

**FINAL Meeting Notes  
Lewis River License Implementation  
Aquatic Coordination Committee (ACC) Meeting  
April 14, 2011  
Merwin Hydro Control Center, Ariel, WA**

**ACC Participants Present (16)**

Adam Haspiel, USDA Forest Service  
 Dave Hu, USDA Forest Service (Teleconference)  
 Diana Gritten-MacDonald, Cowlitz PUD  
 LouEllyn Jones, USFWS  
 Eric Kinne, WDFW  
 Pat Frazier, WDFW  
 Josh Halowatz, WDFW  
 Shane Hawkins, WDFW  
 Frank Shrier, PacifiCorp Energy  
 Sabrina Hickerson, PacifiCorp Energy  
 Todd Olson, PacifiCorp Energy  
 Jeremiah Doyle, PacifiCorp Energy  
 Erik Lesko, PacifiCorp Energy  
 Ethan Bell, Stillwater Sciences  
 Jody Lando, Stillwater Sciences

**Calendar:**

May 12, 2011	ACC Meeting	Merwin Hydro
June 9, 2011	ACC Meeting	Merwin Hydro

<b>Assignments from March 10, 2011 meeting:</b>	<b>Status:</b>
<b>Review ACC/TCC Annual Report</b> – Comments are due March 31 <sup>st</sup> .	<b>Complete</b>
<b>Aquatic Fund Final Proposals</b> – Comments are due March 17, 2011.	<b>Complete</b>
<b>Aquatic Fund Annual Report</b> – Out for 30-Day review. Though the report has already been submitted to FERC, the ACC has until <b>May 11, 2011</b> to comment or initiate ADR process.	<b>Pending</b>
<b>Bull Trout Subgroup</b> – Todd Olson (PacifiCorp) will draft a schedule and bring to May’s meeting for discussion	<b>Pending</b>

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

*9:20 a.m. – Meeting began*

Frank Shrier (PacifiCorp Energy) called the meeting to order at 9:20 a.m., reviewed the agenda for the day and requested any changes or additions. Adam Haspiel (USFS) had emailed Sabrina Hickerson (PacifiCorp Energy) the night prior to the meeting to request an additional agenda item to discuss the Forest Service’s upcoming maintenance and

repairs on the Canal Bridge. This item was added as requested. No other changes or additions were made and the agenda was accepted at 9:25 a.m.

Last month's action items were reviewed and marked as complete. Hickerson announced that the ACC/TCC annual report would be submitted to FERC on Friday, April 15, 2011, and requested any last minute comments or changes be submitted as soon as possible. No additional comments or changes were requested.

Additionally, the 2011 Aquatic Fund Annual Report was submitted to FERC on Tuesday, April 12, 2011. The ACC still has until May 11, 2011 to make any comments or initiate the alternative dispute resolution (ADR) process.

Shrier announced reviewed the Aquatic Fund accounting with the ACC. There are additional funds available that had gone unaccounted for in previous years. The current balances are as follows:

- Resource funds: \$662,393.36
- Bull Trout funds: \$521,251.53
- Total: \$1,183,644.88

For more detail, please refer to the *Lewis River Aquatic Fund Projects 2011 Annual Report* posted to the PacifiCorp website at the following link/pathway:

<http://www.pacificorp.com/es/hydro/hl/lr.html> > License Implementation > ACC > Aquatics Coordination Committee 2011 > [Lewis River Aquatic Fund 2011 Annual Report](#)

### **Stillwater Sciences Presentation Lewis River Stranding Monitoring Study**

Ethan Bell and Jody Lando from Stillwater Sciences presented their findings from the study they conducted on fish stranding in the Lewis River. A copy of their presentation is included in [Attachment A](#).

The stranding study was required by section 3.3.2 of the Lewis River Settlement Agreement:

"6.2.3 Stranding Study and Habitat Evaluation. By the third anniversary of the Issuance of the New License for the Merwin Project, PacifiCorp shall complete a stranding study and a habitat evaluation study below Merwin Dam to assess the potential effects of Project operations on steelhead, coho salmon, Chinook salmon, and chum salmon, and their habitats. The total cost to complete both the study and evaluation is estimated to be \$300,000. PacifiCorp shall develop the stranding study objectives in Consultation with the ACC, with final approval by NOAA Fisheries and USFWS. The stranding study shall identify measurable factors affecting potential stranding, the relationship of such factors to each other, and the timeframe and season within which stranding may occur. The habitat evaluation study shall evaluate spawning and rearing habitat from Merwin Dam to the downstream end of Eagle Island across a range of minimum flow operational conditions. The design of the study and evaluations shall be limited to the objectives developed above, must be operationally implementable, and any operational changes implemented for the study and evaluation shall not be considered a breach of any other operational restrictions provided in this Agreement, e.g., shall not be considered a Plateau Change under Section 6.2.2. Based upon the results of the study and evaluation, the ACC may recommend to PacifiCorp, subject to the approval of NOAA Fisheries and USFWS, measures to

minimize or mitigate stranding of salmonids below Merwin Dam. Such measures may include minor adjustments to instream flow levels, or minor adjustments to Merwin Project operations to address Project impacts below Merwin Dam. PacifiCorp shall consider any suggested adjustments to operations and flows of the Project, and shall make reasonable, good faith efforts to address such recommendations. In so doing, PacifiCorp should consider impacts on operational benefits of the Project, including, but not limited to, flood management, power generation, and recreational uses. If PacifiCorp determines not to implement the recommendations, because there would be significant impact on Project benefits, the ACC may elect to mitigate the impacts shown by the study and evaluation by development of habitat enhancement projects through the use of the Aquatics Fund.”

The plan for the stranding study was sent to the ACC on August 10, 2009 for 30-day review and comment period. Additionally, Stillwater Sciences conducted a presentation at the ACC meeting on August 13, 2009.

Stillwater Sciences, with ACC approval, chose to identify potential stranding zones (PSZs) as opposed to actual stranding zones because a stranding study had not been done in this ten-mile stretch before. This meant they had a significant area to study with no prior knowledge of where the PSZs would be in order to focus their attention.

Additionally, they chose to identify the PSZs for all species in the river at a variety of flows. Stillwater Sciences worked with the ACC to lump “guilds” of fish together and look at specific criteria for each, rather than have separate data sets for each individual species of fish. This was done for practicality due to the large area and the speed at which flows can change. Since the river flows so quickly at all times, the differences would not significantly impact the results.

The study identified 84 PSZs based on morphology and life stage. Overall, there was a significant amount of apparent risk based on the morphology, but not a lot of observed stranding or mortality. The primary reason behind the low mortality was downramping rate at two inches per hour. This gives the older, larger fish time to get into the deeper water. Since the low flows (1200 cfs) happen later in the season (late summer and fall), most of the species on which the Settlement Agreement focused are at a later life stage and therefore large enough to swim to deeper water as the flows drop.

One observation made was that it takes more than 24 hours for terrestrial predation to start on stranded or isolated fish on the Lewis River. After that time period, the stranded fish start to desiccate. For other areas in the Northwest it takes hours or less for bird predations to begin, but this was not observed for the Lewis.

As for habitat evaluation, Stillwater Sciences utilized specific criteria to determine rearing and spawning habitats. Spawning habitat was seen as plentiful, even at the range of flows observed in terms of criteria. In general, the river substrate throughout the entire river is ideal for spawning. Based on the flow levels, spawning habitat could move from the middle of the river (at lower flows) to the margins (at higher flows). Though this pattern was observed, Bell noted that it was difficult to observe spawning in the middle of the channel at high flows, so this delineation may not be accurate.

Fry rearing habitat was found throughout the study reach, mostly along the channel margins. Water velocity was mostly what limited fry rearing habitat, small backwater being the best. The habitat shifted based on changes in flows. Theoretically the fish could follow the habitat shift because the rate of change was not too great, from lower stranding areas on a terraced slope to higher stranding areas on the river margins.

Juvenile habitat was limited by velocity and depth, but also found mostly along the channel margins, as well as in some side channels and backwaters. Again, the habitat would shift with river flows.

Eagle Island had more fry and juvenile habitat at lower flows than higher flows, especially in Eagle Island side channel at low flows on the North end.

Eric Kinne (WDFW): Are the flow regimes suitable for all fish? We are focusing our flow regime on the Fall Chinook, but what about the other fish. Bell responded that the study showed plentiful habitat at all flows. Although for chum, there were few areas that would be considered excellent for their rearing.

Kinne also asked Bell if the dam operation and flow regimes were suitable for the fish in the Lewis River, or if there needed to be a change in order to help reduce stranding. Bell responded that frequent and drastic changes in flows would strand more fish. Habitat appeared plentiful even at minimum flows, but significant and recurring fluctuations in flows would be most problematic. He also noted that this is not a usual occurrence for present-day operations but large fluctuations did occur in the past.

Based on the study results, there were 20 or 30 PSZs that are really high risk. However, Bell, would not recommend making physical alterations to these sites because they are great rearing habitats when they are inundated, which they typically are during the spring. Changing the area would destroy the habitat and that would be of more negative impact to the fish.

Shane Hawkins (WDFW) stated that what the study defined as good rearing habitat did not match his observations of what was actually on the river. He specifically referred to a backwater area shown in the presentation that he had seined. Though it meets criteria as good juvenile habitat the fish were not using it.

This brought forward the question: Do the criterion used to define functional rearing and spawning habitats translate properly to what happens on the river? Based on Hawkins information, there appears to be a difference between what was modeled and what has actually been observed. After some discussion, Todd Olson (PacifiCorp Energy) suggested overlaying Hawkins' seining results on Stillwater Sciences' maps to compare potential habitat with actual observations.

The ACC agreed to file the Stillwater Sciences' Stranding Study report with FERC without additional modification. As a separate measure, Hawkins and Bell will get together to put together maps that show areas determined to be viable as good rearing habitat and areas where Shane has collected juveniles by seine and submit their findings to the ACC for review. This decision allows for meeting the FERC deadline for the stranding study (June) while still gathering more information.

<Break 10:35 a.m.>

*Ethan Bell and Jody Lando departed*

<Reconvene 10:52 a.m.>

## **Crab Creek Acclimation Pond Plan**

Shrier announced that PacifiCorp has a design for the Crab Creek acclimation pond based on the ACC's discussion at the last meeting. At that meeting, the determination was made to build a pond-like holding area within the banks of the river where Crab Creek joins the Lewis River. PacifiCorp has an internal deadline to present the ACC with a 60% design for review by May 1, 2011. The design will also include the Muddy and Clear Creek sites that have been proposed for ponds. The goal is to have the design finished by mid-summer in order to proceed with the NEPA process.

Based on what Shrier has seen of the initial Crab Creek sketches, he reports they look good. He also advised that the water coming into the pond comes from Crab Creek and the river itself. The only unknown is how much clean-up will need to be done each year as the winter Lewis River flows break down the structure. Haspiel asked for an estimate of the pond size. Since Shrier has only seen sketches at the 30% level he was not able to provide the size, but did state that the pond fits well within the designated area.

## **Study Updates**

*Release Pond* – Olson announced that PacifiCorp and Cowlitz PUD are very close to closing the deal on the Release Pond site. The Utilities have reached a verbal agreement with the landowners, formed an option agreement and paid earnest money towards the purchase. On April 1, 2011 PacifiCorp submitted to FERC the final design and are just waiting on approval. Upon FERC approval, the company will move forward with completing the transaction.

Kinne asked if there will be any city ordinance issues. Shrier advised that the site does have to be rezoned. However, the city has a clause in its ordinances that allows for “minor utility facility use.” Since Cowlitz PUD is partner in this project, and they are the city's utility, the City Manager believes this zoning ordinance applies. The neighbors have no objection to the proposed usage.

Additionally, only one of the eight acres will be used for the pond. It has not yet been decided what to do with the remaining seven acres, but there will be a road built. They have already flagged off the road for construction.

*Pond 16 at the Lewis River Hatchery* – Erik Lesko (PacifiCorp Energy) announced that the contract has been awarded to Mort McMillen and work will begin soon. Nathan Higa (PacifiCorp Energy) notified the hatchery this morning to start coordinating with the contractor.

*Speelyai Hatchery* – The Request for Proposals (RFP) is out for construction of the kokanee weir.

*Hatchery Supplementation Plan* – Lesko announced that the annual report for the Hatchery and Supplementation program has been completed and was previously submitted for 30-day review and comment period by the ACC. No responses were received so the report has been finalized and will be submitted to FERC on Friday, April 15, 2011.

*Activities* – PacifiCorp employees have been out every week attempting to capture wild winter steelhead. Nine were captured the day before, same as last week, which is about normal for this time of year. As in the past, more males are being caught than female: out of the nine captured yesterday, only three were female.

Lesko did advise that there are fungal problems appearing with fish being held at the hatchery. Options we are considering include the use of circular ponds instead of the rectangular raceways currently in use. He asked the group to let him know if anyone has any temporary circular tanks that could be used as a trial before purchasing permanent tanks.

*Flows at Lewis River Ponds 13 and 14* – Kinne asked Lesko if he has had any update on the flow problem over that the Lewis River hatchery, ponds 13 and 14. He stated that the ponds should be able to handle 4200 gal/min but are only getting about 2300 gal/min. The issue is occurring on the inlet side, not the outlet. They tried to use one pump and got up to 3700 gal/min, when they kicked on a second pump the tower overflowed. Before the ponds were redesigned, the flow was not a problem. Higa is working on this, but there is no update to report at this point.

*Merwin Upstream Schedule* – The permits for this project have been received, and work is starting. There will be more congestion on the road to the powerhouse with the crew and the hatchery personnel both using it.

The construction will require that the trap be shut for a couple of days for intake evaluation. This will mean water will be shunted from the hatchery to the bridge during that time. Coordination will be essential. At this time, the schedule for the trap shutdown is staying the same.

Shrier has requested a response from NMFS that indicates the BiOp covers the dredging. Originally the state had agreed to do the dredging, but this hinges on the Corps of Engineers' Permit 404.

A date has not yet been set for the dredging drawdown, but it will occur sometime in August.

*Swift Downstream Collector* – This project is well underway. The pieces for the belly tanks are being hauled in and six have already arrived. Everything is right on schedule.

The one issue that has come up is the 200,000 lb crane that needs to be brought to the site for the trestles. The problem is that the bridge on the proposed route has not been

evaluated by the Forest Service for that kind of load. This could cause significant delays, and only other route would have another bridge and that may not have been evaluated either. This issue just came up last week and has yet to be resolved.

*Bull Trout* – LouEllyn Jones (USFWS) advised that the based on Consultation meetings between USFWS, WDFW, and PacifiCorp in 2011, the Utility as part of the bull trout operating plan will begin passing bull trout at Swift No. 1 this field season. She requested that regular updates on bull trout be added to the ACC agenda. The Fish and Wildlife Service will be having the ACC review proposals regarding recovery work for bull trout next year and there will need to be some discussion regarding these.

Jones also asked if the ACC was going to form a sub-group for bull trout. Olson was going to put together a schedule but had not completed that yet. He gave himself an action item to bring to the next meeting for discussion.

### **Forest Service Canal Bridge**

Haspiel announced that the Forest Service has a project this summer to repair and maintain the Canal Bridge that spans Cowlitz PUD's canal. The date has been set to start work May 15, 2011. In the meantime, they have not gone out to bid.

There is a bat colony under the bridge which impacts timing of the work to be done.

There are a number of tasks to complete to repair the bridge. The first will be to replace the shims underneath. This is a timber bridge that has creosote or other preservatives in the wood, which reacts with the asphalt and is causing a "black goo" to drip into the canal. The second task will be to close the bridge a day to remove the asphalt and lay down sand to soak up the preservative. The sand will need to be left for an indefinite amount of time (possibly a few weeks), exposed to air and heat to work properly. It may be necessary to clear the sand and replace it more than once, depending on how effective the process is and how much preservative is getting soaked up. Once the process is complete, the last task will be to close the bridge again for two days to repave.

Diana Gritten-MacDonald (Cowlitz PUD) expressed that since Settlement Agreement dollars were being spent on the FERC project, as she wanted Haspiel to represent the Forest Service and to discuss concerns and coordinate items with the ACC. The Forest Service also discussed the bridge work with the TCC.

The Forest Service would like to use the fishing pier as a staging area, but this would require coordination with 26 parties and FERC. There's another area that Gritten-MacDonald showed the Forest Service yesterday as an alternative.

Safety is a concern with the lower beams on the bridge having only five feet or so of clearance above the water. In the agreement with the Forest Service, Cowlitz PUD is requiring the Forest Service and their contractor to coordinate with PacifiCorp regarding safety. Gritten-MacDonald speculated that the work may require an outage.

Gritten-MacDonald expressed another concern regarding the sand on the bridge. How is the contractor going to make sure nothing gets in the water? One person suggested that a large net could be placed under the bridge to catch anything that may fall.

At the TCC meeting on April 13, 2011., Kirk Naylor (PacifiCorp Energy) asked about the weight limit of the bridge, and if it would change when the asphalt was removed and the sand added. The Forest Service did not have an answer yet.

Haspiel was clear that the Forest Service understood that this bridge is critical to other construction going on in the area. To shut the bridge down would cause transportation delays for the construction workers, and during the middle of summer, be a problem for recreation users as well. The Forest Service will coordinate the bridge closure with PacifiCorp.

Gritten-MacDonald also advised that, for public safety, the fishing pier would be closed when the bridge is closed.

Haspiel advised the group that the Forest Service has a blanket permit that allows regular maintenance on the bridge, but he is not sure what, if any, environmental permits would be required.

The ACC recommended that the Forest Service file their work plan with the FERC Portland Regional Office, and suggested even doing a media release of some sort to communicate with the public in the area. For example, PacifiCorp is putting together a brochure for the Swift Collector for the public for coordination and safety purposes. The ACC requested that the Forest Service provide regular updates on the work.

### **Site Visit**

The field trip to review Canal Drain and Upper Release flows was cancelled. It was moved to be a firm agenda item for next month.

### **Agenda items for May 12, 2011**

- Review April 14, 2011 Meeting Notes
- Discussion PIT Tagging Salmon and Steelhead Smolts with Full-Duplex or Half-Duplex Tags
- Upper Release and Constructed Channel Flows – Site visit
- Study/Work Product Updates

### **Public Comment**

None

### **Next Scheduled Meetings**

May 12, 2011	June 9, 2011
Merwin Hydro Control Center	Merwin Hydro Control Center
Ariel, WA	Ariel, WA
9:00 a.m. – 2:00 p.m.	9:00 a.m. – Noon



*Meeting Adjourned at 12:00pm.*

**Meeting Handouts & Attachments**

- Final 4/14/11 Meeting Agenda
- Final 3/9/11 Meeting Notes
- **Attachment A:** Stillwater Sciences Stranding Monitoring Presentation

# Lewis River Stranding Monitoring

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Aquatics Coordination Committee  
April 14, 2011

Ethan Bell and Jody Lando  
**STILLWATER SCIENCES**



## Overview of presentation

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- **Background and process**
- **Approach**
- **Results and discussion**



## Objectives

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- **Identify measurable factors affecting potential stranding, the relationship of such factors to each other, and the time frame and season within which stranding may occur.**
- **Evaluate spawning and rearing habitat from Merwin Dam to the downstream end of Eagle Island across a range of minimum flow operational conditions.**





## Development of Study Plan



### **Lewis River Stranding Monitoring Study Plan**

*Prepared for*  
PacifiCorp  
825 NE Multnomah Street, Suite 940  
Portland, OR 97232

*Prepared by*  
Stillwater Sciences  
850 G Street  
Arcata, CA, 95521

September 2009



## Approach: Field surveys

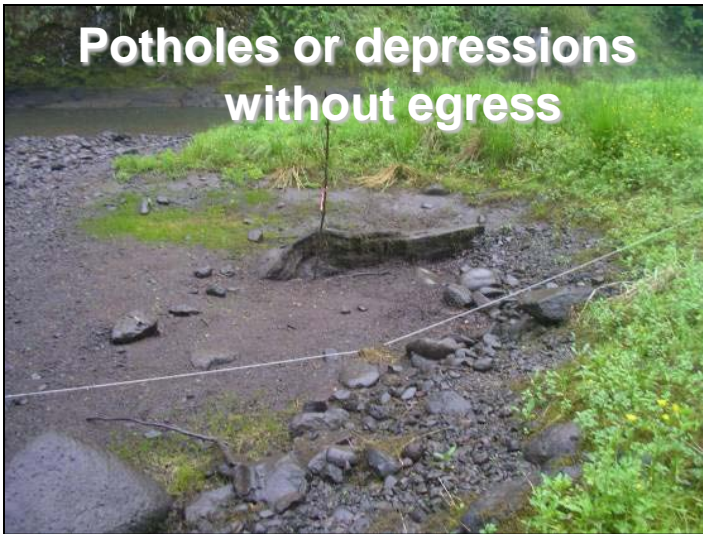
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- **Field evaluation at four minimum flows**
  - **Assess lowest flows first**
- **Identify Potential Stranding Zones (PSZs)**
- **Delineate life stage-specific salmonid habitat downstream of Merwin Dam**
- **All mapping conducted on aerial photographs**





## Approach: Criteria used to Identify Potential Stranding Zone



# Approach: Criteria Used to Evaluate Habitat

Life stage	Habitat characteristic	Range of "good" values	Supporting literature
<i>Chinook salmon</i>			
Spawning	Depth	0.15–1.2 m (0.5–4 ft)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Bovee (1978), Bell (1986), and Bjornn and Reiser (1991)
	Velocity	0.3–1.1 m/s (1.0–3.5 ft/s)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Bovee (1978), Bell (1986), and Bjornn and Reiser (1991)
	Substrate (D <sub>50</sub> )	11–69 mm (0.4–2.7 in)	Primary: Kondolf and Wolman (1993) Secondary: Thompson (1972)
Fry rearing	Depth	<0.6 m (<2.0 ft)	Primary: Everest and Chapman (1972) Secondary: Lister and Genoe (1970), Stuehrenberg (1975)
	Velocity	<0.2 m/s (<0.7 ft/s)	Primary: Everest and Chapman (1972) Secondary: Lister and Ganoe (1970), Stuehrenberg (1975), Thompson (1972)
Juvenile rearing	Depth	0.3–1.1 m (1.0–3.5 ft)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Everest and Chapman (1972)
	Velocity	0.03–0.5 m/s (0.1–1.5 ft/s)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Hardin-Davis et al. (1991), Everest and Chapman (1972)
<i>Coho salmon</i>			
Spawning	Depth	0.15–0.9 m (0.5–3.0 ft)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Thompson (1972) as cited in Bjornn and Reiser (1991)
	Velocity	0.09–0.8 m/s (0.3–2.7 ft/s)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Thompson (1972) as cited in Bjornn and Reiser (1991)
	Substrate (D <sub>50</sub> )	5–35 mm (0.2–1.4 in)	Primary: Kondolf and Wolman (1993) Secondary: None
Fry rearing	Depth	<0.24 m (<0.8 ft)	Primary: Bugert et al. (1991) Secondary: Bisson et al. (1982), Sullivan (1986), Dolloff (1983)
	Velocity	<0.1 m/s (<0.3 ft/s)	Primary: Bjornn and Reiser (1991) Secondary: Reeves et al. (1989)
Juvenile rearing	Depth	0.15–1.4 m (0.5–4.5 ft)	Primary: Lewis River Habitat Suitability Index Curves based on 0.5 suitability (PacifiCorp 2004) Secondary: Sheppard and Johnson (1985), Dolloff and Reeves (1990)



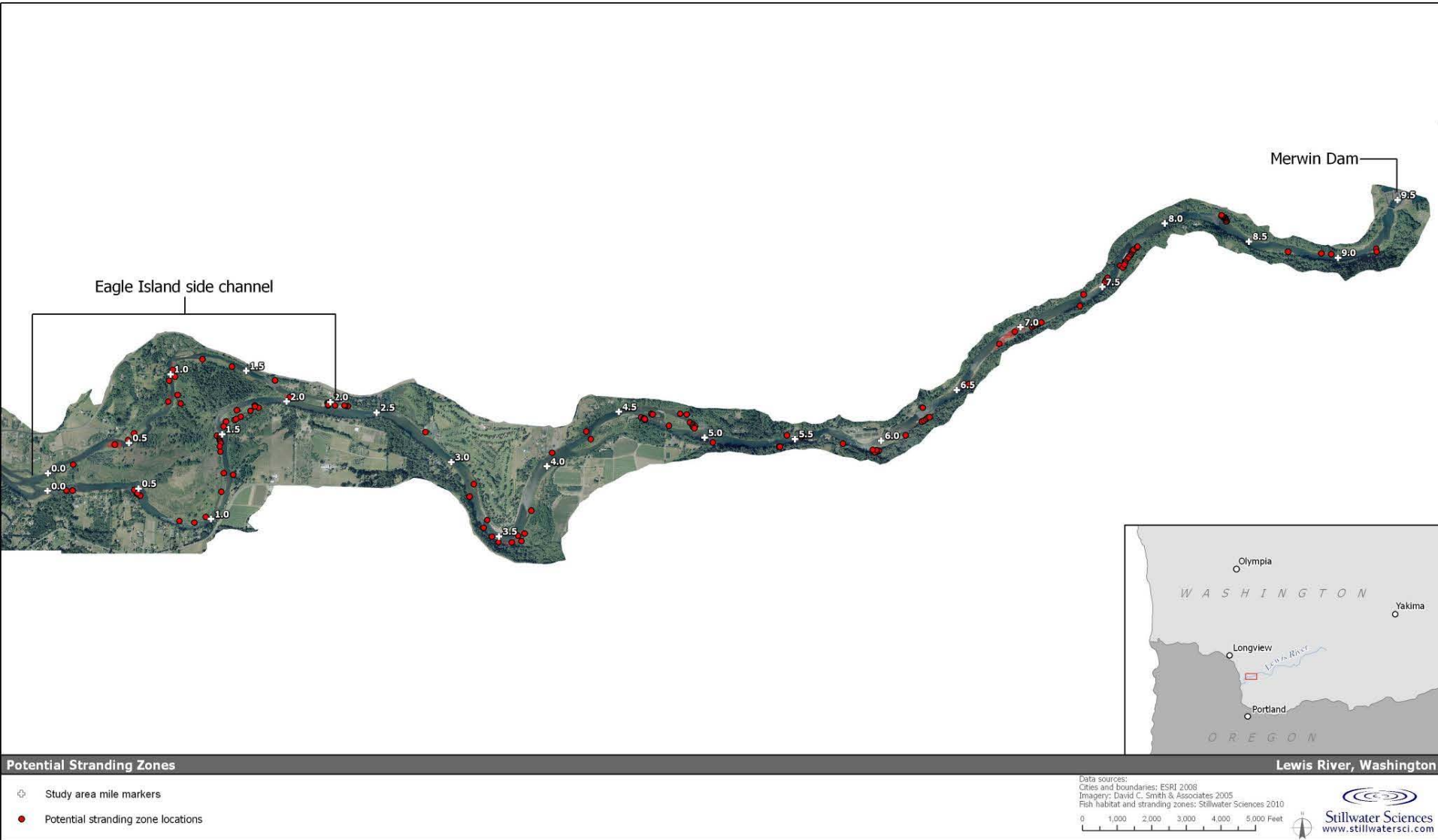
## Approach: Guiding Habitat Criteria

Guild name	Minimum polygon area <sup>1</sup>		Cover Criteria/ substrate criteria	Velocity				Depth			
	m <sup>2</sup>	ft <sup>2</sup>		Minimum		Maximum		Minimum		Maximum	
				(ft/s)	(m/s)	(ft/s)	(m)	(ft)	(m)	(ft)	(m)
<i>Spawning guilds</i>											
Chinook and chum salmon	4.3	46	10–65 mm	0.3	1.0	1.1	3.5	0.15	0.5	1.5	5.0
Coho salmon and steelhead	2.8	30	10–40 mm	0.3	1.0	0.9	3.0	0.15	0.5	0.9	3.0
<i>Fry rearing guilds</i>											
Salmon and steelhead fry	2	22	Within 0.5 m (1.6 ft) of cover <sup>2</sup>	none	none	0.15	0.5	none	none	0.3	1.0
<i>Juvenile rearing guilds</i>											
Salmon Juvenile	2	22	Within 1 m (3.3 ft) of cover <sup>2</sup>	none	none	0.5	1.5	0.15	0.5	1.4	4.5
Steelhead Juvenile	2	22	Within 1 m (3.3 ft) of cover <sup>2</sup>	0.09	0.3	0.8	2.7	0.2	0.8	none	none

## Approach: Flow selection

<b>Target flow (cfs)</b>	<b>Season</b>
<b>1,200</b>	<b>Late summer, WDFW fall spawning surveys. Also similar to summer</b>
<b>2,500</b>	<b>Fall and winter. Also similar to flows occurring during winter, spring, and summer</b>
<b>3,300</b>	<b>Spring</b>
<b>4,200</b>	<b>Early winter</b>

# Results: Stranding Risk





## Results: Stranding Risk at 4,200 cfs



Example of an isolated pool at 4,200 cfs (PSZ 81) with fry observed entrained.



## Results: Stranding Risk at 3,300 cfs



Example of a pot hole at 3,300 cfs (PSZ 69) with fry observed stranded.



## Results: Stranding Risk at 2,500 cfs



PSZ 67 at 3,300 cfs, and at 2,500 cfs



## Results: Stranding Risk at 1,200 cfs



PSZ 25 at 3,300 cfs, and at 1,200 cfs



## Results: Stranding Risk Morphological Characteristics



Example of high stranding risk at an isolated pool at PSZ 11 at 3,300 cfs.

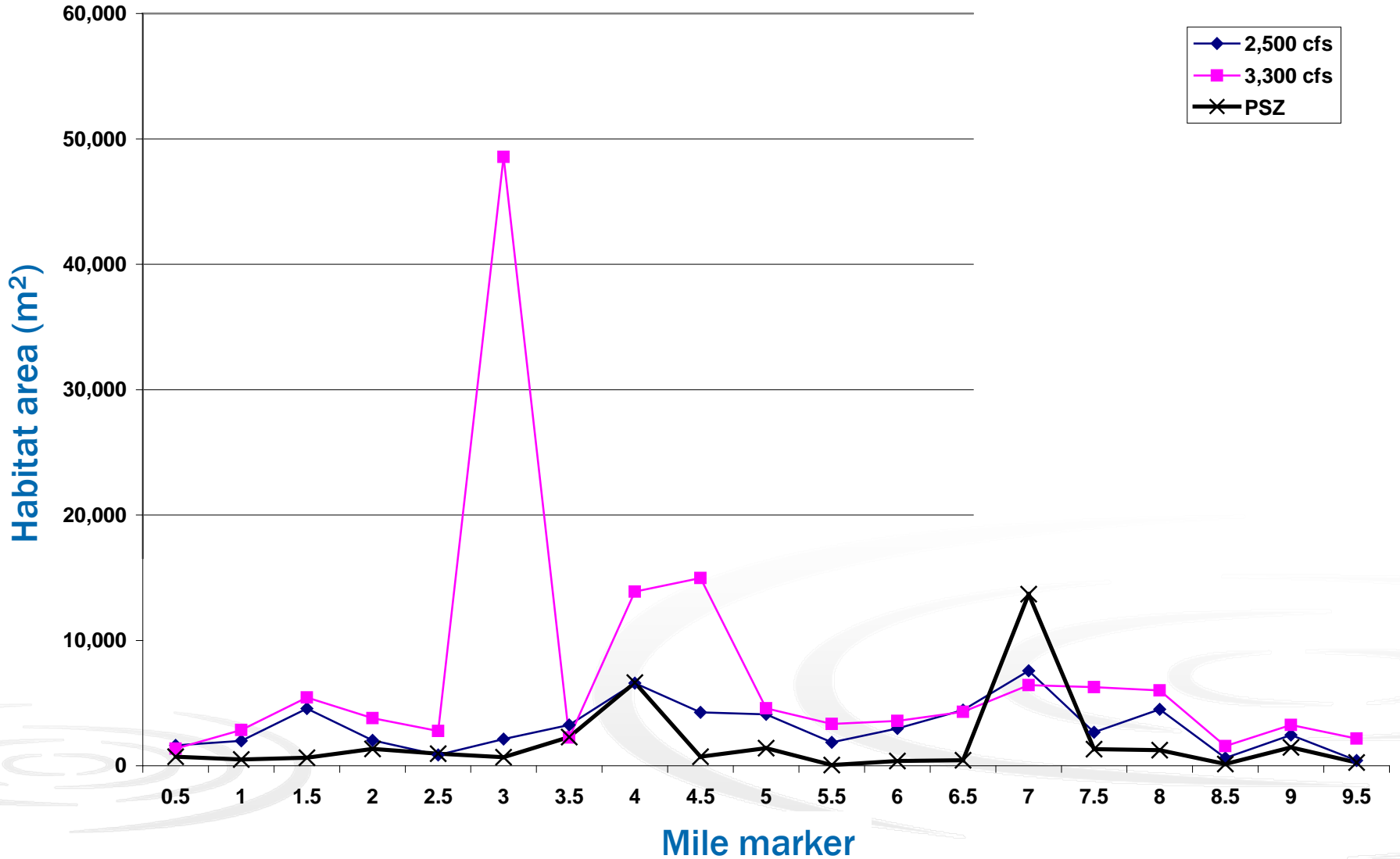


## Results: Stranding Risk Morphological Characteristics



Example of high stranding risk within vegetation at PSZ 58 at 1,200 cfs.

# Results: Stranding Risk Summary





# Results: Spawning habitat





## Results: Fry rearing habitat



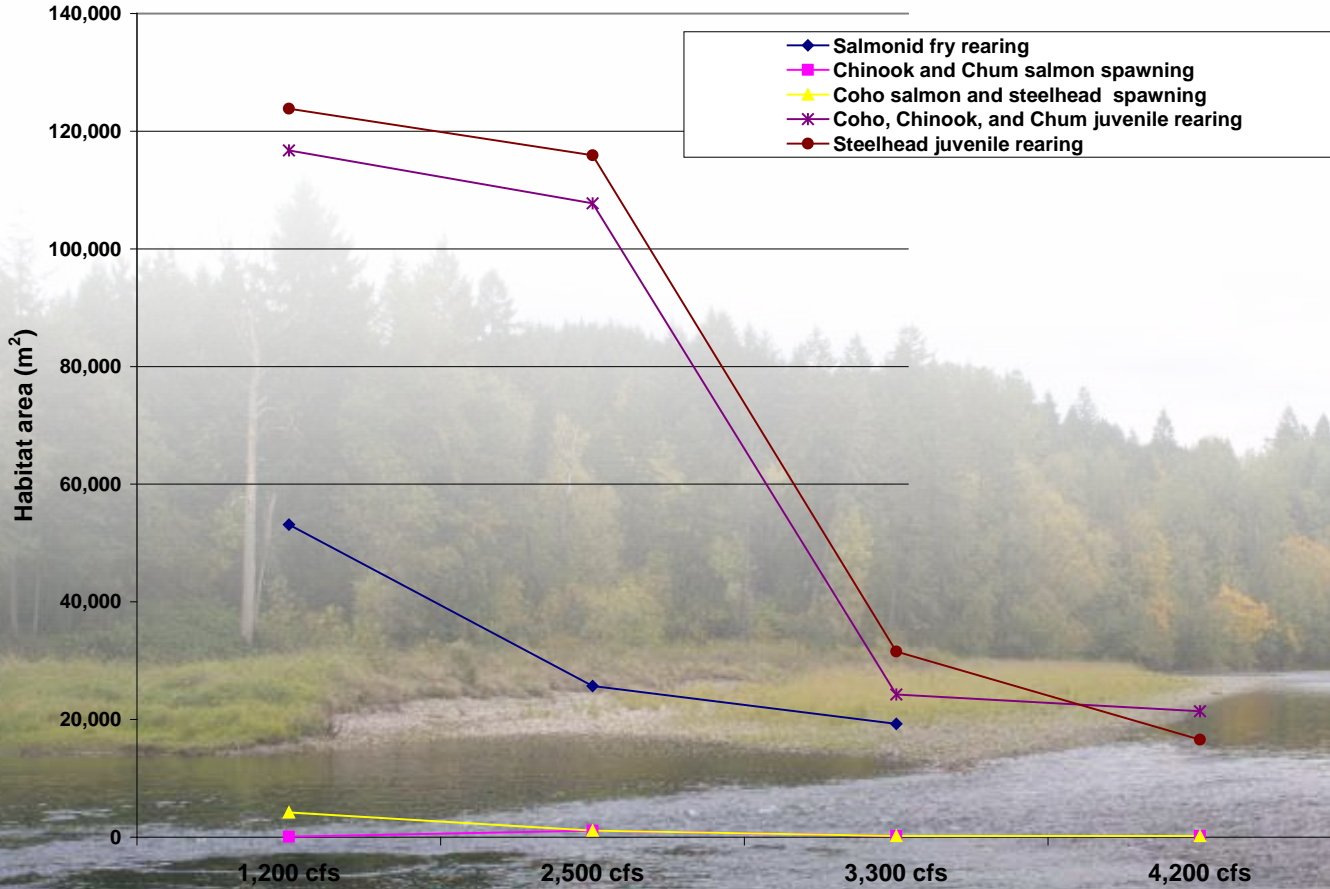


# Results: Juvenile rearing habitat





# Results: Eagle Island Side Channel



## Conclusions

- Spawning and rearing habitat are plentiful throughout the study reach, especially from MM 3 upstream to MM 5. Although the location of habitat shifts with changing flows, habitat availability appears high at the range of flows assessed.



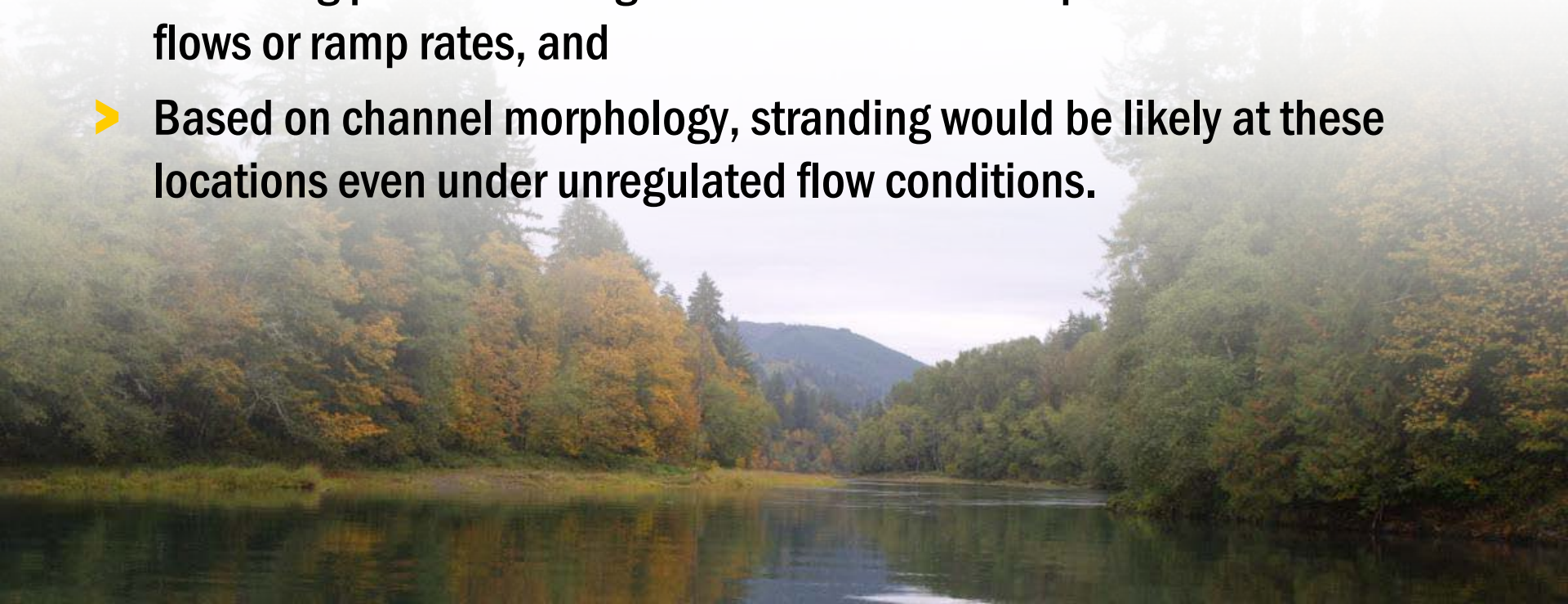


## Conclusions

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**Current minimum flows, or changes in minimum flows, do not appear to be causing significant loss for the following reasons:**

- Restriction of two inches/hour.**
- The majority (~80%) of suitable fry rearing habitat occurs in locations that do not have a high stranding risk.**
- Stranding potential at high risk locations is independent of minimum flows or ramp rates, and**
- Based on channel morphology, stranding would be likely at these locations even under unregulated flow conditions.**





# Results: Stranding Risk

