

**FINAL Meeting Notes**  
**Lewis River License Implementation**  
**Aquatic Coordination Committee (ACC) Meeting**  
**May 10, 2007**  
**Ariel, WA**

**ACC Participants Present (17)**

Jim Byrne, WDFW  
 Clifford Casseseke, Yakama Nation  
 Michelle Day, NMFS (10:00am)  
 Jeremiah Doyle, PacifiCorp Energy  
 Bernadette Graham Hudson, LCFRB  
 Adam Haspiel, USDA Forest Service  
 Joe Hiss, USFWS (via teleconference)  
 LouEllyn Jones, USFWS  
 George Lee, Yakama Nation  
 Jim Malinowski, Fish First (via teleconference)  
 Kimberly McCune, PacifiCorp Energy  
 Todd Olson, PacifiCorp Energy  
 Frank Shrier, PacifiCorp Energy  
 Brett Swift, American Rivers  
 Richard Turner, NMFS (10:45am – 11:45am)  
 Steve Vigg, WDFW (9:45am)  
 John Weinheimer, WDFW

MaryLou Keefe, R2 Resources Consultants  
 Gardner Johnston, Inter-Fluve, Inc.

**Calendar:**

May 18, 2007	Lewis River Site Tour	Lewis River Hatchery
June 13, 2007	TCC Meeting	Lacey, WA
June 14, 2007	ACC Meeting and Habitat Prioritization Synthesis Subgroup Meeting	Merwin Hydro

<b>Assignments from May 10th Meeting:</b>	<b>Status:</b>
Shrier/McCune: Schedule BioSonics to provide a presentation on the Yale Entrainment Study at the June 14, 2007 ACC meeting.	Complete – 5/11/07 MaryLou Keefe presenting.

<b>Assignments from April 12th Meeting:</b>	<b>Status:</b>
Wills: Check on the availability of Cowlitz Indian Tribe office for ACC meeting on 5/4/07 and contact Kimberly McCune (PacifiCorp).	Complete – 4/17/07
McCune: Email WDFW comments regarding the Lewis River Upper Flow Release (6.1.2) to ACC, per request of Michelle Day.	Complete – 4/13/07

<b>Assignments from December 14th Meeting:</b>	<b>Status:</b>
Shrier: PacifiCorp to form technical committee consisting of the USFS, the Tribes and Utilities in order to nail down the acclimation sites.	<b>Complete - 4/27/07</b>

### **Opening, Review of Agenda and Meeting Notes**

Frank Shrier (PacifiCorp Energy) called the meeting to order at 9:10 a.m.

Shrier conducted a review of the agenda for the day and informed the ACC attendees that we are delaying the LWD Study presentation until such time Michelle Day (NMFS) can arrive. In addition, Shrier requested a round-table introduction for the benefit of new attendees and for those participating via conference call.

Shrier requested comments and/or changes to the ACC Draft 4/12/07 meeting notes. Todd Olson (PacifiCorp) requested the addition of the Lewis River Hatchery Tour on May 18, 2007, as requested by Yakama Nation Tribal Council.

No additional changes were requested and ACC attendees present approved the meeting notes at 9:20am.

### **Relicensing Schedule Update**

The NMFS BiOp has not yet been sent to the FERC. NMFS's legal counsel has reviewed the BiOp and has provided edits for NMFS staff internal review. The best estimate for license issuance is September 2007.

### **2007 Habitat Preparation Plan (HPP) Discussion and Comment**

Shrier informed the ACC attendees that **comments on the 2007 HPP are due on or before June 1, 2007**. Kimberly McCune (PacifiCorp Energy) distributed the HPP to the ACC via email on 5/1/07, and distributed hard copies at today's meeting, **Attachment A**.

Olson expressed to the ACC attendees that before the HPP is put together and if there is an abundance of Spring Chinook, PacifiCorp Energy will check in with the Tribes every year to discuss if the HPP should include transporting Spring Chinook. Shrier informed the ACC that 2007 is the 3<sup>rd</sup> year of the HPP program and only two years remain.

Jim Byrne (WDFW) expressed concern about ending this program. Olson communicated that his initial thought with the delay of license issuance, is that PacifiCorp would continue the HPP because it has value. Olson said that after year five of the HPP, PacifiCorp would request the ACC to approve the continuation of the program.

### **Study Updates**

Shrier provided the following study updates:

*Merwin Sorting Facility Design* – 30% design is in progress; expect to receive by the end of August 2007.

*Lewis River Fish Passage Swift Downstream Collection* - 30% design drawing and report to ACC and Services on 4/30/07 for a 45-day review and comment period. Comments due on June 15, 2007.

*Swift Constructed Channel Concept Design* – Final draft report to the ACC on 3/8/07 for a 90-day review and comment period. Comments due on May 25, 2007. PacifiCorp submitted application for permits and is currently working on wetland delineation. Jim Malinowski, (Fish First) noted a few concerns regarding securing the Large Woody Material and construction of rock weirs. He requested that rock gabions not be used.

*Habitat Synthesis Tool* – CDs have been sent to each subgroup participants to include links and photos. Each subgroup participate is taking responsibility for a species to complete the additional links and photos that are needed. The goal of the subgroup is to have the work product ready before the next cycle of funding this year.

*Hatchery Upgrades* – The designing is going well, however, PacifiCorp will not proceed with construction without a license. PacifiCorp will review the 60% design drawings for Lewis River Hatchery Pond # 15 with the engineering subgroup on May 11, 2007.

*Bull Trout Limiting Factors Analysis (LFA) QHA* – A meeting was conducted on April 13, 2007 for input to the QHA model. PacifiCorp received good input and the consultants were provided what they need to complete the models. The LFA will be completed by the end of May 2007.

*Hatchery and Supplementation Plan (H&S)* – Need to complete the HGMPs for Chinook and coho before the H&S Plan can be completed. PacifiCorp is estimating December 2007 for completion of the H&S Plan.

*Acclimation Pond Plan* – The comment period ended on April 27, 2007. PacifiCorp received comments from WDFW which were distributed to the ACC on May 2, 2007.

<Break 9:50am>

<Reconvene 10:00am>

### **Large Woody Debris (LWD) Study – Inter Fluve Presentation and Discussion**

Gardner Johnston (Inter-Fluve, Inc.) reviewed and discussed a *Lewis River LWD Study Technical Memorandum*, dated 4/30/07 with the ACC attendees, which has been incorporated into these meeting notes as **Attachment B**.

Johnston outlined four tasks to be completed as part of the study:

- 1) Complete a reference condition evaluation that will estimate the quantity of large woody debris that would have been expected to pass through the system

historically (historical supply) and how much LWD would have likely been retained in the lower river below Merwin Dam (historical retention).

- 2) Conduct a current condition evaluation that will estimate the quantity of LWD that would be expected to pass through the system if it were allowed to pass through the reservoirs (current supply) and the amount that would be expected to be retained in the river (projected current retention) downstream of Merwin dam.
- 3) Complete an analysis of restoration options which will take into consideration the results of Tasks 1, 2, and 4. The historical and current analyses will provide an understanding of how wood functioned under natural conditions and how those conditions have changed over time. Inter-Fluve is presuming that natural conditions are those to which salmonids have adapted, and will provide the basis for restoration goals. This information will be used to identify the processes and structure that can reasonably be restored given current land use and management constraints. Information from task 4 will be used to identify the restoration options.
- 4) Provide an analysis of fish benefit from LWD which will consist of a qualitative documentation of wood-derived ecosystem dynamics coupled with quantitative calculations of fish capacity potential. These findings will be collected and synthesized for both short-term and long-term benefits in the lower river. Documentation will be both species and life-stage specific to the extent possible.

General discussion took place re PacifiCorp's available records of LWD, current supply to each reservoir, taking LWD from the upper basin and placing in the lower basin. Clifford Casseseka (Yakama Nation) emphasized not taking wood from the lower to the upper basin as it could affect the fish negatively. Other discussion items included conditions in the river that would not support wood retention, review of historical changes in the channel and impact of flood events on wood retention.

Johnston informed the ACC attendees that Inter-Fluve is using pre European settlement for reference conditions.

Michelle Day (NMFS) requested Inter-Fluve include in their study the addition of Chum in the Task 4 section. Other ACC participants requested considering adding Bull Trout and Spring Chinook also to the Task 4 section.

Shrier asked the ACC if a comment due date of 6/1/07 relating to the LWD Study is an acceptable due date. The earlier the comments are received the earlier the consultants can proceed with the study. The ACC confirmed that they will do the best they can to meet this date.

The ACC attendees were invited to contact Gardner directly for questions or comments at: [gjohnston@interfluve.com](mailto:gjohnston@interfluve.com)

## Yale Entrainment Report – Discussion and Comment

Shrier provided a review and PowerPoint presentation for the ACC attendees, which can also be viewed on the Lewis River website at the following link:

<http://www.pacificorp.com/Article/Article71045.html>

He informed the ACC that the Report was distributed on 5/2/07 for the 45-day review and comment period. **Comments are due on or before June 15, 2007.**

The study's original purpose was to evaluate fish entrainment at Yale prior to the implementation of entrainment reduction measures. This study would assess entrainment prior to measures, then be repeated after measures, thus showing the effectiveness of entrainment reduction. Study objectives include evaluating fish entrainment into the turbine intakes to determine how many fish are entrained and if any of the entrained fish are bull trout.

The methods used included:

- Hydroacoustic detection
  - 2 transducers – one over each turbine intake
  - 24/7 monitoring from Nov. 2005 to July 2006
- Video recording
  - Two 4-hour blocks per day

Shrier provided an illustration and a general schematic of the two transducers which cover 6 ½ feet at the bottom of the intake at a depth of 66'.

Two data questions were discussed:

- 1) Are all the targets actual fish?
- 2) Are all the fish within the detection area actually entrained?

The next three slides illustrated a normal hydroacoustic view and an acoustic view at turbine shutdown with hydroacoustic software, which breaks down the raw data into unfiltered and filtered traces. An illustration was provided of the fish entrainment zone and actual fish traces also showing the estimated length of fish in centimeters, entrainment zone, distance from the transducer, number of fish detected and the number of fish above and below the entrainment zone. Since the hydroacoustic cone does not cover the total area of the intake actual fish target numbers were expanded to give a weighted total for the entrainment estimate. The weighted total is as follows (24/7 November – July):

Turbine 1

- Weighted total of entrained fish = 796
- Mean fish length = 17 cm (6.7 in.)
- Mean Daily entrainment rate = 0.26 f/h

Turbine 2

- Weighted total of entrained fish = 336

- Mean fish length = 16 cm (6.3 in.)
- Mean Daily entrainment rate = 0.14 f/h

A video analysis was performed to determine what species are being entrained:

- 616 hours of record
- 2 blocks per day
  - 0600 to 1000 hrs
  - 1600 to 2000 hrs

It was determined that the hydroacoustic equipment does not provide a large enough area of view needed to identify the species. The video results provided only two fish actually observed that could be positively identified.

Shrier also provided the following comparison to a 1997 study:

<b>1997</b>	<b>2006*</b>
Duration 11 weeks	Duration 34 weeks
Random samples	Continuous
28.5 fish per hour	0.19 fish per hour
50,780 total fish	1,132 total fish
138 mm (5.4 in.)	178 mm (7 in.)
No fish entrainment zone (FEZ)	Used fish entrainment zone

\*Steve Vigg (WDFW) would like to see the comparison also include the hits outside of the FEZ.

Shrier discussed the fish size comparison on a relative scale (upper size limits) and the majority of the entrained fish are 5cm to 25cm.

Shrier concluded the PowerPoint presentation with the following recommendations:

- Based on size statistics, bull trout are not likely the primary species being entrained through the turbines.
- Most likely that bull trout enter Lake Merwin via the Yale spillway.
- Entrainment reduction device does not seem warranted for protection of bull trout.

Olson requested the ACC provide comments such as: Is there another way of looking at things? To address technical questions, PacifiCorp can invite a representative from BioSonics to the next ACC meeting. Olson also asked the ACC to consider what information they may need by looking at the merits of the study.

Some ACC members expressed concern that we don't know the size of the bull trout population. A suggestion was made to include a technical explanation of how the data is interpreted by the software that predicts certain assumptions. In addition, more information is needed regarding the technology used to determine the fish size, and if this technology can be used to get at fish identification.

The ACC agreed that an invitation would be extended to BioSonics to include their presentation on the June 14, 2007 ACC agenda.

In order to allow time for a BioSonics presentation the comment due date will be revised to reflect an additional one week of review.

**The new comment due date is June 22, 2007.**

### **New Topics**

LouEllyn Jones (USFWS) informed the ACC that she will be in Washington, DC for the next three months (June, July, August). During this time, she has designated Joe Hiss (USFWS) as the USFWS alternate representative for the ACC and TCC meetings during her absence. Jones also requested we keep Shelley Spaulding (USFWS) informed and copy her on the ACC & TCC activity.

### **Agenda items for May 10, 2007**

- Yale Entrainment Study - BioSonics Presentation
- Study/Work Product Updates
- Relicensing/BiOp Update
- Swift Surface Collector Design Update

May 18, 2007	June 14, 2007
Lewis River Hatchery Tour	Merwin Hydro Facility
Ariel, WA	Ariel, WA
9:00am – 3:00pm	9:00am – 3:00pm

### **Meeting Adjourned at 12:15pm**

### **Handouts**

- Final Agenda
- Draft ACC Meeting Notes 4/12/07
- 2007 Habitat Preparation Plan, prepared by PacifiCorp Energy – **Attachment A**
- Lewis River Large Woody Debris (LWD) Technical Memorandum dated April 30, 2007, as provided by Inter-Fluve and Cramer Fish Sciences - **Attachment B**
- Yale Entrainment Study as provided by PacifiCorp Energy, R2 Resource Consultants and CH2M Hill,  
<http://www.pacificorp.com/Article/Article71045.html>

## 2007 Habitat Preparation Plan

North Fork Lewis River

Prepared by PacifiCorp

### 1.0 Introduction

The Lewis River Settlement Agreement (Section 7.4) calls for the following plan development to take place within six months after the effective date:

*Habitat Preparation Plan.* “PacifiCorp shall develop a plan (the “Habitat Preparation Plan”) in Consultation with the ACC to release live adult hatchery anadromous salmonids into Swift Reservoir, Yale Lake, and Lake Merwin for the purpose of preparing the habitat in those locations for the reintroduction of anadromous salmonids. The objective of the Habitat Preparation Plan will be to make possible (1) nutrient enrichment in the waters through decay of the adult hatchery fish and, (2) tilling of the gravel by the released hatchery adults as they attempt to spawn. The number, sex, and species of hatchery adult salmonids shall be determined as part of the Habitat Preparation Plan. PacifiCorp’s performance obligation under the Habitat Preparation Plan shall be limited to placing live adult hatchery anadromous salmonids for a period of five years in each of Swift Reservoir, Yale Lake, and Lake Merwin, commencing in each case five years prior to expected completion of the downstream fish passage facility from that reservoir. PacifiCorp shall implement the Habitat Preparation Plan at Swift Reservoir beginning as soon as practicable after the Habitat Preparation Plan is finalized and at the other reservoirs as provided in the Habitat Preparation Plan. PacifiCorp shall implement this program only to the extent there are excess hatchery fish available beyond those required for the Hatchery and Supplementation Plan described in Section 8. PacifiCorp shall not be required to pass or collect the progeny of hatchery adult anadromous salmonids introduced under the Habitat Preparation Plan unless and until collection and transport facilities for such progeny are constructed in accordance with Section 4. For the Merwin and Yale Projects, PacifiCorp’s obligations under this Section 7.4 shall cease if the Yale Downstream Facility or Merwin Downstream Facility, respectively, will not be constructed pursuant to Section 4.1.9.”

The purpose of this plan is to provide the logistical information and methods necessary to collect, transport, and distribute excess hatchery fish to the Lewis River upstream of Merwin dam. The transportation of adult hatchery fish into the upper basin is intended to prepare the stream gravels (through redd construction) and provide nutrient enhancement to potential spawning and rearing areas prior to formal supplementation and construction of juvenile collection facilities. It is anticipated that the components of this plan may be modified from year to year based predominately on run size and stock availability.

For purposes of implementing this plan, release locations for transported fish will change based on completion of juvenile collection facilities planned at all three hydroelectric projects. According to the settlement agreement schedule (Section 7.4: Habitat Preparation Plan), excess hatchery fish will be transported to Swift reservoir from 2005 through 2009, to Yale reservoir from 2014 through 2018 and to Merwin reservoir from 2018 through 2022. This schedule will provide nutrient enhancement and spawning gravel preparation for formal reintroduction efforts as described in Section 4.0 of Settlement Agreement.



## 2.0 Plan Components

Stock Selection: In 2007, early (type S) coho salmon will be used for transportation into the upper watershed. It is expected that some late (type N) coho will be selected during transportation activities; however, this stock will not be deliberately selected for transportation. Due to requests made by the Yakama Nation in 2006 and 2007, and poor run predictions, no spring chinook will be transported to the upper watershed in 2007.

The selection of early coho has several biological advantages over other species returning to the Lewis River, which include the following:

- Early coho salmon historically used the Lewis River headwaters and tributaries in which to spawn.
- Competing uses (e.g., nutrient enhancement, tribal, in-river harvest and food banks) for returning adults are less compared to other species.
- Coho salmon are able to negotiate complex passage barriers, thus distribution of adults from their release point is maximized
- Transportation survival of coho is high relative to other species.
- Early coho salmon returns are sufficient to achieve transportation goals of the plan

The current hatchery broodstock collection goals for early coho are 1,277 adults. The ratio of females to males is 60:40. Table 1 provides trapping results for both early and late coho salmon.

Table 1. Trap results for early (Type S) and late (Type N) coho salmon captured at the Merwin dam fyke and Lewis River hatchery ladder: 1998-2006. (Source: WDFW Hatchery Escapement Reports available at <http://wdfw.wa.gov/hat/escape/escape.htm>)

Year	Coho			
	Type S		Type N	
	Adults	Jacks	Adults	Jacks
1998	7,142	3,528	10,817	2,089
1999	14,962	2,343	17,724	6,757
2000	17,031	7,281	23,106	10,910
2001	38,783	1,291	60,873	533
2002	17,334	8,177	6,294	6,212
2003	38,367	1,932	21,896	2,569
2004	22,134	1,438	13,944	1,713
2005	21,458	2,544	21,386	2,156
2006	19,972	2,419	22,095	2,233

Collection Methods: Collection of adult coho will take place at both the Lewis River and Merwin traps located at the Lewis River hatchery and base of Merwin dam, respectively. The Lewis River trap along with fish from the Merwin trap will continue to be used for broodstock collection, nutrient enhancement programs (other than included in this plan) and food bank needs. In selecting adult fish for transportation, fish shall be in good health and have no

puncture wounds. Any fish with eye trauma (e.g., scrapes, lacerations or fungus) shall not be transported upstream. Fish should be bright and firm to help ensure maximum geographic distribution of fish and eventual carcasses in the upper watershed.

Transportation Number: The number of coho to be transported from the traps (in 2007) will total at least 2,000 adults. This number is based on preliminary run estimates from the Washington Department of Fish and Wildlife (WDFW). Females shall have priority over males when selecting fish for transportation. A high percentage of females will facilitate redd construction, and thereby, help meet the plan objective of gravel tilling.

Transportation Vehicles: Fish tanker trucks will be used for transportation activities. Hatchery or PacifiCorp staff will use existing hatchery or purchased vehicles to meet the transportation goal in 2007. Each fish tanker truck may complete up to four trips per week. Each 1,500 gallon truck can transport up to 120 adult coho per trip, or up to 480 coho salmon per week. PacifiCorp may use company purchased and owned fish trucks to transport adults to the upper basin.

Schedule: The schedule for coho will begin in September and continue for a period of up to five (5) weeks. The exact start dates will vary based on run timing and size projections.

Release Points: Swift boat ramp will be used as the primary release point during transportation activities upstream of Swift reservoir. If reservoir levels are too low for planting of fish from the Swift boat ramp, the Eagle Cliff bridge, Swift Dam, Muddy River or bridge crossing near the Curly Creek confluence (Curly Creek bridge) shall serve as alternates to the Swift boat ramp.

Pathogen Screening: According to WDFW disease policy, in-basin fish transfers do not require pathogen screening. Therefore, fish that are transported from either the Merwin or Lewis River trap upstream will not be tested.

Harvest Restrictions: The fishing season on Swift reservoir and upstream of Eagle Cliff Bridge closes on October 31. During the September and October period when coho are being released into the upper watershed, angling pressure is traditionally very light and no adverse effect is anticipated.

### **3.0 Plan Modifications**

On an annual basis, this plan shall be reviewed and modified if necessary by the Aquatics Coordination Committee. PacifiCorp, in consultation with the WDFW and Yakama Nation, will present the plan to the ACC for approval each year after final run projections are estimated by the WDFW (usually by March).

# Technical Memorandum



Project Name: Lewis River LWD Study

Tech Memo Title: DRAFT Study Plan

To: Frank Shrier, PacifiCorp

From: Inter-Fluve, Inc, Cramer Fish Sciences

Primary Authors: Gardner Johnston, Martin Fox, Jody Lando

Date: 5/14/2007

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This document represents the draft Study Plan for the Lewis River Large Woody Debris study. This Study Plan is being provided to PacifiCorp and the Aquatics Coordination Committee for their review according to Section 7.1.2 of the Lewis River Settlement Agreement (SA). Study Plan components are discussed below according to the tasks outlined in the Large Woody Debris Assessment Scope of Work taken from Schedule 7.1.2 of the SA.

## Task 1: Reference Conditions

The reference condition evaluation will estimate the quantity of large woody debris<sup>1</sup> (LWD) that would have been expected to pass through the system historically (historical supply) and how much LWD would have likely been retained in the lower river below Merwin Dam (historical retention).

Historical supply will be estimated by looking at regional studies where wood budgets have been conducted. A number of studies will be reviewed with respect to their potential applicability to the Lewis Basin. Wood supply rates and volumes from other studies will be applied to the Lewis Basin using basin size, contributing channel length, source attributes, retention factors, or other attributes as adjustment factors. Looking at multiple regional studies will provide a range of historical LWD supply values that could have been expected in the Lewis Basin.

Historical retention will be estimated by applying regression equations developed to predict LWD concentrations in reference streams. The equations were developed using data from largely unmanaged<sup>2</sup> (Fox 2001) reference stream channels in western Washington (Fox and Bolton *In press*). These equations use channel width, forest type, channel bedform, gradient, and confinement as predictor variables for LWD frequency (i.e. pieces per 100 meters of channel length) and LWD volume (i.e. cubic meters per 100 meters of channel length). Additionally, the spatial distributions of historical wood quantities will be characterized based on how wood is organized laterally, longitudinally, and by piece size in unmanaged channels of similar geomorphology (Fox 2003). The estimates will also be compared to the results of other studies that have quantified historical LWD concentrations and volumes.

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<sup>1</sup> The term 'Large Woody Debris' denotes a size definition referring to pieces of wood equal to or greater than 2 m in length and 0.10 m at midpoint diameter (Bilby and Ward 1991; Schuett-Hames et al. 1999; Fox 2001)

<sup>2</sup> Fox (2001) defined 'unmanaged' as never having been logged, no roads, without hydro or channel modification, and otherwise minimal human influence. Fire suppression may have occurred.

## Task Summary

### *Component 1: Historical LWD supply to lower river (below Merwin)*

- Apply values from modeling efforts on other PNW rivers (e.g. LWD volume per year per upstream watershed area)
- Estimate from other regional empirical/historical studies (e.g. work conducted on Puget Sound streams)

### *Component 2: Historical LWD loading ranges in lower river*

- Regression equations (Fox and Bolton, *In press*)
- Characterize the spatial distribution, organization, and size distribution of historical wood loads likely to have occurred
- Compare to results of other regional empirical/historical studies (e.g. work conducted on Puget Sound streams)

## Task 2: Current and Projected Conditions

The current condition evaluation will estimate the quantity of LWD that would be expected to pass through the system if it were allowed to pass through the reservoirs (current supply) and the amount that would be expected to be retained in the river (projected retention) downstream of Merwin dam. Current supply is affected by a number of different management activities including forest harvest, fire, roads, and reservoir effects. Projected retention is affected by channel and bank alterations, hydro-regulation, wood removals, and riparian management. The range of flows and channel conditions that make up the existing condition in the lower river will be defined.

The analysis of current supply will focus on the fluvial inputs of LWD to the reservoirs. The primary source of information will come from PacifiCorp records of wood removals from the reservoirs. Wood removals occur relatively frequently in Swift Reservoir (annually) and infrequently for Merwin and Yale Reservoirs (every 5-10 years). Records of wood removals will be obtained from PacifiCorp staff. Staff will be interviewed for additional information regarding wood quantities, piece sizes, and timing. Wood that is contributed to the reservoirs but that does not make it to the debris impoundment booms above the dams for removal will not be quantified. Potential effects on wood supply from the 1980 Mount Saint Helens eruption will be described. The amount of wood supplied to the lower river from lower river riparian areas will be evaluated through a review of existing riparian and channel morphology studies on the lower Lewis River.

Projected retention in the lower river will be evaluated through an assessment of hydrology, hydraulics, geomorphology, riparian conditions, and management practices. Factors to consider include modifications of the flow regime from hydro-regulation, changes to the channel hydraulics resulting from levee construction, riparian and streambank alterations, and forest and river management. Geomorphic analysis will include a review of historical changes to channel planform and cross-sectional channel geometry; and how these changes have impacted wood retention. Current "key" pieces (Fox 2001), if present, will be measured and used as indicators of the piece size required for retention under the existing conditions. An at-a-station hydraulic analysis (i.e. Manning's equation) will be used to estimate the stage-discharge relationship at select cross sections. Cross-sections will be obtained from existing studies or surveyed during field visits. Stage-discharge relationships will be related to the size distribution of the current wood supply in order to describe the capacity of the lower river, in its present state, to retain large woody debris (e.g. Braudrick and Grant 2000). Additionally, current retention of wood relative to historical conditions (i.e. before hydro-regulation and significant channel alterations) will be evaluated by comparing the difference in the stage-discharge relationship induced by the presence of levees, which serve to increase stage through channel confinement. In areas with levees, historical cross-sections can be approximated by adjusting the current cross-section to eliminate the levee fill; similar at-a-station hydraulic analyses may then be run on these sections.

## Task Summary

### *Component 1: Current LWD supply*

- Records of wood removals from reservoirs

### *Component 2: Current potential retention in lower river*

- Current potential wood loading in the lower river will consider:
  - Geomorphology – historical changes to planform and cross-section geometry.
  - Hydraulics – effects of current channel conditions on wood transport capacity.
  - Riparian/streambanks – changes to recruitment and retention processes.
  - River management – clearing and snagging in the lower river.
  - Forest management – historical changes to size distribution of wood.
- Observations of current retention processes
  - Assessment of current LWD and Key pieces quantities through wood surveys and aerial photo analyses.
  - Assessment of geomorphic features conducive to wood retention

## Task 3: LWD Restoration Options, Feasibility, and Risks

The analysis of restoration options will take into consideration the results of Tasks 1, 2, and 4. The historical and current analyses will provide an understanding of how wood functioned under natural conditions and how those conditions have changed over time. We are presuming that natural conditions are those to which salmonids have adapted, and will provide the basis for restoration goals. This information will be used to identify the processes and structure that can reasonably be restored given current land use and management constraints. Information from task 4 will be used to identify the restoration options that will provide the greatest benefit to aquatic species.

The potential effectiveness, location, feasibility, and risks of restoration measures will be described. Limiting factors for aquatic habitats typically formed by wood will be evaluated. Restoration measures will focus on producing and maintaining natural habitat conditions to the extent possible. Restoration project types will include active and passive measures, and may include construction of structures designed to capture/retain wood, installation of large wood complexes, restoration of channel function that supports LWD recruitment and retention, and riparian/streambank measures. Appropriate types of restoration measures will be identified for particular areas along the lower river. Restoration measures and locations will be described at a conceptual level; drawings will not be provided. Feasibility issues, including costs, logistics, and permitting will be discussed. Any potential risks to property or river users will also be described.

## Task Summary

- Evaluation of habitat quality limited by wood
- Review effectiveness of potential measures (e.g. retention structures, constructed jams, restoration of channel function, riparian restoration)
  - Describe objectives of various measures
  - Describe potential effectiveness given conditions in Lewis River
  - Describe effectiveness of similar projects constructed in the past
- Identify suitable locations for restoration project types

- Describe feasibility of measures (e.g. costs, logistics, permitting)
- Discuss risks of measures (e.g. risk of failure, risk to property, risk to river users)

#### Task 4: Fish Benefit

The analysis of fish benefit from LWD will consist of a qualitative documentation of wood-derived ecosystem dynamics coupled with quantitative calculations of fish capacity potential. Regionally applicable studies have documented the response of juvenile and adult fish to LWD accumulation – key pieces and wood jams (Cederholm et al 1997, Montgomery et al. 1999, Roni and Quinn 2001). These findings will be collected and synthesized for both short-term and long-term benefits in the lower river. Documentation will be both species and life-stage specific to the extent possible.

The quantitative comparison of historical LWD conditions versus current potential retention will incorporate findings from the qualitative assessment with a focus on juvenile and adult capacity. Capacity estimates will be made by habitat type, species, and life stage to support a comparison between historic and current/proposed conditions. Given habitat requirements and data availability, the following species and life-stages will serve as the focus of the analysis:

- Fall Chinook spawning and rearing
- Coho summer and winter rearing (parr and pre-smolt)
- Steelhead parr rearing (Age 1+)

The comparison of capacity benefits will include two scenarios: LWD loading under reference conditions and LWD loading under projected and restored conditions. Findings will be presented both graphically and statistically. The results of this analysis will inform the restoration recommendations of Task 3.

#### Task Summary

- Characterize the benefits of stable (long-term) LWD accumulations in the lower river
  - Describe the physical and biological benefits of LWD accumulation
- Characterize the benefits of transient (short-term) LWD in lower river
  - Describe the benefits
- Compare historical fish benefit to the benefit of current restoration options
  - Analyses will focus on stable LWD
  - Quantify benefits to fish using predictive models. Focus analysis on critical species and life-stages.
    - Fall Chinook spawning and rearing
    - Coho summer and winter (parr and pre-smolt)
    - Steelhead parr Age 1+
- Provide input to recommendations for LWD restoration measures

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