Downstream: below Merwin boat ramp	21	13
Lewis River Downstream: Lewis River Hatchery	22 & 23	14

Table 1. Location of detection zones and corresponding antenna array(s).

Location	Antenna	Detection Zone
Cedar Creek	24	15
Lewis River Downstream at the smolt Release Pond.	25	16

Analyses

Within the release groups, the behavior of individual tagged fish moving through the 10 detection zones in the tailrace will be analyzed. The analysis will be completed using individual tagged fish as the unit of replication, instead of tag groups, for the following reasons: 1) individuals with substantially greater numbers of detections will dominate the analysis if the number of detections aggregated across all fish is analyzed; 2) there are individual behavioral differences among fish, and we want to incorporate this variability; 3) analysis will be completed on the data as it is measured, rather than on an average or summed quantity to avoid obscuring individual fish behavior.

Objective 1. Determine trap effectiveness based on Adult Trap Efficiency (ATE) and compare that to the ATE performance standard for efficient passage. The Lewis River Settlement Agreement (SA) defined ATE as the percentage of adults that are actively migrating above Merwin Dam and are collected by the Merwin fish trap. The ATE for test fish, ATE_{test} will be calculated by dividing the number of actively migrating tagged fish that enter Merwin tailrace, *M*, by the number of tagged fish that are passed upstream successfully, *C*. *C* will be determined based on unique detections from Zone 12 plus any additional tags collected manually from the collection facility or during fish sorting. Any tagged fish that are found dead or mortally wounded in the trap and those captured after a predetermined time period (as described in Objective 4) will be excluded in determining the value of *C*. Detections from Zone 10 will be combined with any unique first detections from other tailrace zones (1-9) to derive *M*. The appropriate statistical test to apply to determine if ATE_{test} is statistically different than expected ATE will be selected based on the value of *C*. If *C* is large, greater than 100, a One-sample t test can be applied. Whereas, if *C* is considerably smaller than 100, a non-parametric test such as a binomial or Chi-sq test will be applied to the data to address this objective.

Objective 2. Determine if fish show directed movement to the trap entrance. If some fish do not, what movement patterns are evident for these fish in the tailrace?

The number of transitions between tailrace zones and the number of zones used by fish will provide information on effectiveness of the trap location and fish attraction to the trap entrance area. The number of transitions observed by zone for each species/stock will be enumerated and summarized. Directed movement would be indicated by fewer transition and transitions in zones that bracket the trap entrance. If some fish do exhibit a lot of transitions, we will document if they move throughout the array, exhibit focused movement into and out of specific zones, or are they leaving the tailrace proper. In 2005, tag groups where fish showed fewer transitions and greater time in zones downstream of the trap had higher rates of trap efficiency. Tag groups with lower efficiency rates exhibited more wandering among zones and spent more time below the tailrace in the large holding pool downstream of the bridge. Tag groups with higher trap efficiency rates spent more time in Zones 1-3. Data on fish movements within the tailrace provide information regarding what tailrace zones, if any, are more or less attractive to fish and will be useful for informing post-Phase 1 decisions about holding and alterative trap entrances.

Objective 3. Determine if fish in the tailrace spend the majority of their time in the area in front of trap. If some fish do not, are they holding in another zone within the tailrace?

Time in distinct tailrace zones provides information on effectiveness of the trap location and fish attraction to the trap entrance area. We will compare time spent among the tailrace zones to determine where the most fish for each group spend most of their time in the tailrace. Percentage of total time in Zone 1 (2 and 4) as a function of total time in the tailrace will also be calculated. Tag groups where fish spend most time in Zone 1 would be expected to show higher trap effectiveness. Total time in this zone also will be useful information for Objective 4. In 2005, tag groups with more time in Zones 1 and 2 generally had higher collection rates Tag groups with lower capture rates spent more time in more zones including those far away from the trap entrance and downstream of the tailrace proper.

If some fish appear to be holding in zones away from the trap, as evidence by proportionally greater time spent in these zones, we will document where they are holding and if they are aggregating in any detection zone. Large proportions of tagged fish aggregating in tailrace zones away from the trap without prior detection in Zone 1 or 11 would suggest poor attraction to the trap. Large proportion of tagged fish aggregating in zones away from the trap after initial exposure to it as indicated by detection in Zone 1 or 11 would be indicative of trap rejection. Data on time spent in tailrace zones will be useful for informing post-Phase 1 decisions about holding and alterative trap entrances.

Objective 4. Determine the total time fish are present in Merwin tailrace. The total time fish are present in the tailrace will provide information on attraction of the new trap to fish and will be used to assess the potential for fish delay at Merwin Dam (Section 4.1.4c of the SA). We will attempt to calculate total time in the tailrace as the temporal difference between the initial time into Zone 10 and the time of first detection in the ladder or trap. However, in the 2005 study documented a good amount of fish milling in the pool below the tailrace. If this milling behavior is found to extend to the area below the bridge it would result in fish moving in and out of Zone 10 repeatedly, thus complicating the time of initial entry. In that event, an alternative calculation for total time will be used based on the total time fish spend in each of the ten tailrace zones. We will determine the median and ranges for total time in the tailrace to compare with the ATE standard of a median of 24 h with fewer than 5% of fish passing after 168 h. A non-parametric analysis for the median

Objective 5. Describe the movement of tagged fish that do not enter, or choose to leave, the tailrace and move downstream in the Lewis River, past fixed telemetry stations. Develop tracks for fish that move downstream based on detections in fixed telemetry location within the Lewis River. In addition to potential strays discussed, tagged fish may also include those that are destined for Lewis River Hatchery, for spawning in Cedar Creek, and coho or Chinook salmon that are destined to spawn downstream of the dam (i.e. are progeny of spawning in this area). Thus, a proportion of tagged fish should be expected to move downstream from the tailrace after release. We do not have a good way to estimate what the total proportion of fish with other Lewis River destinations might be. This task will provide data regarding the disposition of those fish within distinct sections of the lower Lewis River or beyond. Furthermore, the data will be used to generate information on the proportion of fish that leave the tailrace with no documented destination.

Objective 6. Determine the condition of fish that are captured by the trap, as a function of rates of descaling and injury. All fish collected for radio tagging will be assessed for injury and descaling after tagging and prior to release, and then again during sorting. In addition a random sample of approximately 100 run of the river fish from each species should be anesthetized and examined for descaling and injury to correlate levels seen in test fish with the overall migratory population.

SCHEDULE

This study will be conducted over a two year timeframe. Setup should occur during the low flow period sometime between mid July and late August the same year that the trap is constructed. Tagging of coho salmon may need to occur as early as mid-September of Year 1. To accommodate the study schedule the trap must be operable by early July. Year 1: The trap evaluation will start with the coho salmon run in the fall 2012, continue with winter steelhead in late fall and early winter and through the end of spring Chinook run in spring 2013. A second year of study will be used to focus on any questions or concerns that arise or fill in data gaps from Year 1. A contingency for a third year of study is in place if unforeseen events (e.g. 100 year flood event) prevent us from completing a successful evaluation of the trap for all three species in two years. Any contingence would move forward with ACC consultation and approval from NMFS. If needed, this contingency would have impact on the implementation schedule for any Phase II modifications.

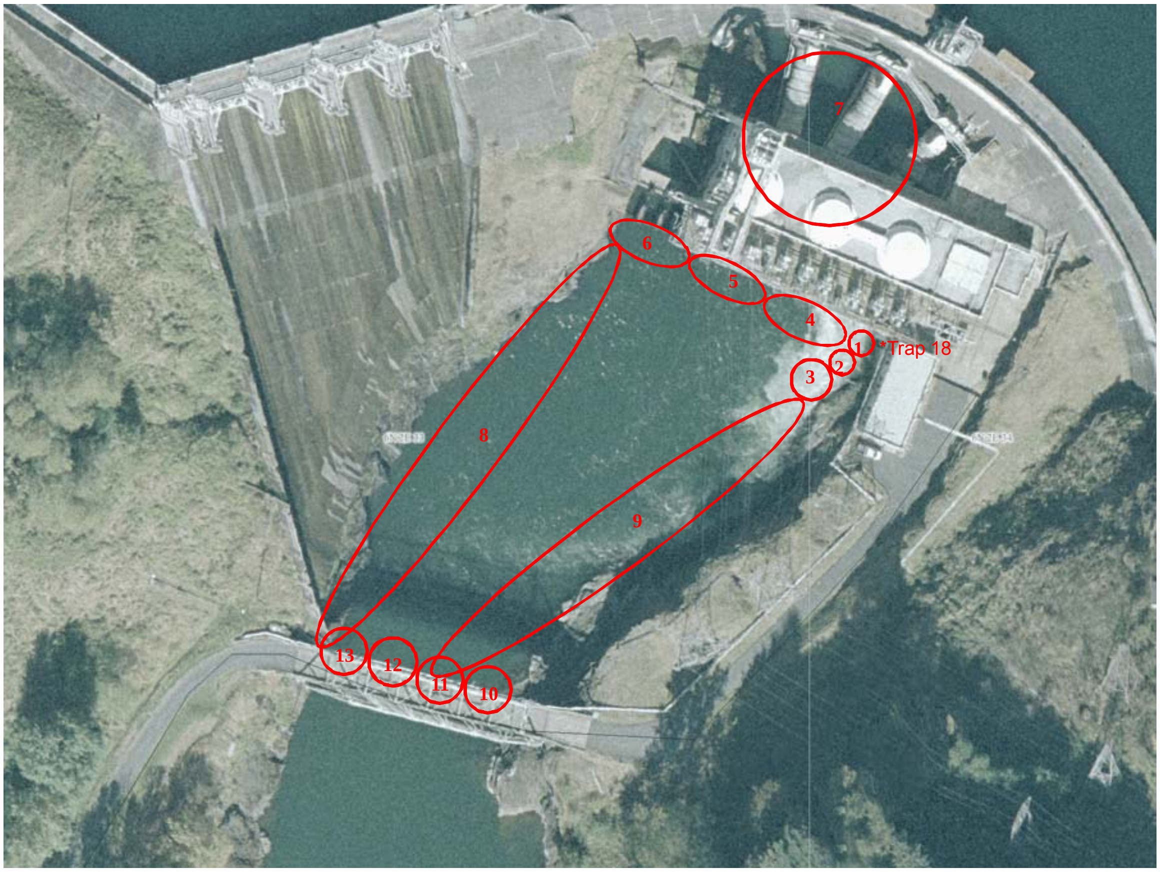

Figure 1. Proposed locations of radio antennas within the Merwin Tailrace.

Figure 2. Proposed locations of radio antennas from Merwin Tailrace to the Merwin boat ramp.

Figure 3. Locations of downstream radio antennas from the Merwin tailrace (1-18) to Lewis River Hatchery (24).

Figure 4. The location of the furthest downstream antenna to be located at the juvenile release facility in Woodland, WA.

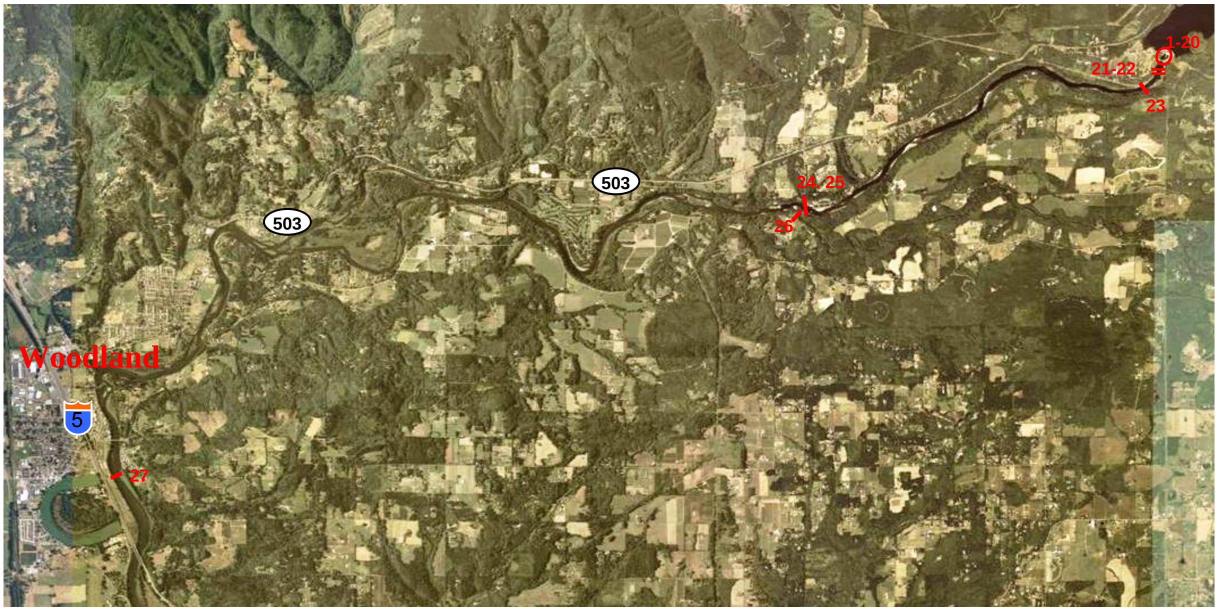

Figure 5. Location of the proposed fixed telemetry array providing coverage from Merwin Tailrace to the juvenile release facility in Woodland WA.

ATTACHMENT A

ATE PERFORMANCE STANDARD

Section 4.1.4c of the SA requires the ACC to "… develop an ATE performance standard for the term of each New License to ensure the safe, timely and efficient passage of adult salmonids."

The ACC agrees that for ATE performance standard evaluation purposes at Merwin Dam, the following conditions apply:

a) ATE is calculated by taking the number of actively migrating test fish that are passed upstream in a safe, timely and efficient manner, divided by the number of actively migrating test fish entering the Merwin tailrace.

b) Actively migrating is defined as fish that enter the Merwin tailrace and are migrating to a location above the trap.

c) The Merwin tailrace is defined as the river between Merwin Dam and the Project access bridge.

d) Test fish are fish that are tagged for the ATE tracking study, after capture from the Merwin Trap or locations downstream, and are considered to be active migrants subject to the conditions below.

e) Dropbacks are test fish that do not enter the Merwin tailrace. Dropbacks are considered to be either fish that have strayed into the Lewis River system, or fish that spawn in the Lewis River below the Merwin tailrace. Dropbacks are not considered to be active migrants for purposes of calculating ATE.

f) Fallbacks are test fish that require multiple attempts to pass Merwin Dam, and may re-enter the Merwin tailrace multiple times. Fallbacks are considered to be active migrants for purposes of calculating ATE.

g) Tag loss and tagging mortality will be identified by methods to be described in the tracking study plan. Test fish that lose their tags or are tagging mortalities are not considered to be active migrants for purposes of calculating ATE.

h) Test fish that enter the Lewis River Hatchery are not considered to be active migrants for purposes of calculating ATE.

i) Test fish that are captured by the sport or commercial fisheries are not considered to be active migrants for purposes of calculating ATE.

j) Delay time is defined to be the total time it takes for a test fish to locate and enter the Merwin Trap, calculated as the time period between initial tailrace entry and final trap capture.

To achieve the ATE performance standard, the ACC agrees that:

a) Safe passage means that active migrants must be re-captured and passed upstream of Merwin Dam with facility-induced injury less than 2% and mortality rates less than 0.5% as defined in Section 4.1.4 of the SA. Adult injury rate (AIR) will be calculated as follows:

AIR = IAC/TAC

Where:

IAC = Number of injured actively migrating adults collected in the Merwin Trap

TAC = Total number of actively migrating adults collected in Merwin Trap

Adult mortality rate (AMR) will be calculated as follows:

AMR= AM/TAC

Where:

AM = Number of actively migrating adults killed through Merwin adult trapping operations, as measured at point of release

TAC = Total number of actively migrating adults collected in the Merwin Adult Trap

b) Timely passage means that the median delay time for active migrants must be measured at less than or equal to 24 hours, with no more than 5% of the active migrants taking longer than one week to pass, and migrants must be transported upstream of Merwin Dam within 24 hours of trap capture. If study results show the median delay is less than 30 hours and all other upstream fish passage SA performance standards at Merwin Dam are met, the 30-hour median delay may be acceptable based on consensus of the ACC. Median delay times of less than 24 hours have been demonstrated to be achievable for multiple adult salmonid species at other hydro projects (see April 10, 2008 ACC meeting minutes: simple median and percent exceedence calculations).

c) Efficient passage means that at least 98% of the active adult migrants must be passed upstream of Merwin Dam. Passage success has been measured at greater than 98% for multiple adult salmonid species at other hydro projects (see July 10, 2008 ACC meeting minutes). Adult passage efficiency (APE) will be calculated as follows:

APE= TAC/AMA

Where:
TAC = Total number of actively migrating adults collected in the Merwin Adult Trap
AMA = Number of actively migrating adults

The ATE criteria would be when the four adult passage sub-criteria are achieved:

1. Adult Injury Rate (AIR) is less than 2%.
2. Adult Mortality Rate (AMR) is less than 0.5%.
3. Adult Timely Passage (ATP) is less than or equal to 24 hours (median value) and no more than 5% of the active migrants take longer than 1 week to pass.
4. Adult Passage Efficiency (APE) is equal or greater than 98%.

If median delay time is less than 30 hours, and all other criteria are achieved, then the ATE criteria may be met with a consensus vote of the ACC.

Until ATE performance standards are achieved, the Merwin Trap will be adjusted or modified per Settlement Agreement Section 4.1.6 and in consultation with the ACC. After ATE performance standards are achieved, no further adjustments or modifications to the Merwin upstream passage facility will be required.

Appendix D

Ocean Recruits Analysis

Appendix D - Ocean Recruits Analysis and Formulas

There are three possible options for calculating Ocean Recruits for the H&S Plan:

1. Catch Plus Escapement (CPE)
2. Adult Equivalent Run Size (AER)
3. Age 2 recruitment

The calculations used for completing each of the three analyses are performed as follows:

1. Catch plus escapement, $(C+E)_Y$, for brood year Y is computed as:

$(C+E)_Y = Xesc_Y + Xterm_Y + Xcol_Y + Xocean_Y$, where

$Xesc_Y, Xterm_Y, Xcol_Y, and\_Xocean_Y$ are brood year escapement; terminal, mainstem, and ocean harvest based on expanded CWT recoveries.

2. Adult equivalent return, $(AER)_Y$ for brood year Y is computed as:

$(AER)_Y = \sum_{age=1}^{NN} R_{Y,age}$, where

$R_N = C_N + Xocean_N(1+oi_N)(1-n_N)^{(na_N-1)}$, and

$C_N = R_{N+1} + B_N/(1-mm_N) + Xcol_N(1+ci_N)$, and

$B_N = A_N + Xterm_N(1+ti_N)$, and

$A_N = Xesc_N/(1-ps_N)$, and $R_{NN+1} = 0$

Symbols are defined in Figure D-1 below.

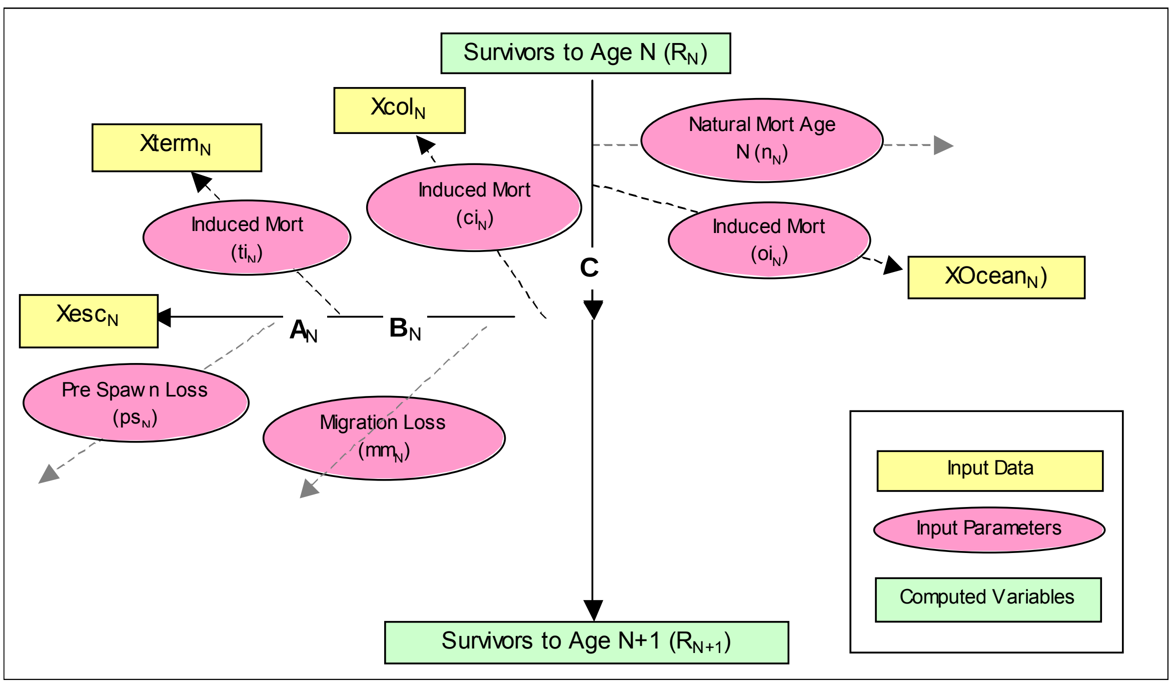

Figure D-1. Age 2 recruitment, A2R, is computed as R_2 in AER equation above.

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Appendix E

PacifiCorp Response to Draft M&E Plan Comments

Cowlitz Indian Tribe – dated September 17, 2009		
Comment Number	**Comment**	**PacifiCorp Response**
Cowlitz Indian Tribe-1	First and foremost, we need to have strong adaptive management language in the Plan. We need to be able to try new techniques and have flexibility when needed to ensure a successful fish reintroduction and their persistence over time.	The M&E Plan requires that an annual report to FERC describing M&E activities and results be submitted. This report will be reviewed and approved by the ACC. Part of the review process will be to determine if studies are going as anticipated, if new technologies or study methods have been developed that would improve the M&E program, and results obtained in other restoration efforts being conducted in the Northwest. These activities will ensure that the M&E program adapts to new information and keeps the reintroduction program on target.
Cowlitz Indian Tribe-2	The Lewis M&E Plan needs to be consistent with NOAA's newest document: "Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead-Listed Under the Federal Endangered Species Act (Idaho, Oregon and Washington)" (Crawford & Rumsey 2009). Consistency should be paramount in developing the biological monitoring. We need the ability to compare across ESU domains in the Pacific Northwest.	Based on conversations with the ACC the M&E Plan has been altered to be consistent with these guidelines.
Cowlitz Indian Tribe-3	We would like some type of data summary/conclusion to be included in the Annual Report. Also Data Summary Tables are needed and they should be straight forward and easy to read.	Data summary tables will be included in all annual reports. Examples of these type of tables are shown as under most objectives (e.g. see Table 2.1.1)
Cowlitz Indian Tribe-4	We need to have a statistically valid design for all biological monitoring data collected.	Statistically valid sample designs have been incorporated where possible into the M&E Plan (see objectives 1 and 2 as examples).
Cowlitz Indian Tribe-5	An Eagle Cliff screw trap is needed for PIT tagging purposes and a PIT tag detector should be at the bottom of Swift Reservoir-survival estimates.	A screw trap at Eagle Cliff (head of reservoir) has been included in the M&E Plan.
Cowlitz Indian Tribe-6	We would like ocean recruit monitoring done on all species.	Ocean recruit data will be collected on natural anadromous transport species and hatchery spring Chinook, steelhead and coho where possible (see objective 12).
Cowlitz Indian Tribe-7	Adult field surveys should be done weekly.	As described in 2.15.1.3 of the revised M&E Plan, all spawning survey sample reaches will be surveyed within 10 days or less after starting the first survey (Jacobs et al. 2002). Subsequent re-surveys of all sample reaches will

Cowlitz Indian Tribe – dated September 17, 2009		
Comment Number	**Comment**	**PacifiCorp Response**
		also be conducted within 10-days or less from the previous sample reach survey date. This 10-day rotation is based on experiments that suggest the average lifespan of adult coho and Chinook on spawning grounds is slightly more than ten days (Willis 1954, Perrin and Irvine 1990). This 10-day survey rotation will be maintained throughout the entire spring Chinook and coho spawning periods until no new fish or are found in all sample reaches in the survey panel.

Washington Department of Fish and Wildlife – dated September 21, 2009		
Comment Number	**Overarching Comment**	**PacifiCorp Response**
WDFW-1	WDFW believes the strategy presented in the plan does not provide the most accurate estimate of fish entering Swift Reservoir. Fish collected at the SDF represent a subset of the fish that enter Swift Reservoir and it is therefore likely that these fish are not a representative sample offish entering Swift Reservoir. Collection of fish needs to occur at the head of the reservoir and WDFW believes that a Screw Trap would effectively catch fish in that location. WDFW believes that Section 2.7 should incorporate the use of a Screw Trap at the head of Swift Reservoir to collect fish entering Swift Reservoir.	A screw trap has been added to the study design at Eagle Cliff (head of reservoir).
WDFW-2	WDFW believes that PIT tags will have a variety of uses in the implementation of this Monitoring and Evaluation Plan. To that end WDFW believes that PacifiCorp should plan on installing PIT Tag detectors as the facility is being built.	PIT tags and detectors have been included in the study design.

Washington Department of Fish and Wildlife – dated September 21, 2009		
Comment Number	**Overarching Comment**	**PacifiCorp Response**
WDFW-3	Regarding Objectives 2.15 and 2.16: An effective monitoring plan must have the following characteristics: 1. Clearly defined goals 2. Produces unbiased estimates 3. Study design provides adequate level of precision; typically a coefficient of variation is 15% is appropriate 4. Hatchery returns are monitored upon return to the hatchery and elsewhere in the basin, including spawning grounds	Objective 2.15 in the Draft M&E Plan has been completely revised and now includes more clearly defined goals. Overall, the revised adult and redd surveys will produce unbiased estimates of adult and redd abundance and the revised level of sampling effort is statistically rigorous. It is expected to meet or exceed the precision recommended by NMFS (2009) for a coefficient of variation (CV) on average of 15 percent at a 95 percent confidence level for total spawner estimates of the sample universe based on fish counts and for estimates of total redds. Objective 2.16 has also been revised and now includes the following fall Chinook and chum monitoring objectives: • Determine the spatial and temporal distribution of fall Chinook and chum spawning downstream of Merwin dam with the ability to detect a change in distribution of ± 15% with 80% certainty; • Provide an “unbiased” estimate of adult fall Chinook and chum abundance downstream of Merwin dam with a coefficient of variation (CV) on average of 15% or less; and • Estimate juvenile abundance with a coefficient of variation (CV) on average of 15% or less. Like Objective 2.15, monitoring of viable salmonid population (VSP) parameters will be designed to meet objectives and precision goals outlined by NMFS in their recent Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead (NMFS 2009).

Washington Department of Fish and Wildlife – dated September 21, 2009		
Comment Number	**Overarching Comment**	**PacifiCorp Response**
WDFW-4	Objective 16 should be expanded to include winter steelhead and coho so that all species spawning below Merwin Dam will be included in the Monitoring and Evaluation Plan.	The referenced section has been expanded to address winter steelhead and coho below Merwin Dam.
WDFW-5	Objective 15, 16 and 17 lack the specificity that is included in other portions of the plan. Other parts of the plan describe specific data that will be collected and how that data will be analyzed and presented in the annual report. For these three sections there are general descriptions of methods and assumptions but little documentation as to the data that will be collected and what is the precision of the data collected. Most other sections of the plan include tables showing specific metrics that will be measured and how those metrics will be used to evaluate specific actions to occur. The level of detail is needed for Objectives 15, 16 and 17.	Objective 15 has been revised and will produce unbiased estimates of adult and redd abundance and the revised level of sampling effort is statistically rigorous. It is expected to meet or exceed the precision recommended by NMFS (2009) for a coefficient of variation (CV) on average of 15 percent at a 95 percent confidence level for total spawner estimates of the sample universe based on fish counts and for estimates of total redds. Regarding Objective 16, please see our response to WDFW-3. Like Objective 2.15, monitoring of viable salmonid population (VSP) parameters will be designed to meet objectives and precision goals outlined by NMFS in their recent Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead (NMFS 2009). Regarding Objective 17, we have revised the Drat M&E Plan to include a description of the objectives of these surveys. A full description of how the Utilities will complete actions towards these objectives is provided in the Lewis River Bull Trout Annual Operating Plan. This plan is developed each year in consultation with the USFWS and may adaptively change per their direction or as new scientific information becomes available. The results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.

Washington Department of Fish and Wildlife – dated September 21, 2009		
Comment Number	**Overarching Comment**	**PacifiCorp Response**
WDFW-6	WDFW believes that this Monitoring and Evaluation Plan needs to be consistent with other existing plans and guidance documents…… NOAA's National Marine Fisheries Service has released a draft document entitled "Guidance For Monitoring Recovery of Pacific Northwest Salmon and Steelhead - Listed Under the Federal Endangered Species Act (Idaho, Oregon and Washington)" (Crawford & Rumsey 2009). This guidance documents outlines the "desired level of monitoring to be conducted and will provide a consistency across ESU domains in the Pacific Northwest".	As described in Section 2.15.1, the Revised M&E Plan includes a sampling design that will follow the U.S. Environmental Protection Agency (EPA) – Environmental Monitoring and Assessment Program – Generalized Random Tessellation Stratified (GRTS) sampling method. GRTS minimizes the overall survey bias through the use of a spatially balanced random sample and a high subsampling rate (i.e., 33 percent), and provides a rigorous statistically valid means of estimating the total number of redds and spawners in each sample frame and in the total sample universe. This method is recommended by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009) and by the AFS in their *Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations* (Johnson et al. 2007).
WDFW-7	Objectives 15 and 16 should be expanded to collect data called for in NOAA's guidance document and precision levels should be as recommended in that same document.	As described above, Objective 15 has been completely revised and will produce unbiased estimates of adult and redd abundance and the revised level of sampling effort is statistically rigorous. It is expected to meet or exceed the precision recommended by NMFS (2009) for a coefficient of variation (CV) on average of 15 percent at a 95 percent confidence level for total spawner estimates of the sample universe based on fish counts and for estimates of total redds. Regarding Objective 16, please see our response to WDFW-3.

Washington Department of Fish and Wildlife – dated September 21, 2009		
Comment Number	**Overarching Comment**	**PacifiCorp Response**
WDFW-8	WDFW would like to work with PacifiCorp to modify Objectives 15 and 16 to address our concerns. WDFW suggests that convening a small work group, as was done for the H&S Plan, that focuses solely on Objectives 15 and 16 would have the potential to address WDFW's concerns in an expedient manner.	PacifiCorp appreciates WDFW's willingness to work with its staff and consultants and over the past three ACC subgroup meetings; we believe we have come to an agreement with the ACC M&E subgroup regarding the overall approach to Objectives 15 and 16.

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-1	**Section 2.1:** We believe in the use of all quantitative methods to track movements on survival including CWTs, PIT tags and some radio tags where applicable. All facilities should be constructed to accommodate radio and PIT tag detection.	All three technologies have been included in the M&E Plan.
WDFW-2	**Section 2.1.1.1:** The first bullet limits ODS to only active migrants whereas ODS is defined as the number of fish that enter Swift Reservoir are collected, transported and released. This first bullet eliminates those juveniles that spend some time rearing in Swift Reservoir. Radio tags require larger size migrants due to 2% weight criteria, which adds a size selection bias to data. Need representative sample of all fish entering reservoir so need to collect and mark fish entering reservoir rather than fIsh that have already reached the collector.	The first bullet has been eliminated. Based on input from the ACC, test fish may be collected at the head of the reservoir or at the SDF, with preference being to use fish collected using a screw trap at Eagle Cliff.
	The fifth bullet talks about rearing within the reservoir; however, the first bullet states the assumption that the test fish are already actively migrating therefore the test fish will not provide you with an accurate assessment regarding the use of the reservoir for rearing purposes.	Estimating the proportion of fish rearing in the reservoir was not called for in the Settlement, and was therefore not included in the study design.
WDFW-3	**Section 2.1.1.2:** Define what the word "consistently" means.	See edits in document.

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-4	**Section 2.2:** The study defines a juvenile available for collection as one found within the zone of influence (ZOI) of the SDF entrance. Any juvenile within Swift Reservoir is available for collection, however, practicality dictates that there should be a starting point and the (ZOI) estimate should suffice to generate an estimate.	Agreed
WDFW-5	**Section 2.3:** Is the assumption that radio tags will remain functional after a passage through the Swift 1 turbines true? If not, what is backup?	Tests will determine if the assumption is indeed true. No backup plan is proposed as the data are not needed for the study. Once Yale and/or Merwin collection facilities come on-line, the issue will be revisited based on the results of this initial test.
WDFW-6	**Section 2.4.1.1:** With this protocol how many release ponds will be required?	Protocols are designed to monitor all release ponds present. The current design has three release ponds and one redundant pond. The three ponds are thought to be adequate for the anticipated numbers of outmigrants.
WDFW-7	**Section 2.6.2.2:** Need to determine methodology for collecting 10% sub-sample (e.g. 6 min/hr)	Edit made in document.
WDFW-8	**Section 2.7:** Requires estimate of number of fish entering the reservoir. We are not sure that the mark recapture methodology at the SDF will provide us with an accurate estimate. Use of a screw trap at the upper end of Swift Reservoir would be used to validate the accuracy of this estimate. For example for marking screw trap fish we could make an estimate of loss of fish between the head of Swift Reservoir and Swift Dam. WDFW sees this as a requirement per section 9.2.1 of the SA.	Screw trap collection has been incorporated into the design.
WDFW-9	**Section 2.7.1:** Smolts are only one part of the juvenile population.	Agreed. The M&E subgroup agreed that fish down to 60mm would be marked and assessed. Fry would be included later once a suitable marking methodology is found that will not compromise fry survival.
WDFW-10	**Section 2.7.1.3:** Assumption 1 is not correct because the SA includes all juvenile life stages. Not addressing fry ignores one of those life stages.	Agreed. Correction made to study plan.

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
	Assumption 4 can be tested by tagging fish using a screw trap at the upper end of Swift Reservoir in conjunction with the method proposed in section 2.7.1.1 Assumption 3 radio tagging does not cover the same breadth of juvenile life stages in comparison to the screw trap. For instance, small juveniles and fry are not of a size that allows the application of radio tags.	A screw trap has been added to the study. Agreed. PIT tags have been added to the study to account for this but fish less than 60 mm will not be sample-marked (see previous response)
WDFW-11	**Section 2.8:** Use PIT tags to compare juvenile migration timing for Spring Chinook released from acclimation sites and entire Spring Chinook population.	Added. See footnote in text.
WDFW-12	**Section 2.8.1:** Screw trap operation will help determine juvenile versus just smolt migration timing. Document migration timing of Spring Chinook smolts released from acclimation site. Some Spring Chinook may migrate throughout the summer as sub-yearlings; other migrate as yearlings. Screw trapping plus PIT tagging will allow determination of reservoir survival for sub-yearlings who may reside sometime within the reservoir, beyond radio tag battery life.	Recommendations included in study design.
WDFW-13	**Section 2.8.1.1:** Interrogate Spring Chinook smolts to recover PIT tag information from juveniles released from acclimation sites (fall and spring releases).	Included.
WDFW-14	**Section 2.9.1.1:** Review temperature data. The 10°C temperature limit appears to be too low. We believe the temperature difference is 10°F not 10°C.	Change made based on WDFW comment.
WDFW-15	**Section 2.12:** Entire section needs to be rewritten to be consistent with the finalized H&S plan	This section was revised to be consistent with the finalized H&S Plan.
WDFW-16	**Section 2.13.1.1:** Measuring SAR at Merwin Dam may bias SAR low because fish spawning below Merwin Dam will not be included in this SAR calculation. Monitoring returns to below Merwin Dam would be necessary to provide this missing data. Need to identify method to mark fish for recovery in Lewis River basin. Most effective method would likely be a PIT tag.	The smolt-to-adult survival rate is measured as the number of juveniles leaving the release ponds alive divided by the number of adults captured at Merwin Dam. Fish caught in fisheries, spawning below Merwin Dam or recaptured in other basins will not be included. However, estimates of total survival (ocean recruits, harvest etc.) will include adult fish not returning to Merwin Dam.

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
		CWT will be used to mark Lewis River fish.
WDFW-17	**Section 2.13.1.3:** Assumption is not valid because we have documented that fish originating from other basins or the lower Lewis River have been trapped at Merwin Dam.	The assumption is likely violated as noted. Assumption deleted.
WDFW-18	**Section 2.15:** Section 2.2 was very specific with quantitative analysis, equation and a full Appendix B. The methodology for Section 2.15 is more narrative and qualitative. There is not the same level of detail in regard to determining abundance and distribution.	See our responses to WDFW-6 and WDFW-7
WDFW-19	**Section 2.15.1.1:** Spawn timing, spatial distribution and abundance are important VSP parameters so monitoring should be conducted consistent with NOAA guidance. (Crawford and Rumsey, 2009 Draft) Need to clearly clarify what "estimate total number of redds" means. Will the estimate be for the entire upper basin or just the locations that are surveyed? If estimate is for the entire basin then the methodology used to account for areas not surveyed needs to be described. Redd surveys for coho may not be effective due to weather conditions, water conditions, access issues, etc... Should consider conducting juvenile parr sampling instead of redd counts for coho or other species where redd counts are problematic, as per NOAA monitoring guidance. All salmonid observations should be documented, especially bull trout. For aerial surveys need to identify number and frequency.	As described in Section 2.15.1, the revised M&E Plan includes a sampling design that will follow the U.S. Environmental Protection Agency (EPA) – Environmental Monitoring and Assessment Program – Generalized Random Tessellation Stratified (GRTS) sampling method. GRTS minimizes the overall survey bias through the use of a spatially balanced random sample and a high subsampling rate (i.e., 33 percent), and provides a rigorous statistically valid means of estimating the total number of redds and spawners in each sample frame and in the total sample universe. This method is recommended by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009) and by the AFS in their *Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations* (Johnson et al. 2007). Statistical estimates of total spawners and redds will be calculated for each of the 4 sample frames (the North Fork Lewis River and minor tributaries, Pine Creek watershed, Muddy River watershed, and Swift Creek Reservoir tributaries). Estimates from sampled reaches will also be pooled to generate an estimate of the total spawners and

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
		redds at the entire sample universe spatial scale (i.e., all accessible habitat upstream of Swift Dam). In addition, the revised M&E Plan includes juvenile sampling (steelhead and other species) in areas that may be difficult to access for a variety of reasons outside of PacifiCorp's control. All salmonid observations will be documented during both the spawning and juvenile surveys.
WDFW-20	**Section 2.15.1.2:** Surveys should be weekly for coho because redd life is likely less than 2 weeks during periods with winter freshets. If CWT recovery is necessary then surveys occurring every other week will likely not provide adequate numbers of tags recovered. Ability to conduct bi-weekly surveys may be compromised by weather conditions. Weekly surveys improve ability to capture breadth of run. Spring Chinook surveys should begin August 15. Coho surveys should begin October 1.	As described in 2.15.1.3 of the revised M&E Plan, all sample reaches will be surveyed within 10 days or less after starting the first survey (Jacobs et al. 2002). Subsequent re-surveys of all sample reaches will also be conducted within 10-days or less from the previous sample reach survey date. This 10-day rotation is based on experiments that suggest the average lifespan of adult coho and Chinook on spawning grounds is slightly more than ten days (Willis 1954, Perrin and Irvine 1990). This 10-day survey rotation will be maintained throughout the entire spring Chinook and coho spawning periods until no new fish or are found in all sample reaches in the survey panel. PacifiCorp believes that a 10-day survey rotation will be more than adequate to recover an sufficient number of CWTs (if necessary). In the revised M&E Plan, spring Chinook spawning surveys are scheduled to commence within one week after the first release of spring Chinook adults into Swift Creek Reservoir, or start on August 15 (whichever is later). Coho surveys are scheduled begin within one week after the first release of coho adults into Swift Creek Reservoir (probably around October 1).

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Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-21	**Section 2.15.2.3:** Assumption 3 will estimate be for total number of redds excavated (see comments on Section 2.15.1.1).	Statistical estimates of total spawners and total redds will be calculated for each sample frame (the North Fork Lewis River and minor tributaries, Pine Creek watershed, Muddy River watershed, and Swift Creek Reservoir tributaries). All sampled reaches will also be pooled to generate estimates of total spawners and redds at the entire sample universe spatial scale (i.e., all accessible habitat upstream of Swift Dam).
WDFW-22	**Section 2.15.2.4:** Expand on what study results will be provided in the ACC/TCC annual report. For instance how will spatial distribution data be presented (e.g. GIS layers) and at what level of detail.	At a minimum, results will summarize the number of live and dead fish, and redds counted by species by reach, and provide a GIS map of sample reaches and redd locations. Sex ratios by sample frame and sample universe, any identified marks, and egg retention in carcasses will also be reported. For each sample frame and sample universe, the estimate of total spawners and redds by species will be reported along with the calculated coefficient of variance (CV) at a 95% confidence level. Total number of spawners will also be calculated based on an expansion of redd counts using regionally applied fish-per-redd expansion factors.
WDFW-23	**Section 2.16:** Objective 2.16 should be expanded to fully evaluate wild fall Chinook and chum populations. Fully evaluate means monitoring all VSP parameters consistent with NOAA monitoring guidance. Objective 2.16 should be expanded to included steelhead at the same level of fall Chinook. Evaluation of Chinook, chum and steelhead populations to meet NOAA VSP parameters need to be identified, and methodologies described as outlined in Crawford and Rumsey, 2009 Draft.	Regarding Objective 16, please see our response to WDFW-3.

WDFW – dated September 21, 2009		
Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-24	**Section 2.16.1:** Time frame for young-of-the-year collections should be late May through early July.	The time frame for young-of-the-year collections will be late May through early July.
WDFW-25	**Section 2.16.2.1:** Time frame for adult surveys should continue through January to cover entire spawning period for chum. Sampling area for adult surveys should include Cedar Creek to encompass all known fall Chinook and chum spawning areas.	The time frame for adult surveys will continue through January.
WDFW-26	**Section 2.16.2.3:** Make it clear that assumption 3 applies to bright stock fall Chinook but is not adequate for Tule stock fall Chinook or late returning bright fall Chinook.	We have made the requested clarification.
WDFW-27	**Section 2.17.1:** Need to add "associated spawning tributaries" to title of Section 2.17.1 Need to define what we are monitoring. An estimate offish large enough to migrate to area of natal stream should be our goal.	Issues related to bull trout monitoring are covered in the Bull Trout Annual Monitoring Plan which follows objectives identified in the M&E Plan but provides specific activities from year to year.
WDFW-28	**Section 2.17.1.2:** Collect genetic information from all bull trout collected for comparison to baseline data.	As described above, issues related to bull trout monitoring are covered in the Bull Trout Annual Monitoring Plan which follows objectives identified in the M&E Plan but provides specific activities from year to year. Some of the specific activities may include MtDNA analysis when it is appropriate.
WDFW-29	**Section 2.17.2:** Need to quantify bull trout genetics in basin. Transport, when necessary (from bypass, or Yale tailrace), to the appropriate stream of origin.	Issues related to bull trout monitoring are covered in the Bull Trout Annual Monitoring Plan which follows objectives identified in the M&E Plan but provides specific activities from year to year. Some of the specific activities may include MtDNA analysis when it is appropriate.
WDFW-30	**Section 2.17.3.2:** Table 2.17.1 should include Ole Creek also.	As noted previously, issues related to bull trout monitoring are covered in the Bull Trout Annual Monitoring Plan which follows objectives identified in the M&E Plan but provides specific activities from year to year. Some of the specific activities may include bull trout surveys in Ole Creek when it is appropriate.

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Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-31	**Section 2.17.4:** Need to define purpose and objectives of surveys. Need to clearly describe methodology and how that will achieve the aforementioned purpose and objectives.	We have revised the Drat M&E Plan to include a description of the objectives of these surveys. A full description of how the Utilities will complete actions towards these objectives is provided in the Lewis River Bull Trout Annual Operating Plan. This plan is developed each year in consultation with the USFWS and may adaptively change per their direction or as new scientific information becomes available. The results of completed plan actions and monitoring are provided in the annual Aquatic Coordination Committee/Terrestrial Coordination Committee reports.
WDFW-32	**Section 2.18.1:** Operation of a screw trap was included in the Baseline Assessment Plan develop by the baseline monitoring subgroup to determine what level of anadromous smolt production is occurring from existing resident populations. This action needs to be included in this section of the M&E plan also.	Disagree with the purpose of the screw trap as it relates to baseline monitoring. Baseline monitoring will occur in the Spring of 2010 using the screw trap to add to the baseline database in terms of species diversity and relative abundance prior to anadromous reintroduction.
WDFW-33	**Section 2.18.2.1:** Methods described are focusing on redd superimposition by bull trout, implying that bull trout spawn earlier than coho salmon. This assumption may be incorrect. Methods do not fully address the specified objective of determining if coho salmon compete with bull trout for spawning habitat. Baseline assessment of bull trout preferred spawning locations and numbers in index areas to provide future comparison with coho salmon and steelhead spawning locations and numbers.	If it is found that some percentage of coho spawn before bull trout, both coho and bull trout redds will be differentially marked throughout the monitoring period to determine any impacts on the bull trout population. The results of the baseline spawning surveys in Cougar Creek will also provide a description of primary bull trout spawning locations (using GIS maps).
WDFW-34	**Section 2.18.2.2:** Surveys should occur weekly to increase the likelihood of correctly assigning redd to species.	To be consistent with other spawning surveys in the upper basin, bull trout and coho surveys will be performed every 10 days starting in September and continuing until January, weather and access permitting.

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Comment Number	**Section Comment**	**PacifiCorp Response**
WDFW-35	**Section 2.18.3:** Task 18.3 assumes that there will be annual abundance but that objective, and associated methodology, was not clearly identified in 2.17.4.	Issues related to bull trout monitoring are covered in the Bull Trout Annual Monitoring Plan which follows objectives identified in the M&E Plan but provides specific activities from year to year. These activities will likely include annual abundance surveys.
WDFW-36	**Section 2.20:** The Lower Columbia Salmon Recovery Plan sets forth recovery goals for all listed populations above and below Merwin Dam. These goals should be used to determine if recovery has been achieved. Monitoring of populations for the purpose of measuring progress to recovery is outlined in NOAA's monitoring guidance draft document that is currently under public review. This document outlines monitoring needs to assess progress towards achieving VSP parameters. The monitoring methodology presented in this document should be used to guide actions described in other sections of this M&E Plan.	PacifiCorp is aware that the Lower Columbia Salmon Recovery Plan sets forth recovery goals for all listed populations above and below Merwin Dam and that these goals are being used to determine if recovery has been achieved. We have revised Section 2.15.1 of the M&E Plan. It now incorporates a sampling design to assess progress towards achieving VSP that will follow the U.S. Environmental Protection Agency (EPA) – Environmental Monitoring and Assessment Program – Generalized Random Tessellation Stratified (GRTS) sampling method. GRTS minimizes the overall survey bias through the use of a spatially balanced random sample and a high subsampling rate (i.e., 33 percent), and provides a rigorous statistically valid means of estimating the total number of redds and spawners in each sample frame and in the total sample universe. This method is recommended by NMFS in their recent *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (NMFS 2009) and by the AFS in their *Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations* (Johnson et al. 2007). Statistical estimates of total spawners and redds will be calculated for each of the 4 sample frames (the North Fork Lewis River and minor tributaries, Pine Creek watershed, Muddy River watershed, and Swift Creek Reservoir

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		tributaries). Estimates from sampled reaches will also be pooled to generate an estimate of the total spawners and redds at the entire sample universe spatial scale (i.e., all accessible habitat upstream of Swift Dam). In addition, the revised M&E Plan includes juvenile sampling (steelhead and other species) in areas that may be difficult to access for a variety of reasons outside of PacifiCorp's control.

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Comment Number	**Comment**	**PacifiCorp Response**
TU-1	**Objectives Generally:** While it appears that most of the elements identified in the SA are present in the M&E plan, there are a few missing elements that should either be added or explained. For example, the Settlement Agreement calls for review and evaluation of migration timing and numbers, survival and injury of fish populations through all three reservoirs and collection facilities. However, in several instances the existing draft appears to focus only on Swift reservoir and facilities. Focusing on Swift may be appropriate this time, but the M&E plan should either address the additional facilities or provide a placeholder noting that M&E planning will take place related to these objectives as the facilities are developed over time.	In the introduction it is noted that the M&E Plan currently applies only to Swift, and that the M&E Plan will be updated as new facilities come on-line.
TU-2	**Objective 1:** Quantify Overall Juvenile Downstream Survival. 2.1.1 - Task 1.1 indicates that ODS estimates for sea-run cutthroat trout will be delayed until data indicate that this life history is present and that the number of juveniles produced is sufficient for experimental purposes. Which data will be relied upon and how will it be collected? How will a "sufficient" number be calculated?	Text has been changed to allow USFWS to make this decision.

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Comment Number	**Comment**	**PacifiCorp Response**
	2.1.1.1 Methods. What was the justification for the choice of 44 fish for each species and what is the level of confidence that those numbers will be available for sampling during the time frame provided? For the control group used for the tag failure and decay rate and to determine post-release mortality, how many fish of each species will be included in the control group and how will those numbers affect the ultimate estimate of Overall Downstream Survival (ODS)? In calculating ODS, shouldn't S[COL] be the same as PCE? 2.1.1.3 *Assumptions*. In attempting to quantify the post-release mortality, how will adjustments to the survival rates for test fish affect estimated precision/confidence in survival estimates generally? This question is similar to the previous comment related to sample sizes for control groups. 2.1.1.4 *Results and Reporting*. For this and other reporting sections (eg. Tables 2.2.1 and 2.7.1) an opportunity should be provided for reporting additional weeks as appropriate.	Sample size has been changed to reflect NMFS requirements. Text explains that sample size is based on achieving NMFS required level of statistical precision and confidence. ODS is now measured using PIT tags so comments on radio-tags as they relate to ODS no longer apply. Formula is correct. SCOL is collection survival probability while PCE is the probability of fish being collected. Agreed. Tables are just meant to provide example…weeks of sampling will likely vary by season.
TU-3	**Objective 2:** Estimate SDF Collection Efficiency Collection efficiency should read as (PCOL) = PENC*PCE. The study anticipates that a juvenile that is available for collection is one that is found (detected) within the zone of influence (ZOI) of the SDF entrance. The number of fish "available for collection" should simply be the number of fish that reach the forebay or reservoir in front of the dam. Collecting information on fine-scale passage efficiency (ie: what percentage of fish are getting close to the collector and of those fish that get close, how many are making it through) will help reveal	The formula presented is the one presented in the statistical appendix (B) to provide consistency between the two documents. Based on conversations with the ACC, available for collection is defined as the ZOI. Agreed.

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	whether the defined ZOI is large enough to meet the performance standard or whether it needs to be expanded or repositioned.	
TU-4	**Objective 3:** Determine the Percentage of Juveniles Available for Collection that are Not Captured by the SDF and that Enter the Turbines. This section should include a study to confirm that the tags remain functional after powerhouse passage. If the near-term estimates of powerhouse passage are in error due to non-functioning tags – it seems that those errors would ultimately affect the final configuration of passage facilities (e.g., by assuming the fish simply were not collected and remained in the reservoir versus passed via the turbines). The impact of powerhouse passage on the functionality of tags should be evaluated, and if shown to be problematic or prone to error, a discounting mechanism should be developed to account for the discrepancy.	The study has been altered to utilize PIT tags for ODS. Once the Yale juvenile facility is on-line, studies would be undertaken to determine tag failure rates for any technology used.
TU-5	**Objective 4:** Estimate Juvenile and Adult Collection Survival. The SA calls for monitoring and evaluation of survival, injury, and mortality of kelts collected at each downstream facility. What is the plan for calculating collection and transport survival for kelts?	Steelhead kelts have been added to the study.
TU-6	**Objective 5:** Determine Juvenile Injury Rates During Collection at the SDF Injury will be determined by examination of a subsample of the total juvenile population collected each day. How large a subsample will be used to determine collection injury (i.e.: a pre-determined percentage of the daily total or a total amount regardless of daily variation)?	10% of the juvenile outmigrants entering the SDF will be examined daily.
TU-7	**Objective 6:** Quantify the Number, by Species, of Juvenile and Adult Fish Collected at the SDF 2.6.1.2 *Frequency and Duration* - How will potential diel variation in passage rates be taken into account during subsampling to develop	All hours are sampled at an equal rate. Sample size will vary based on run-timing so some days more fish will be

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	unbiased estimates of passage? What level of precision is expected or required of the subsampling? 2.6.2 – *Calculate Juvenile and Adult Collection Numbers Using Scanner*. The intro to Section 2.6 indicates that a scanner will automatically count all fish passing through the full SDF. The draft plan in 2.6.2 also indicates that scanners will be located at both the subsample and adult holding tanks on the SDF. As written, this suggests that subsampling will be used even when the scanner is used for fish counts. Is this correct? Similarly, related to the proposal to compare hand counts and scanner counts – it appears that the goal of this hand count is to verify the accuracy of the scanners at the subsample tanks only. How will the accuracy of the scanner collecting the total count data for the full SDF be verified?	examined for injury/mortality than others. Statistics will be calculated daily, weekly and for the season. This is correct. A counter will be located upstream of the sample tank. Scanner counts will be compared to hand counts in the sample tank to determine scanner accuracy. When not in subsample mode, fish passing the scanner will be sent to the transport tanks. A correction factor if needed, will be applied to the scanner counts to estimate the total number of fish entering the SDF transport system.
TU-8	**Objective 7:** Estimate the Number of Juveniles Entering Swift Reservoir The draft plan questions the rationale of collecting estimates of juveniles entering each reservoir. Collecting this data could provide estimates of reservoir delay and survival that is independent of the telemetry estimates. This type of validation/confirmation of the telemetry results would have value. It might be possible to develop such estimates using PIT-tagged fish captured and released at the primary head of the reservoir.	PIT tags have been added to the study plan for this reason. Although estimates of reservoir delay and, particularly survival, are not likely to be accurate because of fish that may opt to reside in the reservoir and leave at a later time will initially be considered mortalities since there is no way to assess their status unless they enter the ZOI.
TU-9	**Objective 9:** Quantify Adult Upstream Passage Survival 2.9.1 *Task 9.1 Quantify Upstream Passage Survival*. This section notes that “any dead fish recovered at trapping or release sites will	Agreed. Although injuries may not be observable, dead unrecoverable fish will be accounted for in all calculations.

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	be identified by species and examined for signs of physical injury, to the extent possible." If not all dead fish that are observed can be recovered, this will need to be taken into account in the calculation algorithm.	
TU-10	**Objective 13:** Determine Performance Measures for Index Stocks How will this section account for potential in -basin factors (e.g., hatchery fish management) that may affect the survival rates both inside and outside the basin? If the success of the Lewis will be weighed against another system, it seems the goal would be to identify the least hydro influenced system with the best data. If the comparison is to another system – such as the Cowlitz – that has it's own level of local impacts on survival, we need to develop a way to account for the internal influences or problems on that comparison stocks.	The use of indicator stocks is only meant to inform and compare the success of the Lewis program to other efforts. In-basin metrics such as SAR, fish collection efficiency, ocean recruits analysis etc. will be compared to similar metrics collected in other basins. This will allow us to identify in-basin factors and out-of-basin factors that are impacting restoration efforts.
TU-11	**Objective 15:** Determine Spawn Timing, Distribution and Abundance of Transported Anadromous Adults. 2.15.2.2 – *Frequency and Duration*. The draft plan indicates that supplemental small tributary surveys will occur once a year for each species during the peak spawning period of each species. Providing a sampling intensity for these tributary streams similar to those outlined for the larger streams (i.e. alternate week surveys during the spawning period) would allow for a better estimate for aggregate spawning success and allow for a better understanding the importance these systems to various populations. Providing this more rigorous sampling approach in at least one year - or on some recurring interval – would help to provide a better understanding of the contribution of these smaller streams and tributaries.	As described in Section 2.15.1, the revised M&E Plan includes a sampling design that will follow the U.S. Environmental Protection Agency (EPA) – Environmental Monitoring and Assessment Program – Generalized Random Tessellation Stratified (GRTS) sampling method. GRTS minimizes the overall survey bias through the use of a spatially balanced random sample and a high subsampling rate (i.e., 33 percent), and provides a rigorous statistically valid means of estimating the total number of redds and spawners in each sample frame and in the total sample universe. This method is recommended by NMFS in their recent Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead (NMFS 2009) and by the AFS in their Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations (Johnson et al. 2007). Statistical estimates of total spawners and redds will be

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		calculated for each of the 4 sample frames (the North Fork Lewis River and minor tributaries, Pine Creek watershed, Muddy River watershed, and Swift Creek Reservoir tributaries). Estimates from sampled reaches will also be pooled to generate an estimate of the total spawners and redds at the entire sample universe spatial scale (i.e., all accessible habitat upstream of Swift Dam). In addition, the revised M&E Plan includes juvenile sampling (steelhead and other species) in areas that may be difficult to access for a variety of reasons outside of PacifiCorp's control. All salmonid observations will be documented during both the spawning and juvenile surveys.
TU-12	**Objective 19:** Document Project Compliance with Water Management Requirements 2.19.1.4 *Flow and Ramp Rate Monitoring and Excursion Reporting*. The gauge data should be reviewed at the recorded increment and examined for exceedances of hourly rates over one-hour increments.	As requested, the gauge data will be reviewed at the recorded increment and examined for exceedances of hourly rates over one-hour increments.

Yakama Nation – dated October 14, 2009		
Comment Number	**Comment**	**PacifiCorp Response**
YN-1	When determining ODS, I question using radio tags (especially the small proportion being discussed as an indicator for the overall population) when there is contradictory research out there on the behavioral/migratory alterations that radio tagging may have. Also,	The study has been changed to measure ODS using PIT tags.

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	tagging juveniles surgically is not an easy task (I've done plenty of it). I believe PIT tagging is a less invasive approach in monitoring and the detection technology and cost has come a LONG WAY. Currently in the upper Columbia watersheds, PIT tags are used to determine most of the point-to-point survival indices.	
YN-2	Secondly, in-pond survival may need to have a secondary source of comparison to PIT tags, if used. Currently, at our acclimation sites, I developed a predation model to estimate loss through various observed predators.	PacifiCorp would be interested in seeing the model and discussing its applicability to the Lewis effort.

National Marine Fisheries Service – dated October 21, 2009		
Comment Number	**General Comments**	**PacifiCorp Response**
NMFS-1	The M&E plan should be consistent with NMFS' "Guidance For Monitoring Recovery of Pacific Northwest Salmon and Steelhead" Draft dated June 12, 2009.1 For example, the results should be provided in terms of coefficient of variation.	Objective 15 has been completely revised and will produce unbiased estimates of adult and redd abundance and the revised level of sampling effort is statistically rigorous. It is expected to meet or exceed the precision recommended by NMFS (2009) for a coefficient of variation (CV) on average of 15 percent at a 95 percent confidence level for total spawner estimates of the sample universe based on fish counts and for estimates of total redds.
NMFS-2	The tests should have 95 percent confidence with a precision level of plus or minus 1.5 percent.	Based on ACC input, we will be using 0.025 and a 95% CL.
NMFS-3	We need to discuss how error values apply to the performance standard. When the performance standards were developed, they were points not associated with error e.g., Overall Downstream Survival of 80 percent and 75 percent were the minimum values not values to obtain within an error range.	See NMFS-2.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-1	Section 1.0, even though there are not quantitative numbers yet available for the reintroduction outcome goal, there is a clear definition2 for this term. The M&E plan must address indicators related to the reintroduction outcome goal and not just focus on those studies needed to determine when the performance standards outlined in Section 4 of the Settlement Agreement (SA) are achieved.	M&E activities identified in this plan and the H&S Plan identify and address these factors. Data are being collected on juvenile production, spawning distribution and success, SAR, and ocean recruits, proportion hatchery fish on the spawning grounds and in-hatchery survival factors.
NMFS-2	Table 1.1.1, the injury standard applies to all juveniles not just smolts.	According to the Settlement (section 4.1.4) the collection survival (CS) and injury standard is as follows: “ (ii) a CS of equal to or greater than 99.5% for smolts and 98% for fry… “Design performance objectives for Injury are less than equal to 2%.” Thus, the definition of the lifestages to be measured for injury are unclear. However, the M&E subgroup agreed that fish greater than 60 mm would be marked and assessed. Fry would be included later once a suitable marking methodology is found that will not compromise fry survival.
NMFS-3	Section 1.0, second paragraph above Figure 1.1.1, “Because the M&E Plan will be updated approximately every five years...” The SA calls for the Licensees to “… Consult with the ACC as necessary, but no less often than every five years, to determine if modifications to the M&E Plan are warranted.” This means that the M&E plan could be updated more frequently than every five years. In the beginning of the reintroduction it may be necessary to update the M&E plan frequently as we are learning about the system and new collection facilities, etc.	We expect that research plans will be updated yearly.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-4	Section 1.0, second paragraph above Figure 1.1□1, "The SDF will be used to collect juvenile anadromous salmonids migrating downstream..." The facility will also be used to collect downstream migrating steelhead kelts. Additionally, what are the M&E measures proposed for kelts to ensure the performance standard of safe, timely, and effective passage for kelts and downstream migration of adult sea□run cutthroat is met?	A discussion of steelhead kelts has been added to the injury/mortality section measurements of SDF. Handling of kelts will be minimized. Dead or injured kelts will be enumerated and reported. Sea-run cutthroat trout studies will be undertaken once this species is observed using the facility and the USFWS determines studies can begin.
NMFS-5	Section 1.0, Figure 1.1-1, the *80% should have an equal to and greater than symbol in front of it.	Change made.
NMFS-6	Section 1.0, last paragraph, section 8.2.6 of the SA is specifically addressing hatcheries and supplementation aspects. While this may inform the M&E and necessitate updates it is not the main guidance. The main guidance is found it section 9.1 of the SA which calls for the Licensees to "… Consult with the ACC as necessary, but no less often than every five years, to determine if modifications to the M&E Plan are warranted." This means that the M&E plan could be updated more frequently than every five years.	Agreed. We expect to review and update study methods on a yearly basis.
NMFS-7	Section 2.0, Objectives, what are the differences in the terms (quantify, estimate, determine) used for the objectives?	Section has been changed so that most bullets use the term quantify. Meaning that an estimate with errors bounds will be developed for the parameter.
NMFS-8	Section 2.1.1, please explain how SA SCHEDULE 4.1.4: Juvenile Downstream Survival Equations were used in this section.	The formulas in the SA schedule are consistent with those used in this analysis; at least for Swift (studies will not be undertaken at Yale and Merwin until later). The formulas used in the M&E Plan combine some terms (such as reservoir survival and collection probability) as these cannot be separated using the methodology proposed). Additionally, the SA schedule uses estimated of total juveniles arriving at the reservoir as one term in measuring ODS; the M&E Plan only uses tagged fish.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-9	Section 2.1.1 Task 1.1□ Estimate ODS for Anadromous Fish Species above Swift No. 1 Dam. a. The study plan needs to describe exactly how migration, rearing or dead fish behavior will be determined. b. What are the criteria for selecting study fish from the SDF? c. Some fish/species may be too small to radio□tag. How will ODS be estimated for these fish? d. What is the utility of releasing tagged dead fish into the SDF to check on the ability to detect dead fish? If a fish is in the collector, it will likely have swam in. The number of fish killed in the SDF will likely be very small or zero.	The study has been changed to use PIT tags for determining ODS. Fish captured in the SDF will be considered migrants. Fish that never enter the trap are considered dead. The definition of rearing is subjective. Yes.
NMFS-10	Section 2.1.1.1, second bullet, only test fish will be tagged, correct? The wording could leave a reader to believe all fish captured will be tagged.	Clarified in text
NMFS-11	Section 2.1.1.1, fifth bullet, it may be better to do more frequent boat surveys than 1 per week to gain a better understanding of fish behavior in the reservoir.	Boat surveys have been eliminated as PIT Tags are now being utilized.
NMFS-12	Section 2.1.1.1, it would be better to use acoustic tags for the studies to lessen the potential behavior changes to fish from the radio tag antennas.	ACC subgroup agreed to use radio-tags.
NMFS-13	Section 2.1.1.1, sixth bullet, will the tags last long enough to give an estimate of ODS?	PIT Tags now being used instead.
NMFS-14	Section 2.2.1 Task 2.1□ Estimate SDF Collection Efficiency (PCE). There needs to be a methodology specified to determine the ZOI. For example, if a flow line is established for a current velocity of 0.1 ft/s, it will be different for a flow line established by a current velocity of 0.00001 ft/s, and the ZOI volume will vary widely in these two examples. NMFS suggests describing the ZOI where velocity is 10 percent above ambient reservoir velocity and the flow line enters	In recent discussion, a new ZOI has been agreed to by the ACC…an area 150ft in front of the SDF entrance.

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	the collector. To verify that the flow line enters the collector, flow calculations should indicate that across any vertical cross section of the ZOI, the flow should equal the flow into the SDF net transition structure (i.e. assure flow continuity). A sufficient grid of velocities should be measured such that no sub□section of the vertical cross section should include more than 5 percent of the total SDF flow. The antennae array should minimally cover the entire ZOI. Also, it should be recognized that if collection efficiency and survival standards are not, the ZOI may be too small and guide nets or SDF flow increases are required.	
NMFS-15	Section 2.1.1.2, Frequency and Duration, "ODS estimates will be developed weekly throughout the major portion of the juvenile migration season…" ODS should be estimated for the whole out migration.	Change made to text.
NMFS-16	Section 2.2.1.2, Frequency and Duration, "SDF collection efficiency will be quantified weekly for approximately 6 weeks around the expected peak migration period. . ." Collection Efficiency should be estimated for the whole migration period. The ACC sub□group needs to discuss this; are there any factors that could make collection efficiency different at different times of the migration season e.g., changes in temperatures, flows, dam operations, etc.?	Text has been changed to state: Releases will be made weekly throughout the major part of the migration season (April-June). A total of 996 fish of each species will be released over the course of six weeks in proportion to the run-timing of each species. PIT tag releases would be extended if juvenile run-timing data collected during the initial pilot study (see below) indicate that fish migration extends into summer or fall.
NMFS-17	Section 2.2.1.2, "The study will continue yearly until either the collection efficiency standard is met, or it is determined by the ACC and the Services that improvement in collection efficiency is not possible." This last part is a change to the SA and should be deleted. Also, collection efficiency should still be measured once met to ensure there are not changes.	Edit made to text to reflect comment
NMFS-18	Section 2.2.2.2, to be consistent with the comment above, the frequency of estimates of the number of juveniles encountering the SDF entrance should be developed any time collection efficiency is being developed.	Numbers encountering entrance are only made when collection efficiency estimates are developed.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-19	Section 2.4.1.1, first bullet, there should be counts and recording of dead fish each time the release pond is emptied not just during tests.	Footnote added to clarify.
NMFS-20	Section 2.4.1.1, calculating juvenile collection survival, estimates of CS will be developed daily, but transport survival which is used in its calculation is only done weekly.	Correct. Assumed that direct estimates of transport survival are only needed weekly, as we are simply attempting to pinpoint where in the system mortality and injury occurs. Footnote added to indicate that testing would be more frequent if CS drops below 99%.
NMFS-21	Section 2.4.1.2, “Once met, survival estimates will be developed monthly to document compliance with the collection survival standard.” There should also be daily records of any observed mortalities with corrective action, if necessary.	Footnote added in section 2.4.1.1 to clarify.
NMFS-22	Table 2.5.1, Categories used for documenting visible injury at the SDF collection and transport system. The SA defined injury as visible trauma including but not limited to… we want to keep this in mind as we are monitoring the facilities. Also, the use of the table makes it appear that the categories are linked instead of it just being a list of separate items.	Comment noted.
NMFS-23	Table 2.5.2, “Bruising 0.5 cm diameter” should have a greater than symbol.	Correction made in table.
NMFS-24	Section 2.7, estimating the number of juveniles entering each reservoir is needed. In addition to other uses, it provides information related to the outcome goal, it helps us monitor the total reintroduction program success or status, and allows us to calculate smolt to adult survival. This paragraph needs to be re-written to exclude the suggestion of removing this parameter.	Done.
NMFS-25	Section 2.7.1.2, determining the number of juveniles entering the reservoir should be conducted longer than one year.	Changed to 5 years.
NMFS-26	Section 2.7.1.3, estimates of fry abundance are needed. Some of the SA performance standards apply to actively migrating fish which can include fry. A fish does not need to be smolted to migrate within a river system.	Done.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-27	Section 2.9, "The UPS standard will be considered achieved when the point estimate (mean) is" greater than or equal to 99.5%. This is different than what is proposed for determining when the CS standard is met which is "The CS standard will be considered met if the calculated confidence interval (CI) spans the target survival rate of smolts, fry and adults." As mentioned under general comments, this whole topic of when to considered a standard met needs discussion.	Edit made to text.
NMFS-28	Section 2.9, delayed mortality needs to be evaluated in the UPS standard.	Delayed mortality may or may not be directly related to upstream transport so UPS is determined at the release site only. Other monitoring efforts involving spawning ground surveys will attempt to determine pre-spawn mortality as a way to assess overall survival of transported fish to the spawning grounds.
NMFS-29	Section 2.9.1.1, temperature, "Stream temperature will be recorded for each release group. Stream temperature will not exceed 10°C. If the difference is greater than 10°C then truck water will be tempered with stream water before releasing adults." a. How can it be assured that "stream temperature will not exceed 10°C"? There is probably a typo in this. b. The receiving water temperature measured 1 foot below the water surface should be less than 18°C. Also, there should not be more than a 3°C change from the holding water to the receiving water. If there is a greater than 3°C difference then the water in the truck should be tempered, but this can also cause stress to the fish and therefore should be limited to 3 times per year. If there is a large difference between truck water and receiving water (stream water), tempering may not be able to resolve this issue in a timely manner. Rather than tempering the water at all, it is better to locate a different release site where the unacceptable water temperature differences from truck to release do not occur.	Changed to 10°F. Refers to the difference in temperature; not baseline. Clarification has been made to text.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
	c. What is the protocol for tempering truck water with stream water? Physically, how will this be accomplished for the testing and for the production system? When is tempering complete?	Protocols are being developed as part of Merwin Adult Transport System.
NMFS-30	Section 2.9.1.4 Results and Reporting, Table 2.9.1. Title indicates UPS for coho only – should have all species listed in the title, or list table as an example for coho.	Edit made to table.
NMFS-31	Section 2.10.1 Task 10.1 Develop Estimate of ATE for Adult Fish Originating Above Swift No. 1 Dam. a. Not many adult fish will originate above Swift Dam, unless this statement meant returnees from spawning above the dam. In addition, is there a way to confirm in real time that adult fish are returnees from upper basin spawning? NMFS suggests the title above be revised to reflect the content of Appendix C, which calls for measurement of ATE for actively migrating fish that enter the trap. b. Figure C-1 has some unidentified color lines drawn. What do each of the lines in the Figure represent? c. Appendix C-1 does not detail any methods for a study plan, and it should. The type of tracking study is not even indicated, let alone any study protocols. This needs much more discussion and detail.	 Refers to origin of the fish. See new write-up for this section. Color codes clarified in new section. See new write-up.
NMFS-32	Section 2.10.1.2, "Until ATE performance standards are achieved or the Services and the ACC are satisfied with the UTF performance..." This last part is a change to the SA and should be deleted.	Edit made to text.
NMFS-33	Section 2.10.1.2, "After ATE performance standards are achieved, no further adjustments or modifications to the Merwin upstream passage facility will be required." This is true only as long as the ATE performance standards are maintained. Please revise this section to reflect this.	Edit made to text.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-34	Section 2.11.1.1, The SA defined the lengths of adults only for bull trout and sea-run cutthroat trout. Where did these length numbers come from and why were they used to define adults? All fish captured at the Merwin Dam should be summarized on a daily basis regardless of length. This information can be valuable in management decisions.	Adult definitions for fish other than bull trout and cutthroat trout were provided by WDFW. A definition of adult is needed as targets are based on adult returns. Section 2.11.1.1 states that all fish arriving at the facility will be enumerated etc.
NMFS-35	Section 2.12, what is the reason behind using the average ocean recruits for five consecutive brood years to determine if and when hatchery production levels are altered? Would it be better to use averages based on life histories?	Brood year accounts for life-cycle differences. Data will simply be available sooner for coho than Chinook or steelhead as 99% of the coho return is typically a 3-year old fish.
NMFS-36	Section 2.12.1.1, it is not clear how the index groups data will be collected if some of the fish do not have external marks as depicted in Table 2.12.3. The ACC sub□group should discuss this.	The ACC to will discuss this issue.
NMFS-37	Section 2.13, using other Lower Columbia River stocks as index groups to determine whether the success or failure of the Lewis River reintroduction program is the result of in-basin or out-of-basin factors. While this can provide valuable information, there may be factors in other basins that are affecting those populations to a degree that would make those groups not be good representations for this performance measure. For example, the upper Cowlitz River collection efficiencies of juveniles are still very low and not representative of a system that is functioning where it should be. This type of consideration should be included when considering which groups could be representative.	The use of indicator stocks is only meant to inform and compare the success of the Lewis program to other efforts. In-basin metrics such as SAR, fish collection efficiency, ocean recruits analysis etc. will be compared to similar metrics collected in other basins. This will allow us to identify in-basin factors and out-of-basin factors that are impacting restoration efforts.
NMFS-38	Section 2.13.1.1, how is the “standard error” for CWT fish defined and what is the range of error?	Standard error is estimated by brood year (i.e. the error around the mean). It will vary each year based on survival rates…the higher the survival rate the lower the standard error.
NMFS-39	Section 2.14.1.1 Methods a. This section should include detail on how SDF hydraulics will be adjusted to accomplish design criteria, or how the design criteria will be otherwise verified. Each design criterion from the design	 Actual testing protocols for each design parameter will be developed after completion of the facility. An operations manual will also be developed for the facility. As written in

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Comment Number	**Specific Comments**	**PacifiCorp Response**
	document should be verified. b. Adjustment of screen flow baffles is expected and the measurement/adjustment test regime should be specified and described, including the process that will result in achieving design criteria. c. A velocity measurement grid should be specified for the SDF. At most, each individual velocity measurement should represent 5 percent of the total flow through the measured cross section. For example, if velocity normal to the screen face (screen approach velocity, or Va) is being measured through a 10 foot high by 3 foot long cross section, the total 30 square foot portion of the screen area should be divided into at least 20 measurement points. d. No individual Va measurement should exceed 0.4 fps, after final hydraulic adjustment. e. A hydraulic consultant should be hired to perform baffle adjustment and other SDF hydraulic measurements. f. The design criteria to be checked should be listed in this section, along with a description of how they will be verified, or adjusted until the criterion is achieved.	this section, Doppler and hand held flow meters will be used to document compliance with identified criteria.
NMFS-40	Section 2.14.2 Task 14.2 Confirm Compliance of Merwin Upstream Transport System with Design Criteria. What is the plan to develop this task description, since the Upstream Passage Facility is 90 percent complete? NMFS sees no reason that this could be held up by any design revisions, since the criteria have long been established.	We will discuss this issue with NMFS after the facility is designed and operational. We agree that the criteria have long been established.
NMFS-41	2.14.1.2 Frequency and Duration. Annual flow measurement and adjustment as required, should be made on an annual basis.	Agree but if there is annual consistency over a number of years, we believe the frequency can be extended to longer periods (e.g. every 5 years).

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-42	Section 2.15.1.1, first paragraph, "The spawning surveys will begin in 2011 following the initial adult reintroduction and will continue for a minimum of 5 years." Spawning surveys will need to be conducted longer than this. This is a component related to the Outcome Goal.	PacifiCorp realizes that spawning surveys will be required for many years but will not begin until the first introduction groups are transported to the upper basin. For some stocks this may not be until 2012 or 2013. We have completely revised Section 2.15 to incorporate the survey methods recommended by NMFS in their recent Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead (NMFS 2009) and by the AFS in their Salmonid Field Protocols Handbook, Techniques for Assessing Status and Trends in Salmon and Trout Populations (Johnson et al. 2007).
NMFS-43	Section 2.15.1.1, first paragraph, "At this time, the need for on-the-ground surveys will be reevaluated by the ACC." This is a change to the SA and should be deleted.	This sentence has been deleted.
NMFS-44	Section 2.15.1.1, third paragraph. How has flagging of redds been used in other areas? Was there vandalism to the flags or to the redds?	While vandalism of flagging can be a problem in highly populated areas, we do not expect that it will be an issue in the relatively remote upper Lewis River basin. We are currently using flagging for bull trout surveys and have not experienced any vandalism.
NMFS-45	Section 2.15.1.1, fifth paragraph, "The aerial surveys will begin in 2011 following adult reintroduction and will continue for a period of three years. The need for additional aerial surveys will be evaluated by the ACC." There should be more than three years of aerial surveys. Also, evaluated by the ACC is good, but there is no mention of the requirement of Services approval to changes.	For some stocks this may not be until 2012 or 2013 so text will be revised to reflect that. As described in Section 2.15.2.2 of the revise M&E Plan, Each year, one-hundred adult winter steelhead (collected at Merwin Dam throughout the run time) will be surgically radio-tagged and tracked through weekly aerial spawning ground surveys (as weather conditions allow) using low elevation helicopter flights over the accessible reaches of each stream listed in Table 2.15.1. The objective of these surveys is to document the spawn timing, abundance (based on a survival estimate of radio-tagged steelhead applied to the total number of steelhead transported and

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		released into Swift Creek Reservoir), and distribution of radio-tagged winter steelhead spawning upstream of Swift Creek Dam. These weekly aerial winter steelhead surveys will continue for a minimum of 6 years. After 6 years of surveys, the need for yearly aerial surveys will be re-evaluated by the ACC. Any changes in these surveys will require the approval of the Services.
NMFS-46	Table 2.15.3, all of the survey reach lengths match the migration barrier location except for Cussed Hollow Creek where the survey reach length is beyond the barrier location. Is this an error or was there a reason for this?	This error has been corrected in the Revised M&E Plan.
NMFS-47	Section 2.16, is it technically feasible to tag juvenile chum?	Currently it is not technically feasible due to size limitations.
NMFS-48	Section 2.16.2.1, second paragraph, "To better accommodate redd counts and fish carcass data collection, PacifiCorp will reduce river flows when feasible at Merwin Dam during scheduled survey days." I though PacifiCorp did not agree with this approach.	While PacifiCorp may not agree with this approach, it was accepted in the SA as the standard methodology
NMFS-49	Section 2.16.2.1, third paragraph, how will a subset of the carcasses found be determined to collect length and sex data? In particular, how will it be randomized so that it gives a representative sample of the run.	The ACC has requested clarification of the current WDFW methodology from the State. The plan can be modified if the ACC subgroup decides it is necessary.
NMFS-50	Table 2.17.1, last box in rationale, "Will determine anadromous fish use in the bypass reach and constructed channels…" This applies to more than just bull trout, correct?	This statement applies to all reintroduced anadromous species and bull trout.
NMFS-51	Section 2.18, "Of specific interest to the Settlement parties was the possible effect resident trout released in Swift Reservoir may have on reintroduced salmonids…" Where is this assessed in this plan? Also, this should be reworded as to not convey subjective ideas not carried forward in the SA or Joint Explanatory Statement.	Baseline monitoring that occurred in 2009 will address species diversity and relative abundance prior to anadromous reintroduction. Follow-up duplication of baseline efforts after reintroduction is established will address the two-way effects between anadromous fish and resident fish.

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Comment Number	**Specific Comments**	**PacifiCorp Response**
NMFS-52	Section 2.18.2.1, Do bull trout superimpose on their own redds? If so, how will this be differentiated?	In 2008, PacifiCorp staff observed (for the first time) bull trout superimposition on their own redds in Cougar Creek (2 redds). Careful documentation (GPS) and flagging of individual redds throughout the monitoring period will help to determine if superimposition within species or across species is occurring on a regular basis. In 2008, the superimposed redds were constructed in the same small spatial area along the margin of a tailout. Some bull trout were observed on the redds and each redd was well documented and flagged.
NMFS-53	Section 2.18.2.2, “The study may be repeated for up to 5-years. Study termination would be determined in consultation with the ACC.” This is inconsistent with the SA. Should not conclude at this point that only need 5 years. Also, again consultation with the ACC is good, but this language does not reflect the requirement of the Services’ approval.	We have modified the text in Section 2.18.2.2 (now 2.19.2.2) to state “Surveys will be performed every 10 days starting in September and continuing until January, weather and access permitting. The study will likely be repeated for several years. Study termination would be determined in consultation with the ACC and with the approval of the Services.
NMFS-54	Section 2.18.3, title “Task 18.3 – Determine if Anadromous Fish Introductions are Having a Detrimental Effect on Kokanee Populations in Yale Lake.” This should be reworded to remove subjectiveness. The Task is to determine Kokanee spawner population.	We agree, and have modified the Section title to reflect your comment.
NMFS-55	Section 2.20, regarding Reintroduction Outcome Goals “Until the Services develop numeric goals, the natural adult abundance targets presented under Objective 11 (Ocean Recruits) will be used as the benchmarks for determining the success of the reintroduction effort.” Ocean Recruits are covered in Objective 12 not 11. While this method can give indications of how the reintroduction effort is doing, it is not the measurement for determining success of that effort. This is changing the SA.	There is no intent to change the SA but we need to start somewhere. This issue should be resolved at the ACC subgroup.

US Fish and Wildlife Service – dated December 2, 2009		
Comment Number	**Comment**	**PacifiCorp Response**
USFWS-1	It's important to make sure that the M&E Plan captures not only what we are doing with bull trout but briefly states why. I suggest including this language, or something similar, to the introductory section of this objective.	Bull trout objectives, approved by the subgroup, have been inserted into the M&E plan.
USFWS-2	"The goal of the 2002 Draft Bull Trout Recovery Plan is to ensure the long term persistence of self sustaining, complex, interacting groups of bull trout distributed throughout the species native range so that the species can be delisted. To achieve this, there are four objectives in the Lower Columbia Recovery Unit: 1) maintain current distribution and restore distribution in previously occupied areas; 2) maintain stable or increasing trends in abundance of bull trout; 3) Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and 4) conserve genetic diversity and provide opportunity for genetic exchange.	These objectives have been accepted by the subgroup and will be added to the M&E Plan.
USFWS-3	The purpose for monitoring bull trout on the Lewis River Hydroelectric Project is to help inform management decisions and changes in methodology consistent with the goals and objectives for bull trout recovery. We meet annually to review and evaluate the report of the past year's monitoring effort and adaptively manage our actions and methodology to develop a plan for the upcoming field season."	We have included a description of the annual process in the M&E Plan.

Washington Department of Fish and Wildlife – dated April 28, 2010		
Comment Number	**Comment**	**PacifiCorp Response**
WDFW-1	WDFW's detailed comments were made in a submitted track changes version of the Draft M&E Plan	All of these comments were incorporated into the Final M&E Plan.
WDFW-2	PIT tags applied in the Lewis River basin, and the detectors installed in the upstream and downstream collectors need to be compatible with other PIT tagging and recovery operations in the Columbia River to ensure full recovery of these tags.	The PIT tags and detectors will be consistent with those used in the Columbia River.
WDFW-3	WDFW reiterates the need that all monitoring of viable salmonids parameters needs to be designed to meet the objectives and precisions goals outlined but NMFS in their recent document entitled *Guidance for Monitoring of Pacific Northwest Salmon and Steelhead* (Crawford and Rumsey, 2009).	The Final M&E Plan now incorporates the survey methods recommended by NMFS in their *Guidance for Monitoring of Pacific Northwest Salmon and Steelhead* (Crawford and Rumsey, 2009). Edits were accepted directly from WDFW's track changes version of the Draft M&E Plan
WDFW-4	WDFW comments that during the spawning ground surveys in the upper watershed, it is important to distinguish between Chinook and coho "spawners" and "holders" and provides definitions of both "spawners" and "holders".	The Final M&E Plan now fully incorporates this recommendation.

National Marine Fisheries Service – email dated May 25, 2010		
Comment Number	**Comment**	**PacifiCorp Response**
NMFS-1	I expect this to be an evolving process and expect that agreement now does not preclude changing items in the future. For example, there is some language for when a standard is considered met that I do not agree with: "The CS standard will be considered met if the calculated confidence interval (CI) spans the target survival rate of smolts, fry and adults." In other settings, NMFS works to get acceptable studies and then all parties live with the point estimate. I am willing to save this discussion into the future, since I know we will be updating the M&E plan approximately every five years. I believe further discuss of this topic would be good, but we can do that in the future as we get into the studies.	PacifiCorp understands that the M&E Plan is an evolving process and is willing to work with NMFS in the future (if any changes to the M&E Plan are deemed appropriate).

U.S. Fish and Wildlife Service – email dated April 29, 2010		
Comment Number	**Comment**	**PacifiCorp Response**
USFWS-1	The M&E Plan refers to both an "annual bull trout monitoring plan" and a "bull trout annual operating plan." These two terms actually refer to the same process. For clarity, we recommend that you call them the "bull trout annual operating plan" so that the process can be viewed as analogous to other annual operating plans (e.g., the steelhead annual operating plan) mentioned in the M&E Plan.	We have made the requested clarification.
USFWS-2	We see the development of the "bull trout annual operating plan" as an opportunity for a bull trout sub group of the ACC (including, but not limited to, PacifiCorp, USFWS, and WDFW) to meet, at a minimum, annually. The primary purpose would be to discuss progress in meeting settlement agreement/license requirements for bull trout in the past year, and to develop a plan for the next years' activities. The ACC should be kept apprised of the products and progress of this sub group.	We fully agree with the USFWS, and we have incorporated new text in the M&E Plan to reflect this agreement.
USFWS-3	We recommend that as part of developing yearly "bull trout annual operating plans," PacifiCorp should take the lead in hosting "annual bull trout operations" meetings. These would be separate from, and in addition to, field coordination meetings. With respect to timing, we recommend that the Annual Operating Plan be completed and provided to the ACC for discussion before holding the field coordination meeting. This way, the field coordination meeting can be used to identify gaps in activities that need to be addressed.	PacifiCorp plans on taking the lead in hosting the annual bull trout operation meetings and agrees these meetings would be separate from, and in addition to, field coordination meetings. We also agree that the Annual Operating Plan be completed and provided to the ACC for discussion before holding the field coordination meeting and that the field coordination meeting could be used to identify gaps in activities that need to be addressed.