FINAL Meeting Notes
Lewis River License Implementation
Aquatic Coordination Committee (ACC) Meeting
February 11, 2010
Ariel, WA

ACC Participants Present (22)

Eli Asher, LCFRB
Jeremiah Doyle, PacifiCorp Energy
Diana Gritten-MacDonald, Cowlitz PUD (via teleconference)
Adam Haspiel, US Forest Service
David Hu, US Forest Service
Michael Hudson, USFWS
LouEllyn Jones, USFWS
Eric Kinne, WDFW
George Lee, Yakama Nation
Erik Lesko, PacifiCorp Energy
Kimberly McCune, PacifiCorp Energy
Todd Olson, PacifiCorp Energy
Bob Rose, Yakama Nation (via teleconference)
Rudy Salakory, Cowlitz Indian Tribe
Frank Shrier, PacifiCorp Energy
Ruth Tracy, US Forest Service
Shannon Wills, Cowlitz Indian Tribe
Pete Barber, Lower Columbia Fish Enhancement Group
Gardner Johnston, Interfluve
Chris Maynard, Washington Department of Ecology
Tony Meyer, Lower Columbia Fish Enhancement Group
Brett Raunig, Washington Department of Ecology

Calendar:

March 11, 2010	**ACC Meeting**	**Merwin Hydro**
April 8, 2010	ACC Meeting	Merwin Hydro

Assignments from February 11, 2010 Meeting:	**Status:**
The next ACC meeting on Wednesday, March 11, 2010 will be an aquatic fund project discussion meeting; the final project selection meeting will be in April. Each ACC member must be present at the April 8th meeting or have identified a proxy before the meeting.	

Assignments from January 14, 2010 Meeting:	**Status:**
McCune: Notify all ACC representatives via email of the informal approval of the 12/10/09 meeting notes and request comment, if any, within the 7-day period.	**Complete – 1/14/10**

Assignments from November 12, 2009 Meeting:	Status:
Kinne and Adams: Review fish trap daily return numbers and confirm best 30-day shut down period to address hatchery and construction needs specific to Merwin Trap.	**Complete – 2/11/10 Best shut down period is : 7/16 through 8/15**

Assignments from April 9, 2009 Meeting:	Status:
ACC: Further investigate WDFW carcass survey methods established in 1978 and determine "next step" regarding modifications needed, if any, to the 1978 methods.	**Pending as of 1/14/10**

Opening, Review of Agenda and Meeting Notes

Frank Shrier (PacifiCorp Energy) called the meeting to order at 9:10am and requested a roundtable introduction for those participating via teleconference. Shrier reviewed the agenda for the day and requested any changes/additions. No changes or additions were requested.

Shrier requested comments and/or changes to the ACC Draft 1/14/10 meeting notes. No changes were requested. The meeting notes were approved without changes at 9:20am. Chris Maynard (WDOE) would like to have more detailed discussion around the Swift Upper Release vacuum valve install schedule and releasing flows. Olson suggested we complete that discussion at the end of the meeting when we go over study updates.

Shannon Wills, Erik Lesko and Ruth Tracy joined

2009/2010 Aquatic Fund Proposal Presentation, USDA Forest Service - Adam Haspiel

- **Pepper-Lewis Side-Chanel Instream Habitat Restoration (Attachment A)**

Adam Haspiel (USDA Forest Service) presented a PowerPoint illustrating project location, detailing project description, target species and project length. Haspiel discussed in detail the methods for timber harvest, tree transport, LWD placement, monitoring efforts and the removal of creosote timbers from a logjam using an excavator when the equipment has completed the main project work.

Haspiel also provided a variety of drawings of typical large woody debris structures, and a detailed budget proposal. Fund request is $41,300.

2009/2010 Aquatic Fund Proposal Presentation, USDA Forest Service - Adam Haspiel

- **Pine Creek Instream and Floodplain Structures for bull Trout and Steelhead (Attachment A)**

Haspiel continued his PowerPoint presentation for a second Forest Service project proposal and discussed project location, project description, target species and project length. Haspiel also addressed methods of timber harvest, tree transport via helicopter use for a few strategic locations in Pine Creek, the use of an excavator and skidder for placement and the method of burying trees for key anchor points on the bank. The plan is to bury some trees for key anchor points and interweave the other trees to the anchor points on the bank.

Haspiel also provided a typical picture of the Pine Creek restoration reach, a typical large woody debris structure, and a detailed budget proposal. Funding request is $65,000.

2009/2010 Aquatic Fund Proposal Presentation, USDA Forest Service - Adam Haspiel

- **2010 Nutrient Enhancement on Pine Creek (Attachment A)**

Haspiel continued his PowerPoint presentation for a third Forest Service project which has been ongoing since 2006. He discussed project location, project description, and methods to include truck transport of approximately 2,500 to 3,000 carcasses for distribution in Pine Creek via helicopter. In areas accessible by vehicle within the Forest Boundary area, hand distribution will occur.

Haspiel discussed the benefits of nutrient enhancement to include:

- Increased stream biota
- Increased food base for fish
- Increased riparian vegetation growth
- Indirectly adds to long-term source of large woody debris for Pine Creek

The funding request for this project is $30,776.

Nutrient Enhancement – Results from prior projects (Attachment A and A-1)

Haspiel continued his PowerPoint presentation to include 2009 photos of carcass parts on stream margin and referenced a detailed progress report titled, "*Effect of Salmon Carcass Seeding for Nutrient Enrichment on the Macroinvertebrate Community of Pine Creek, Mount St. Helens National Volcanic Monument, Washington*, February 2009 (**Attachment A-1**) written by Robert W. Wisseman, Aquatic Biology Associates, Inc. and Adam I. Haspiel, Mount St. Helens National Volcanic Monument to provide the ACC with greater detail relative to insect densities, feeding groups, carcass distribution and macroinvertebrate sample locations, macroinvetebrate density, and segmented worm density to determine if salmon carcass enrichment would have a dramatic and perhaps a year afer year cumulative impact on macroinvertebrate standing crops in the Pine Creek basin.

The results to date suggest that seeding is directly boosting algal production and in turn scraper densities at stations receiving direct seeding. Enrichment also appears to be secondarily boosting collector-gatherer densities at all enriched stations, with impacts magnified in the lower Pine Creek mainstem.

2009/2010 Aquatic Fund Proposal Presentation, Lower Columbia Fish Enhancement Group - Gardner Johnston, Interfluve

- **North Fork Lewis River RM 13.5 Habitat Enhancements (Attachment B)**

Gardner Johnston (Interfluve) presented a PowerPoint which provided project objectives and a variety of photos illustrating the project location of backwater channel creation to restore fish passage to a small tributary and an off-channel area.

Johnston provided a detailed project scope and budget that includes the design funding that has been provided by SRFB. The large woody debris materials have already been obtained and stockpiled at the site, permitting is already underway and construction costs are at least 90% of budget. Funding request is $212,720.

2009/2010 Aquatic Fund Proposal Presentation, Cowlitz Indian Tribe – Rudy Salakory and Gardner Johnston, Interfluve

- **Eagle Island Habitat Enhancement, Site A (Attachment C)**

Gardner Johnston (Interfluve) presented a PowerPoint which provided an overview of the project to include the participants of the technical oversight group and consultant team, the existing conditions, the project objectives to include but not limited to:
Promote channel complexity and habitat-forming processes, increase large woody debris quantities and restore a native streambank, riparian wetland and floodplain vegetation community. Johnston also informed the ACC that site investigations were conducted to include all project opportunities, which was later refined to one particular site (Site A) of which 90% design is complete. Johnston provided illustrations of a typical bar apex log jam and typical lateral scour pool jam. Funding request is $74,300*

*If SERF Board (SRFB) does not grant the additional needed funding the ACC funds will be returned to PacifiCorp. SRFB makes decision in December 2010; however, project owners will have a good idea of probability by June/July 2010.

2009/2010 Aquatic Fund Proposal Presentation, U.S. Fish and Wildlife Service – Michael Hudson

- **Bull Trout Population Structure and Habitat Use in Tributaries to Swift Reservoir and the North Fork Lewis River (Attachment D)**

Michael Hudson (USFWS) presented a PowerPoint which outlined that a lack of clear direction exists relative to implementation of aquatic habitat enhancement projects that will benefit bull trout in the Lewis River basin

Hudson further stated that recent surveys have resulted in the capture of juvenile bull trout in upper basin tributaries such as Swift Creek, Drift Creek and Muddy River, and the distribution of bull trout and duration of use within these streams is poorly understood. The ACC could benefit from knowing how these tributaries are being used and if we are currently limiting the geographic scope of projects.

Hudson discussed that radio telemetry is commonly used to understand habitat use by bull trout and other species such as cutthroat trout, and that data collected from radio telemetry has also been used to provide guidance to future habitat restoration projects in other basins.

The goals of the study is to describe the bull trout population structure, distribution and temporal use of tributary habitats associated with Swift Reservoir and the North Fork Lewis to provide direction in future habitat improvement projects. Hudson expressed that the project will include the capture of juvenile and adult bull trout using electrofishing and nets from Swift, Drift, Range and Marble creeks, surgically implanting radio tags in up to 40 fish with transmitters that have at least a one year life span, and setting up remote monitoring equipment. Funding request is $59,500.

Olson informed the ACC participants that the Utilities will evaluate each project and email the ACC its recommendations. **The next ACC meeting on Wednesday, March 11, 2010 will be an aquatic fund project discussion meeting.**

Bob Rose departed

<Working Lunch 12:15pm>
<Reconvene 12:30pm>

Low Impact Hydropower Institute Presentation (LIHI) – Frank Shrier

Shrier presented a PowerPoint presentation (**Attachment E**) to provide the ACC more detail regarding PacifiCorp's submittal of a LIHI certification application for its hydropower facilities. Shrier communicated that a LIHI certification provides market incentive to reduce impacts of hydro generation and it provides credible and accepted standard for consumers to use in evaluating hydropower. Shrier further described what LIHI is, its program focus and its certification criteria areas such as river flows, water quality, fish passage and protection, watershed protection, threatened and endangered species protection, cultural resources, recreation use and access and a hydro facility not recommended for removal.

Shrier identified and provided photos of similar hydro facilities who have received LIHI certifications. These include projects such as Tieton dam, Lake Chelan dam, Pelton-Roundbutte and Nisqually Project. And lastly Shrier addressed why PacifiCorp wants a LIHI certification, how PacifiCorp benefits from a LIHI certification and how its Washington facilities can qualify.

Response to Flow Reductions or Interruptions (6.1.6 c) Discussion

Erik Lesko (PacifiCorp) informed the ACC attendees that plans will be distributed to the ACC in the month of February for their review in accordance with SA 6.1.6 (c) below:

> *c. On or before the date that the Licensees begin delivering flows from the Upper Release Point under this Section 6.1, the Licensees shall prepare and deliver to the Services, WDFW, and the ACC plans for expeditious installation and operation of temporary replacement facilities for delivery of flows from the Canal Drain and Upper Release Point, respectively, to avoid or minimize reductions or interruptions in flow to the extent practicable under the circumstances described in paragraphs* (a) and (b) above.

Study Updates

Shrier and Lesko provided the following study updates:

Swift Upper Release – PacifiCorp is waiting for receipt of a vacuum valve prior to complete the project and release flows; PacifiCorp is reluctant to begin flows because a vacuum could develop in the water supply line that would halt flows. This could cause unnecessary fluctuations in Upper Release Flows. Chris Maynard-WDOE expressed interest in speaking with the ACC in more detail about waiting for the pump vs. shutting off flow and conducting fish salvage for install. He asked whether or not there were any

objections to waiting for delivery and installation of the vacuum pump. There was not any objection voiced so the group agreed to have PacifiCorp follow these steps:

1) Make every attempt to obtain and install a vacuum pump before March 31st;
2) If the pump is not available by March 31st, then start the Upper Release Flow and install the vacuum pump when it becomes available. This is recognizing that fish salvage may be needed if the flows need to be completely shut down for valve installation. There also needs to be a plan in place to provide at least a minimum flow in the Upper Bypass while the valve is being installed.

Hatchery Upgrades –

Lewis River Hatchery Ponds 13 & 14 – Bidders meeting took place last week; construction start date is March 15, 2010 for Pond 14 and one month later for Pond 13.

Speelyai Burrows Pond (2nd Bank) – Construction to be complete Summer 2010.

Swift Net Pens – Waiting for final designs; ACC comment period ended on February 5, 2010.

Hatchery & Supplementation Plan Subgroup – Working on the Wild Winter Steelhead 2010 Plan; next Subgroup meeting will take place on February 25, 2010 at the Cowlitz Tribe office in Longview, WA. The 2009 H&S Annual Report will be distributed to the ACC in February for its 60-day review and comment period.

Release Pond Design – Property owner has verbally agreed to the location of the release pond and to an Easement agreement with PacifiCorp.

Acclimation Pond Plan – PacifiCorp is moving forward with the pre-planning for NEPA; putting together a survey scope for spring 2010; PacifiCorp intends to submit a Plan to the ACC in March 2010 for their review.

Monitoring and Evaluation Plan Subgroup – Meeting on February 12, 2010 and will be submitting an M&E Plan timeline to the ACC around March 1, 2010 for an additional 30-day review. The final document will be submitted to the FERC within 90 days of the ACC review, but no later than June 26, 2010.

New Topics

In response to a question from LouEllyn Jones (USFWS) Eli Asher (LCFEG) communicated that a Tier 1 rating in the context of an aquatic fund habitat enhancement project is linked to recovery plan priority for each population and each watershed in decreasing order of priority.

A tier 1 must have at least one primary species; tier 2 must have a medium priority species, so it has a lower priority than Tier 1 but does provide some benefit to recovery.

Agenda items for March 11, 2010

- Review February 11, 2010 Meeting Notes
- Aquatic Project Proposal Discussion Meeting
- Response to Flow Reductions or Interruptions - 6.1.6 (c)
- Swift Upper Release Flow Discussion
- Study/Work Product Updates

Public Comment
None

Next Scheduled Meetings

March 11, 2010	April 8, 2010
Merwin Hydro Control Center	Merwin Hydro Control Center
Ariel, WA	Ariel, WA
9:00am – 3:00pm	9:00am – 3:00pm

Meeting Adjourned at 2:00 p.m.

Handouts

- Final Agenda
- Draft ACC Meeting Notes 1/14/2010

2009/1010 Aquatic Fund Proposals

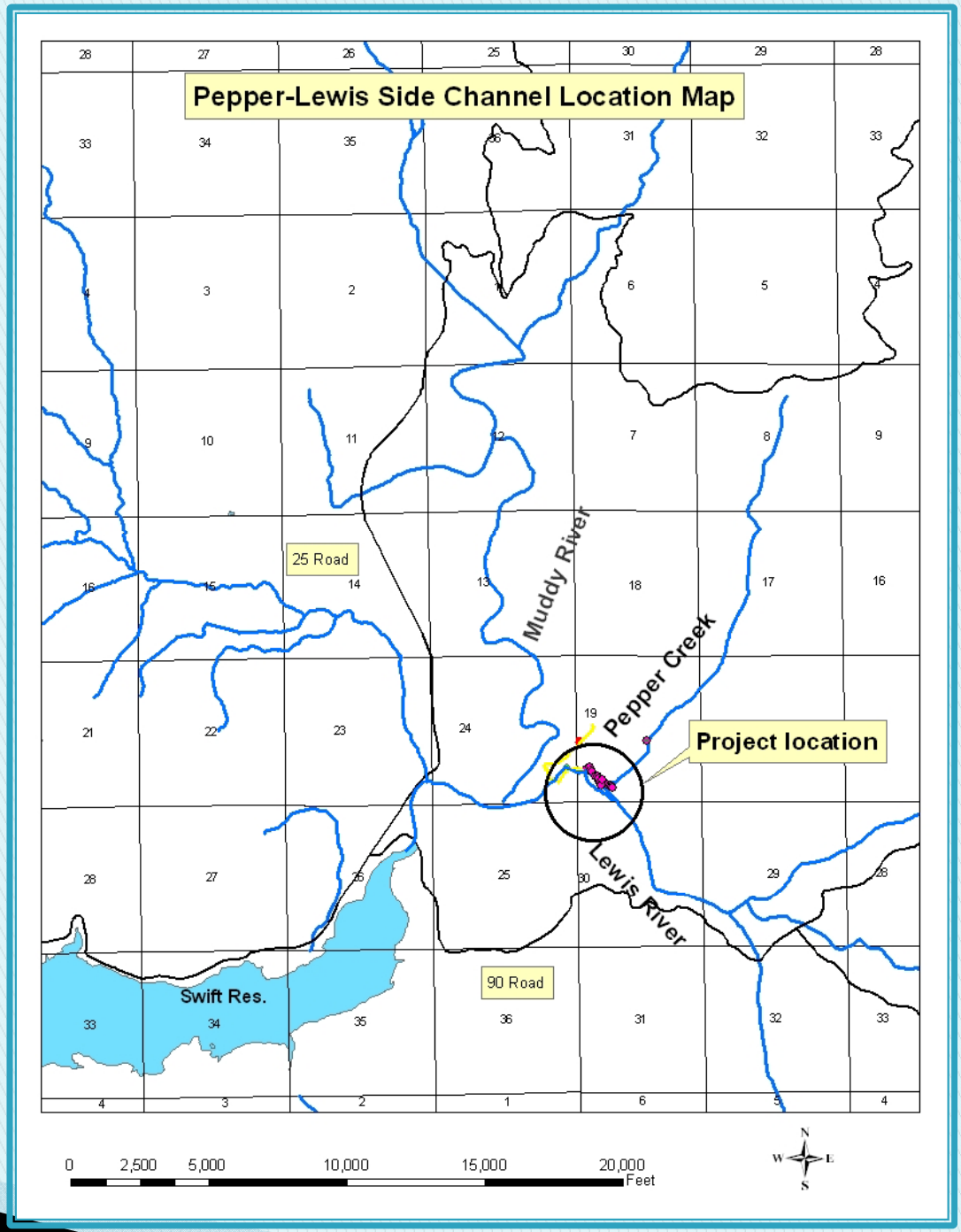
- **Attachment A** - Lewis Side-Chanel Instream Habitat Restoration PowerPoint
- **Attachment A** - Pine Creek Instream and Floodplain Structures for bull Trout and Steelhead PowerPoint
- **Attachment A** - 2010 Nutrient Enhancement on Pine Creek
- **Attachment A-1 -** Effect of Salmon Carcass Seeding for Nutrient Enrichment on the Macroinvertebrate Community of Pine Creek, Mount St. Helens National Volcanic Monument, Washington, February 2009
- **Attachment B –** North Fork Lewis River RM 13.5 Habitat Enhancements PowerPoint
- **Attachment C –** Eagle Island Habitat Enhancement, Site A PowerPoint
- **Attachment D –** Bull Trout Population Structure and Habitat Use in Tributaries to Swift Reservoir and the North Fork Lewis River PowerPoint
- **Attachment E –** Low Impact Hydropower Institute Certification PowerPoint

2010 US Forest Service Aquatic Fund Proposals

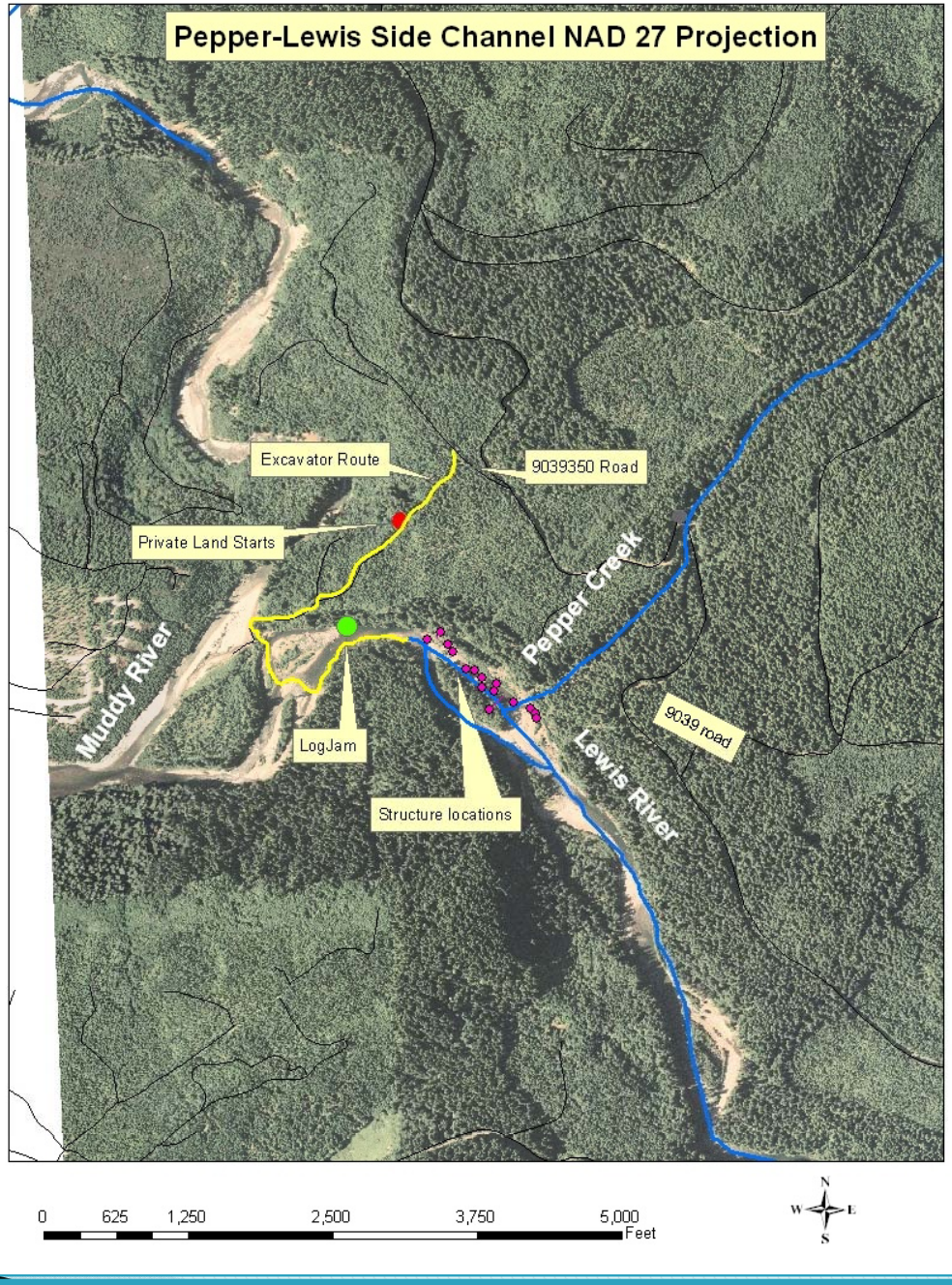
Pepper-Lewis Side Channel
Pine Creek Instream Structures
Pine Creek Nutrients

Pepper Lewis Side Channel

Project Location



Project Location



Project Description

- Restore a side channel with Large Woody Material
- Target Species-Coho Salmon
- Project Length- 0.25 miles
- Approximately 14 structures composed of 161 pieces of LWM

Project Description Cont.

- Side channel is fed by both the mainstem Lewis River and Pepper Creek.
- Continuous water flow into the mainstem during all months because of Pepper Creek
- Separated from mainstem by a stable island
- Remove 10 creosote timbers from logjam in Lewis River on access route to side channel

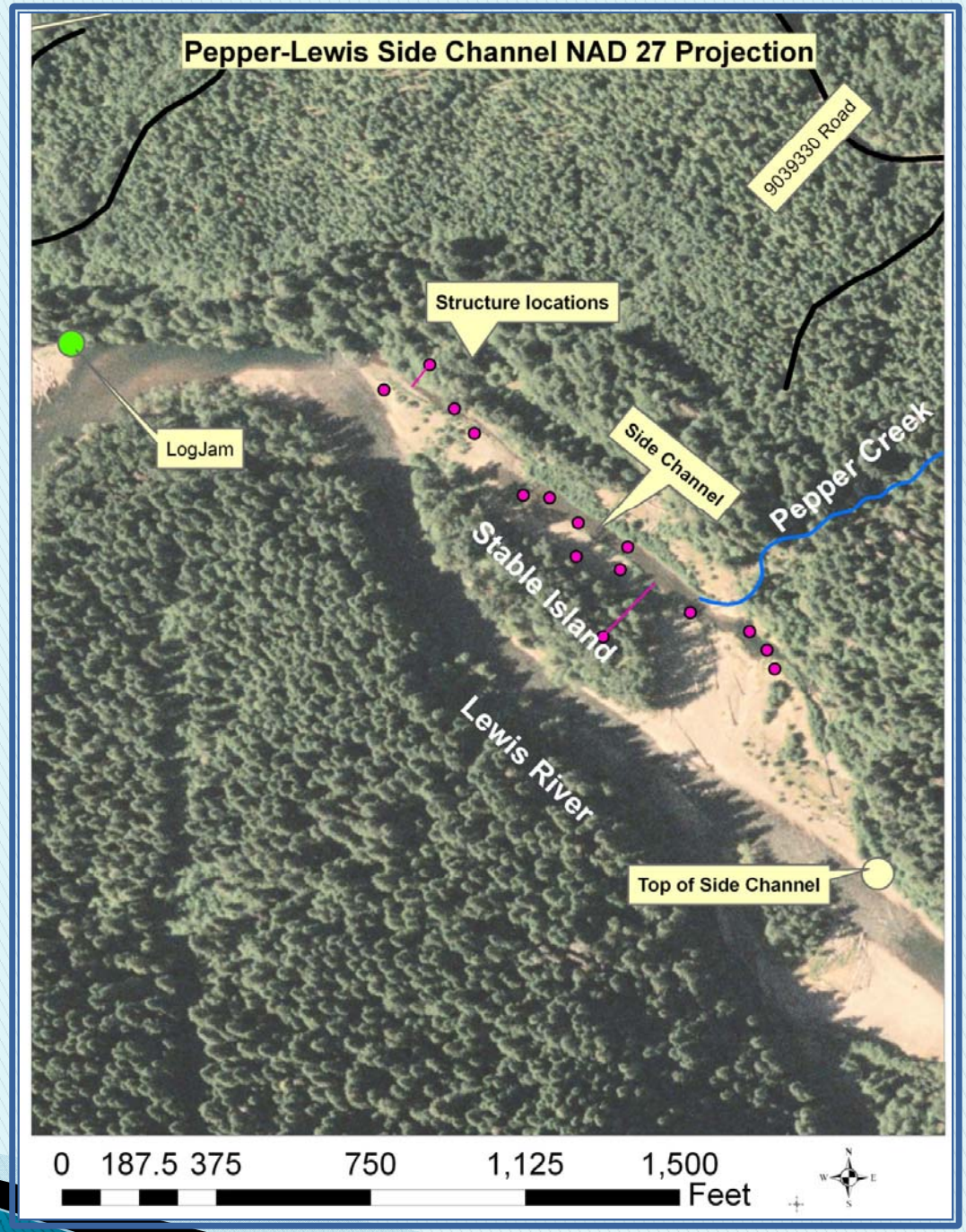
Restoration Plan Applicability

- Tier 1 Watershed- The Lower Columbia Salmon Recovery Plan
- 2nd highest preservation reach in Upper Lewis (EDT)
- Primary coho population site.

Methods

- Thin a timber harvest unit from Pepper Cat to get trees with rootwads.
- Truck trees as long as possible from unit to confluence of Muddy River and Lewis River via Forest Service and Private Roads.
- Transport trees up Lewis River to side channel using skidder and excavator.
- Bury some trees for key anchor points and put others on the bank to create LWM clusters
- Remove creosote timbers from logjam using excavator when equipment is leaving project site.

Side Channel



Typical section of side channel

Side Channel photo

Typical Structure

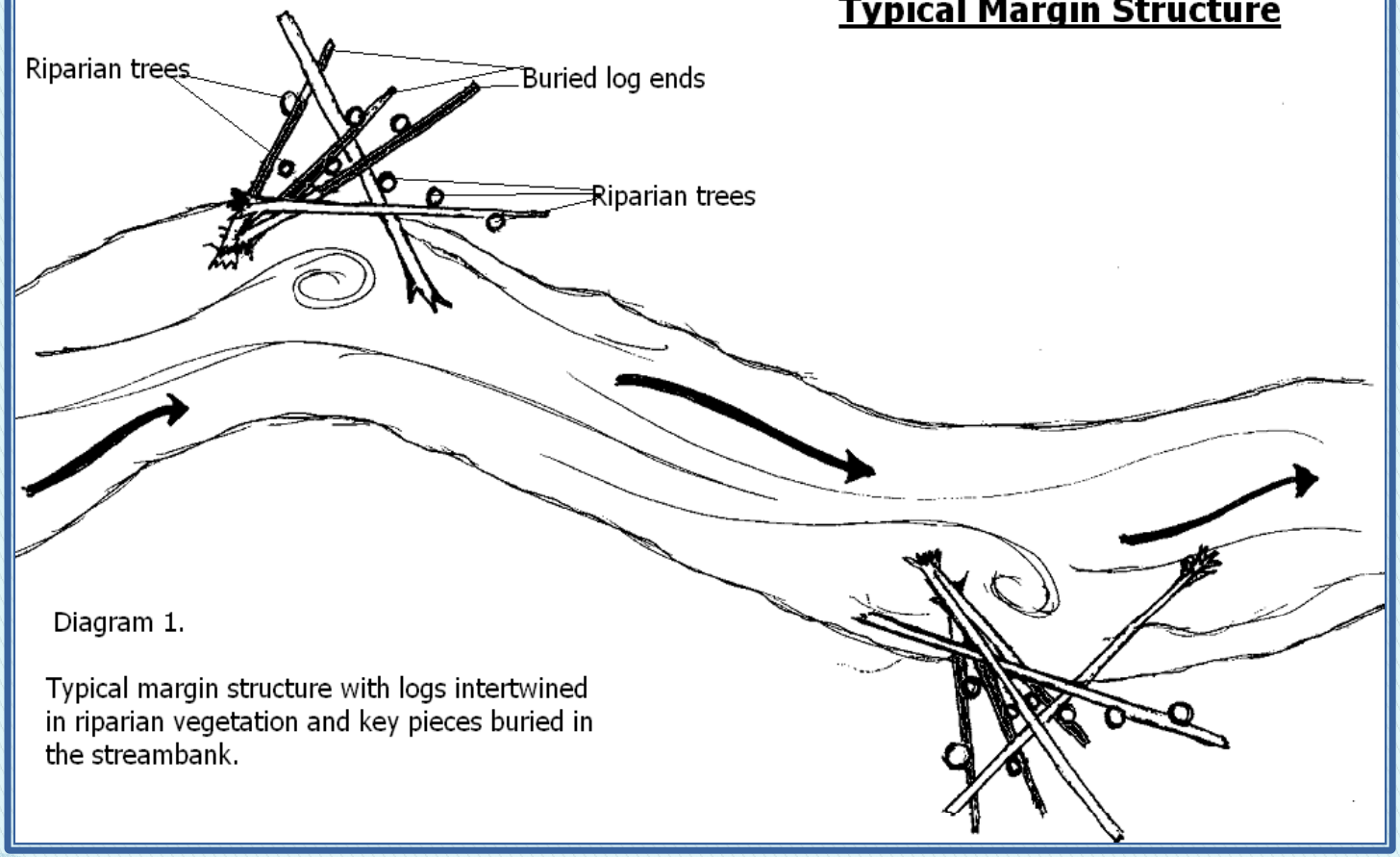


Diagram 1.

Typical margin structure with logs intertwined in riparian vegetation and key pieces buried in the streambank.

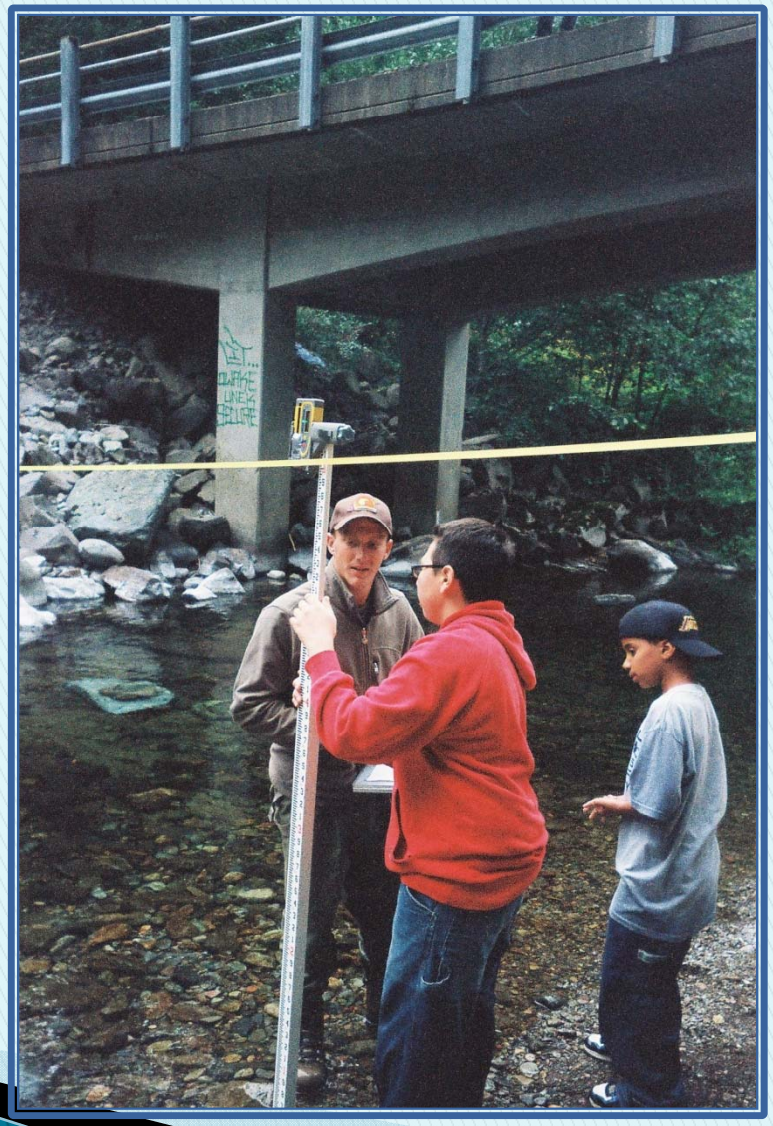
Proposed Budget

- Forest Service In-kind $43,100
  - Includes $16,100 for trees
  - $8,000 NEPA
  - Some design and administration
- ACC $41,300
  - $13,300 contract
  - $11,000 for logging and hauling of trees
  - $4,000 disposal of hazardous materials
  - Some contract administration design and monitoring
- Partners $4,400
  - MSHI $2,000 In-kind
  - Swift Comm. Action Team $800
  - Excavator Rental Services $800
  - Fish First $800
- TOTAL $88,800

Monitoring With MSHI Youth Stream Team

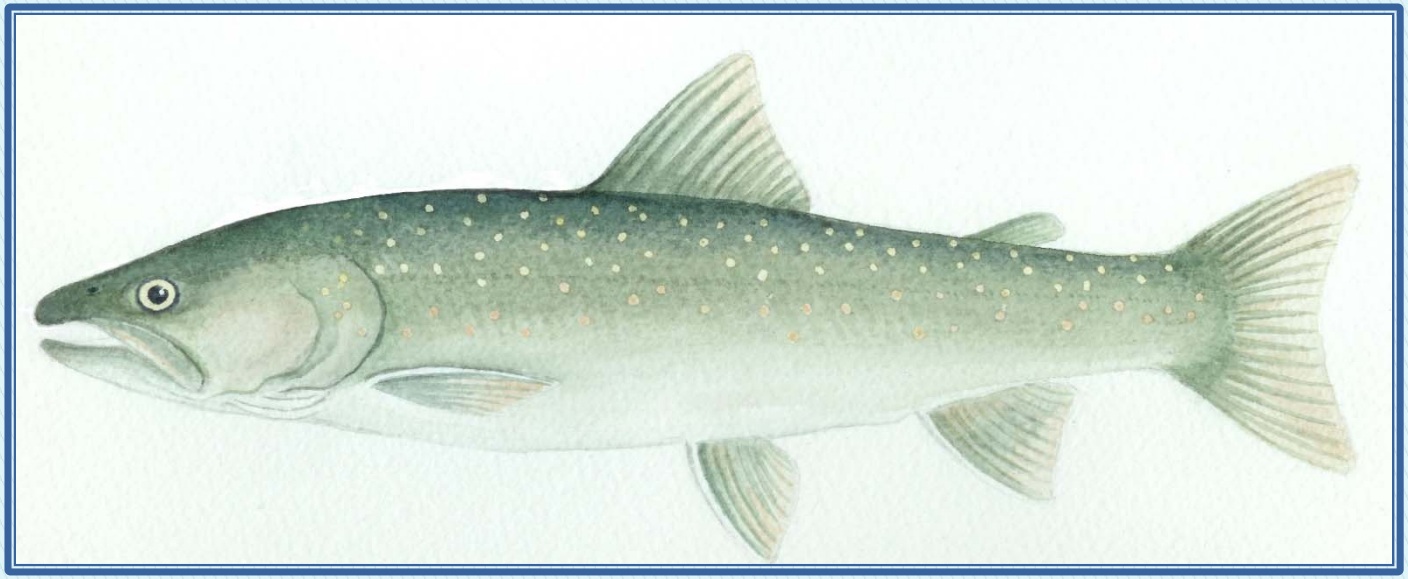
Laser Level for Cross Sections

Using the Survey Rod

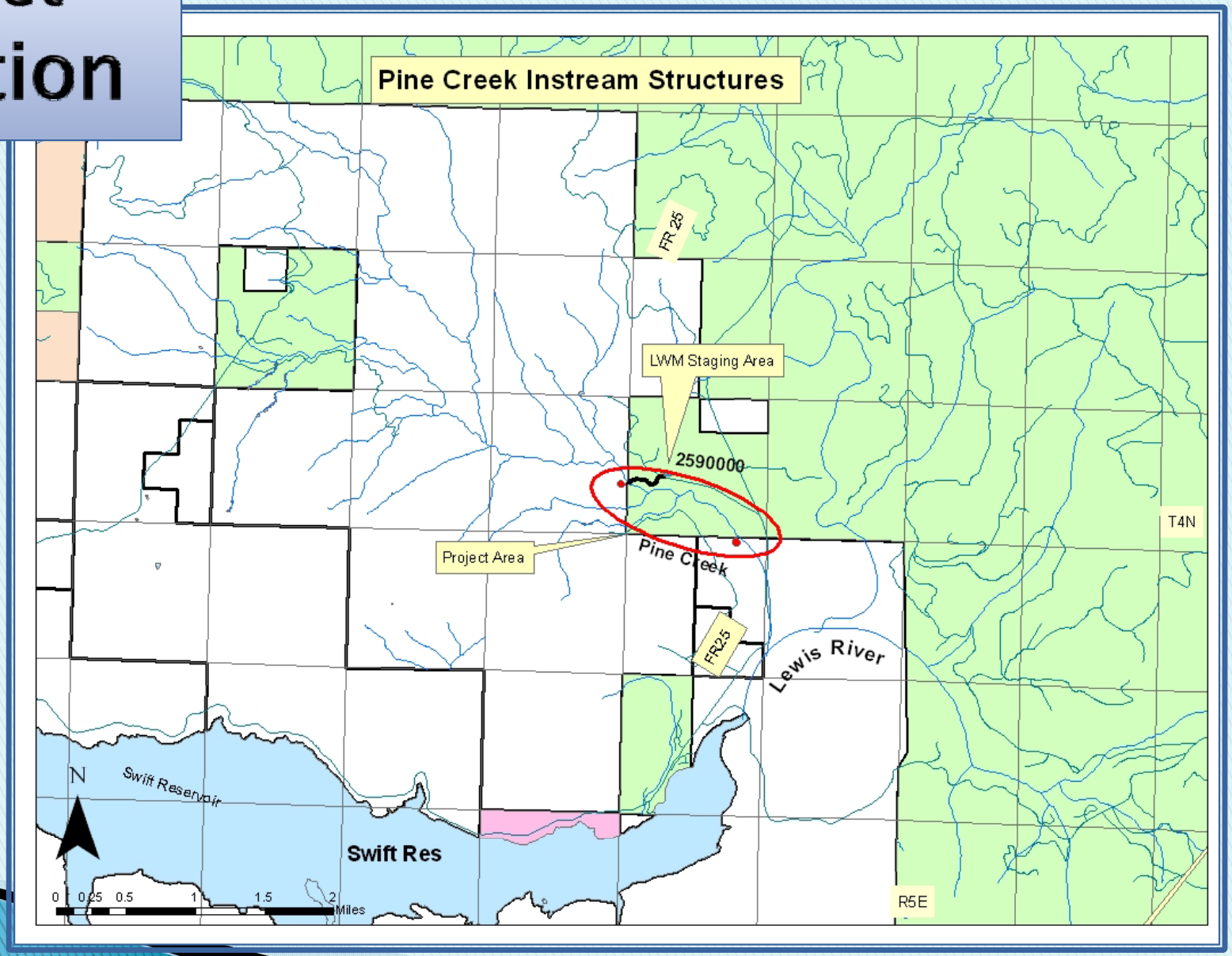


Collecting Macro-invertebrate Samples

Pine Creek Instream Structures



Project Location



Project Description

- Restore Forest Service section of Pine Creek with Large Woody Material. RM 0.9 – RM 1.9
- Project Length- 1.0 miles
- Target Species- Primary Bull Trout
  Secondary Steelhead
- Approximately 15 structures composed of 150-200 pieces of LWM

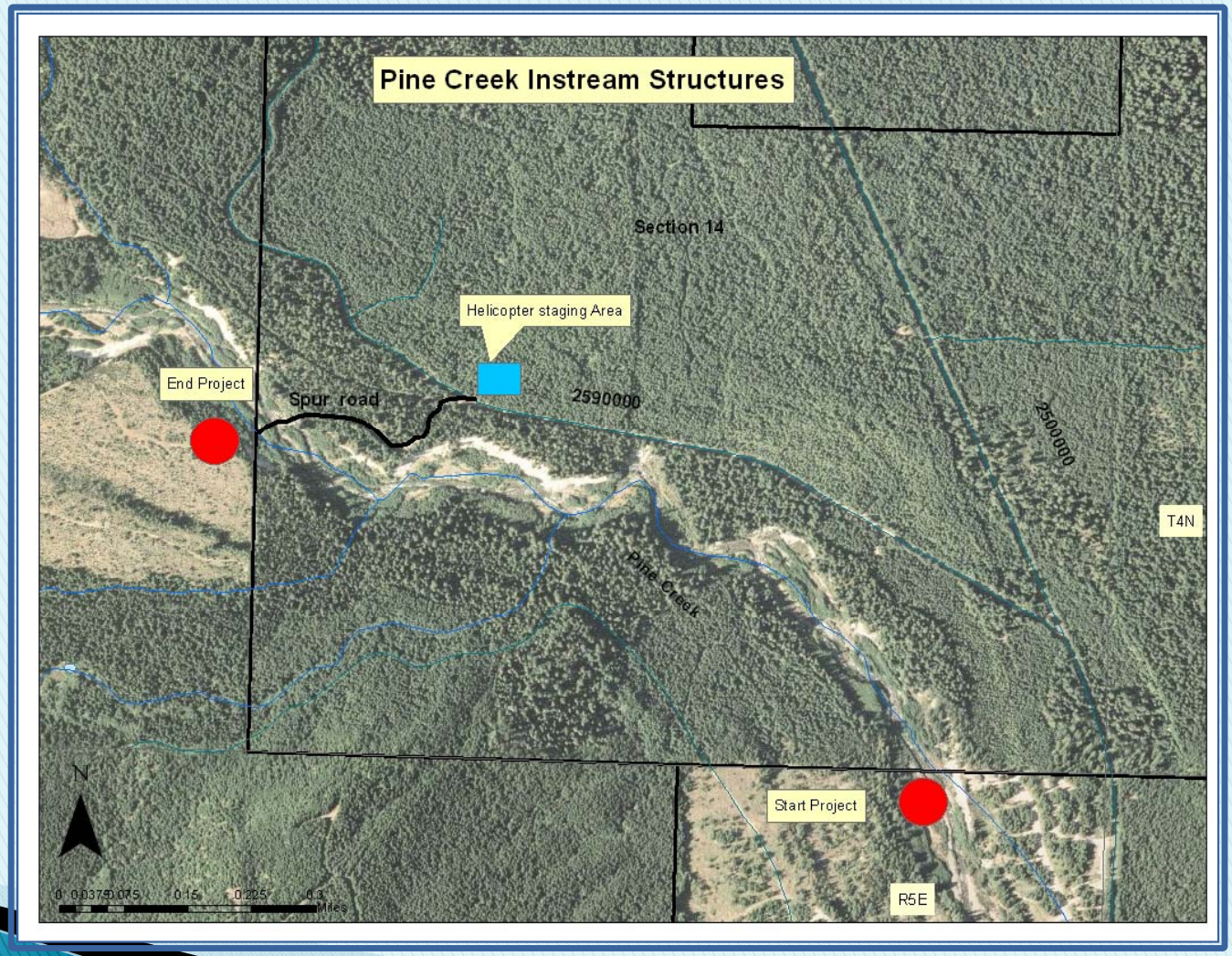
Restoration Plan Applicability

- Tier 2 Watershed–The Lower Columbia Salmon Recovery Plan
- 1 of 2 high use Bull Trout streams on GPNF
- “High Potential” reach for Steelhead Trout (EDT).

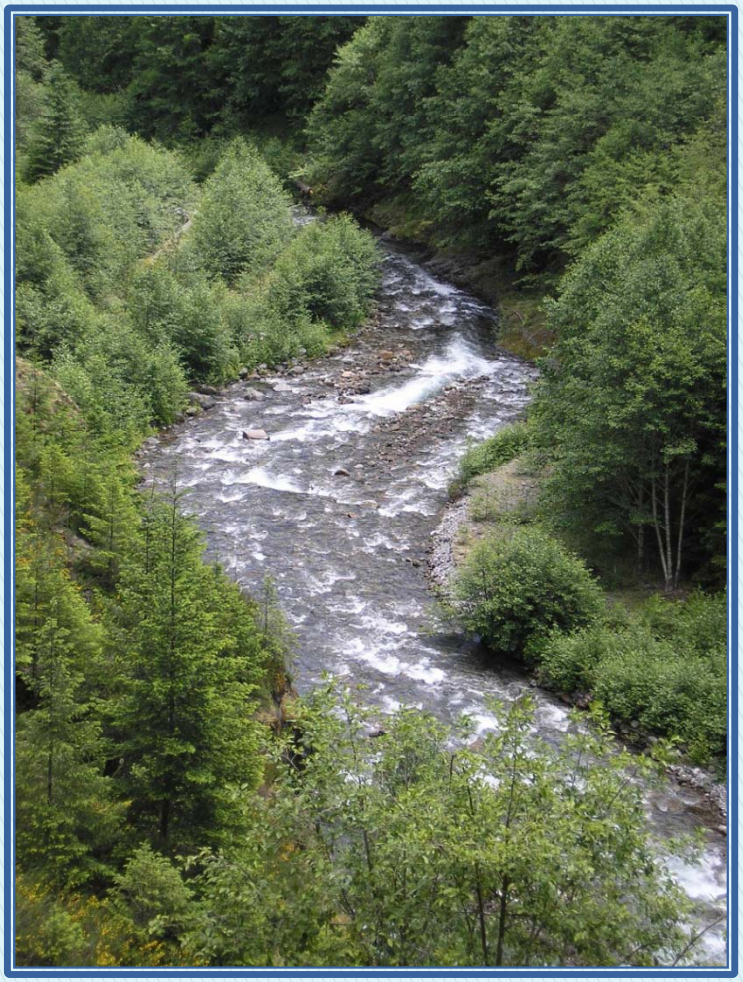
Methods

- Thin a timber harvest unit from Wild Cat to get trees, some with rootwads. May also acquire some trees from Pacificorp Reservoir Cleaning project.
- Truck trees as long as possible from unit to staging area off Forest Road 2590.
- Use helicopter to fly logs into a few strategic locations in Pine Creek to maximize helicopter efficiency and save money.
- Use an excavator and skidder to place trees in selected locations.
- Bury some trees for key anchor points and put others on the bank to create LWM clusters

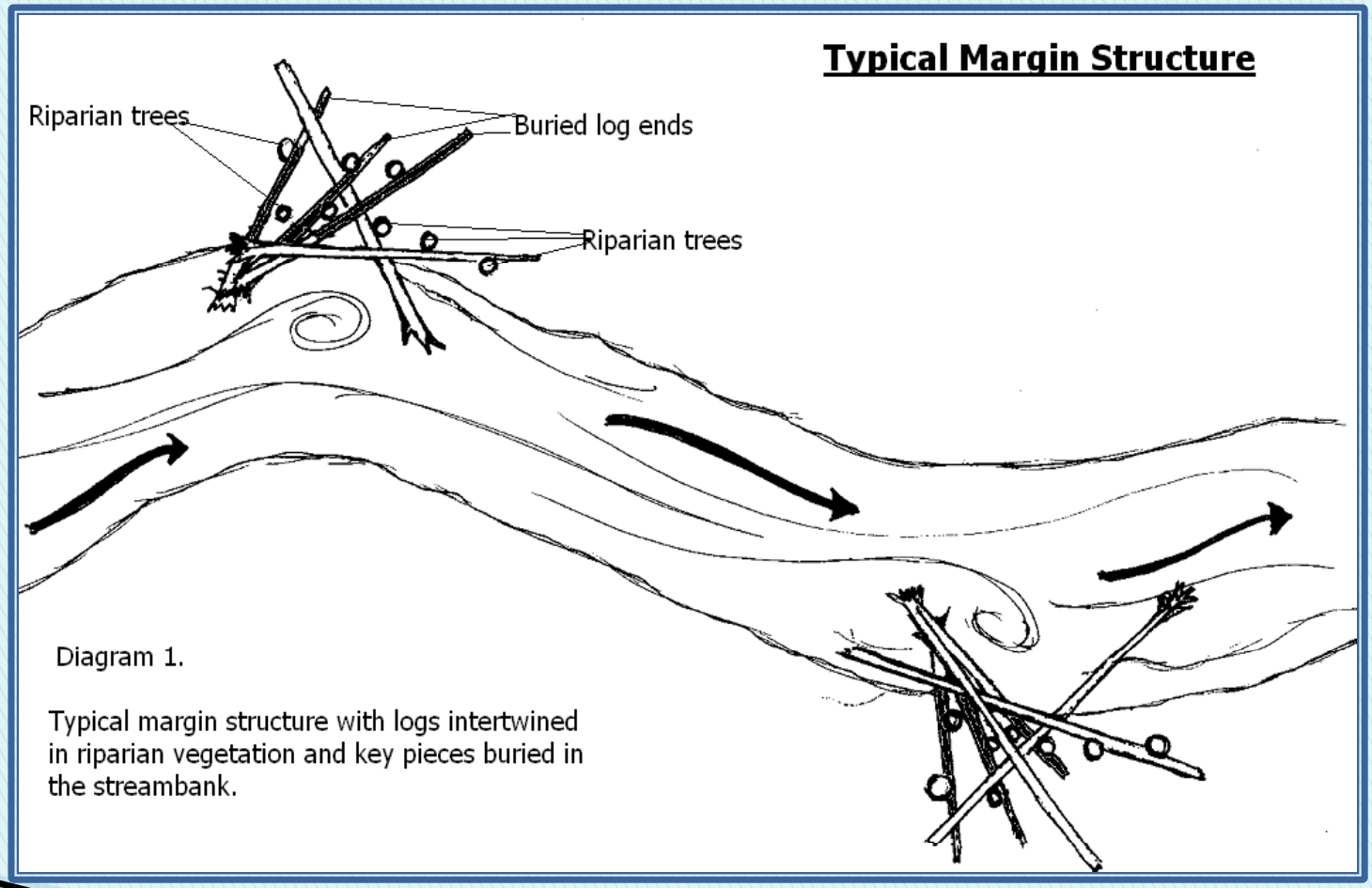
Pine Creek Project



Typical Picture of Restoration Reach



Typical Structure

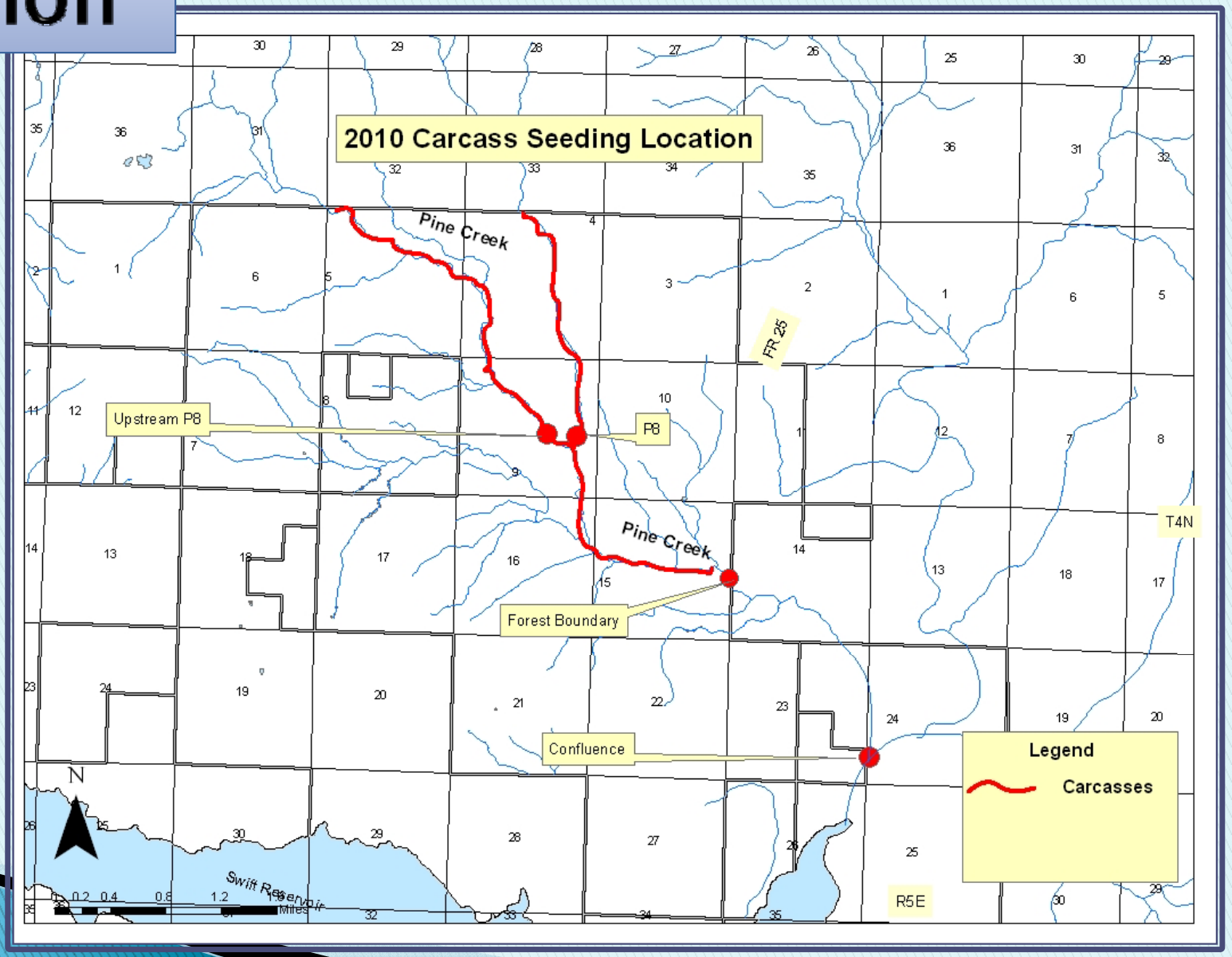


Proposed Budget

- Forest Service In-kind $41,000
  - Includes $20,000 for trees
  - $2,000 NEPA
  - Some design, administration and project mgmt.
- ACC $65,000
  - $12,000 excavator contract
  - $11,000 for logging and hauling of trees
  - $20,000 Helicopter
  - Some contract administration design and monitoring
- Partners $1,000
  - MSHI $1,000 In-kind
- TOTAL $107,000

Pine Creek Nutrient Enhancement

Project Location



Project Description

Because of the lahar flows of 1980, the 1996 floods, and the blockage of anadromous fish by Merwin Dam, Pine Creek is nutrient deficient.

This results in reduced primary and secondary production, creating poor fish habitat, and a poor food base.

This project will utilize coho salmon carcasses to add nutrients to Pine Creek. We plan to add up to 3,000 carcasses to the system over a six mile reach using mostly helicopter support to distribute fish because of poor access.

Access issues include snow and minimal roads near Pine Creek and P8

Pine Creek- 4 Miles

P8 -2miles

Restoration Plan Applicability

- Tier 2 Watershed –The Lower Columbia Salmon Recovery Plan
- 1 of 2 high use Bull Trout streams on GPNF
- “High Potential” reach for Steelhead Trout (EDT).

Methods

- Collect between 2,500 and 3,000 carcasses from Lewis River Hatchery.
- Carcasses were preferred over analogs for this project by ACC members for a variety of reasons including natural to stream, wildlife use and longevity.
- Truck carcasses to Swift Reservoir and use a helicopter to distribute carcasses in Pine Creek.
- In areas accessible by vehicle-Forest Boundary area- hand distribution will occur.
- Macroinvertebrate samples will be collected in October to monitor project effectiveness.

Transfer of fish from tote into helicopter bucket.

Helicopter taking off with 450 lbs of carcasses

The pilot can control the trap door on the bucket so that the carcasses can be spread out over a long stretch of the creek.

Benefits of the project include:

- Increased stream biota
- Increased food base for fish
- Increased riparian vegetation growth
- Adds to long-term source of large woody debris for Pine Creek

Proposed Budget

- Forest Service In-kind $14,000
  - Includes Design and Program Mgmt.
- ACC $30,776
  - Helicopter contract-$20,876
  - Forklift and Semi Trailer Rental-$2,400
  - Macroinvertebrate Analysis-$2,500
  - Program Mgmt.-$2,000
  - Monitoring -$2,000
- Partners $2,000
  - Clark Skamania FlyFishers-$1,000
  - ORM -$1,000
- TOTAL $46,776

Results From Prior Years Projects 2009- Photos

Carcass on stream margin

Carcass parts on margin

Bald Eagle in tree

Four Bald Eagles enjoying the feast

Effect of Salmon Carcass Seeding for Nutrient Enrichment on the Macroinvertebrate Community of Pine Creek, Mount St. Helens National Volcanic Monument, Washington

Progress Report February 2009

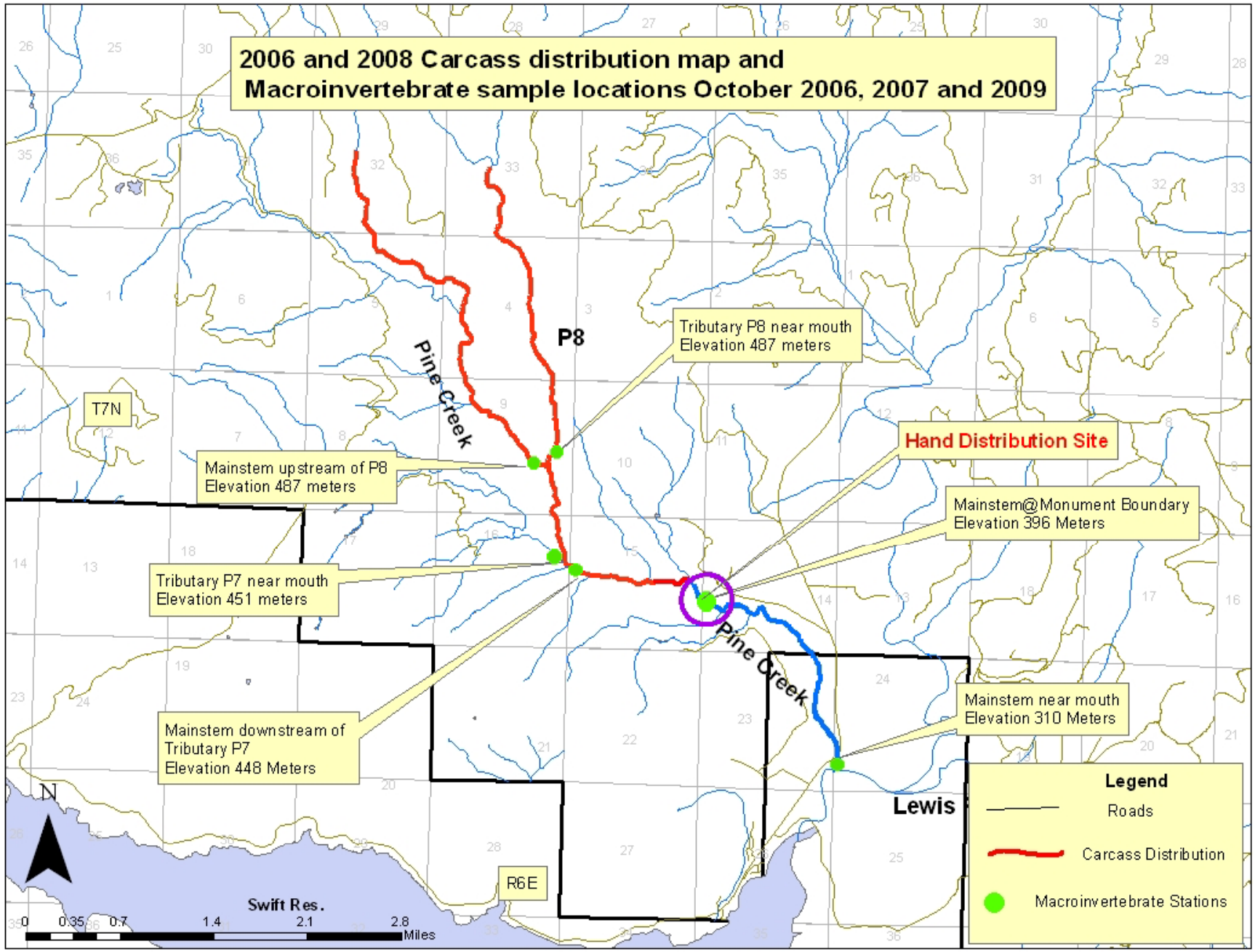
Robert W. Wisseman, Aquatic Biology Associates, Inc. Corvallis, Oregon

Adam I. Haspiel, Mount St. Helens National Volcanic Monument

Report Focus

Preliminary observations on standing crops of benthic invertebrates and how densities may be affected by salmon carcass nutrient enrichment .

Several more years of monitoring are planned to track trends.

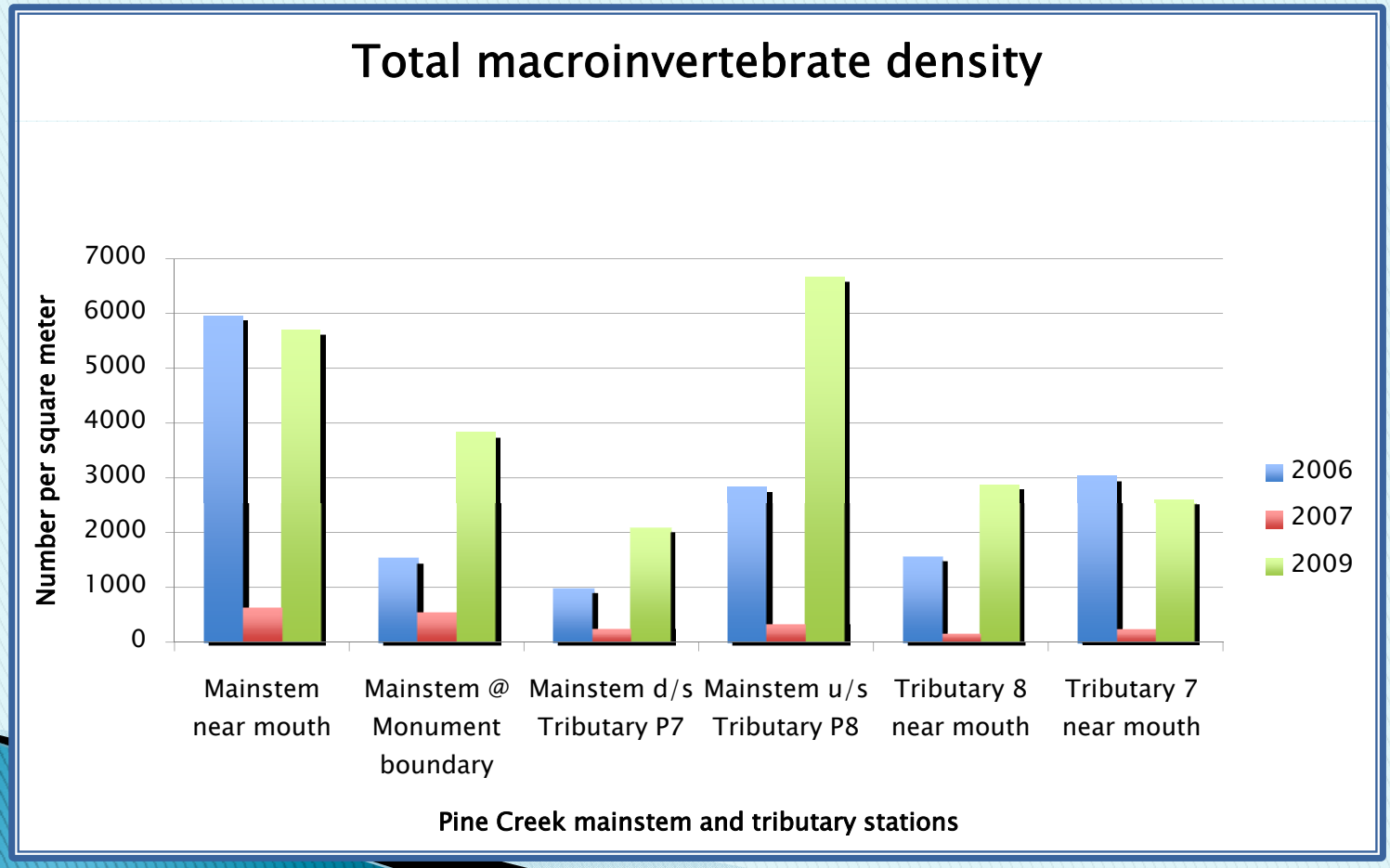

2006 and 2008 Carcass distribution map and
Macroinvertebrate sample locations October 2006, 2007 and 2009
P8
Pine Creek
Tributary P8 near mouth
Elevation 487 meters
T7N
Hand Distribution Site
Mainstem upstream of P8
Elevation 487 meters
Mainstem@Monument Boundary
Elevation 396 Meters
Tributary P7 near mouth
Elevation 451 meters
Pine Creek
Mainstem near mouth
Elevation 310 Meters
Mainstem downstream of
Tributary P7
Elevation 448 Meters
Lewis
N
Swift Res.
R6E
0 0.35 0.7 1.4 2.1 2.8
Miles
Legend
Roads
Carcass Distribution
Macroinvertebrate Stations

Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

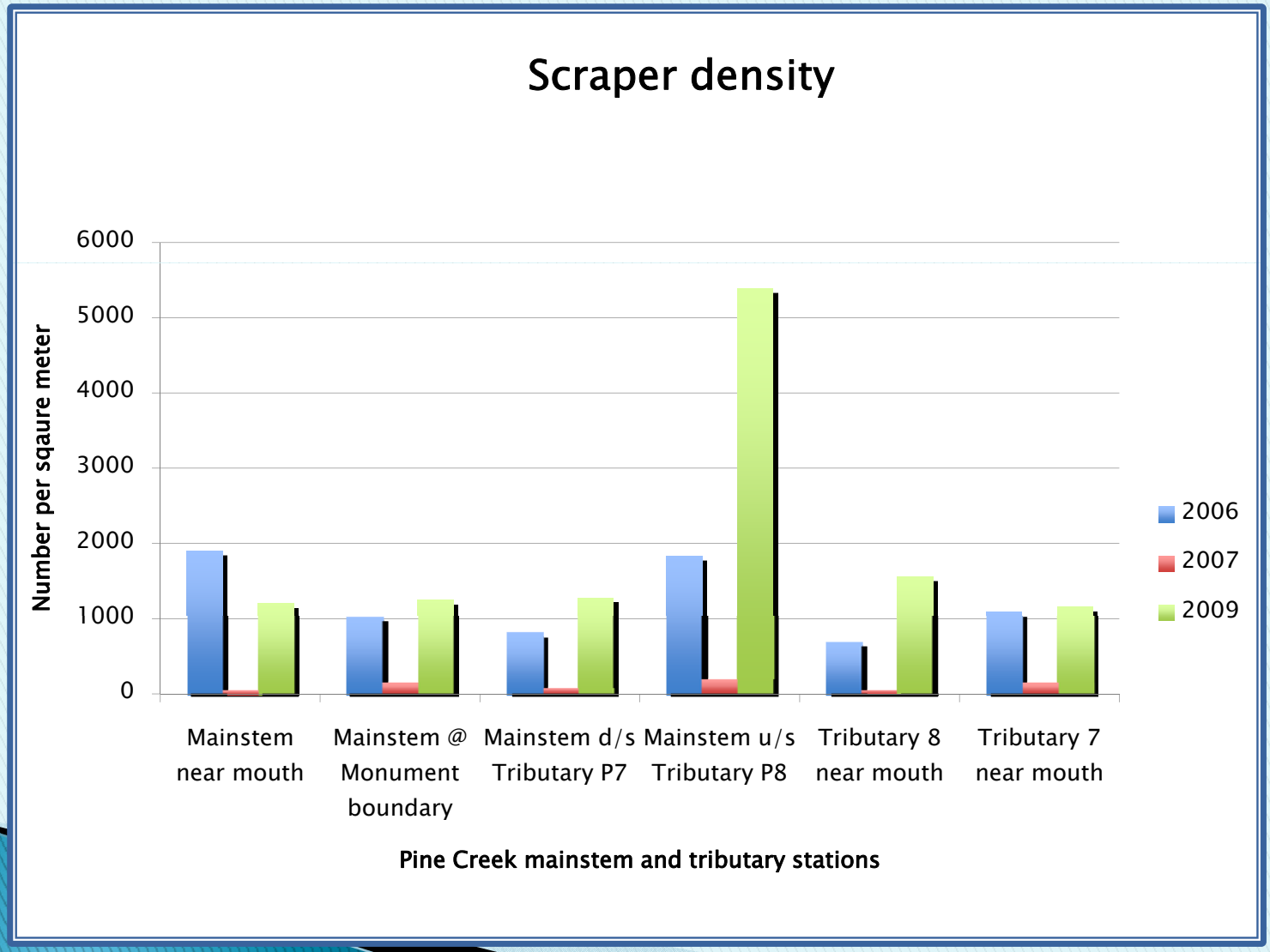
Table/Figure 1

Total invertebrate density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	5961	620	5705	Carcass enriched
Mainstem @ Monument boundary	1528	533	3833	Carcass enriched
Mainstem d/s Tributary P7	970	225	2076	Carcass enriched
Mainstem u/s Tributary P8	2841	328	6660	Carcass enriched
Tributary 8 near mouth	1566	162	2878	Carcass enriched
Tributary 7 near mouth	3034	236	2604	Control, not enriched

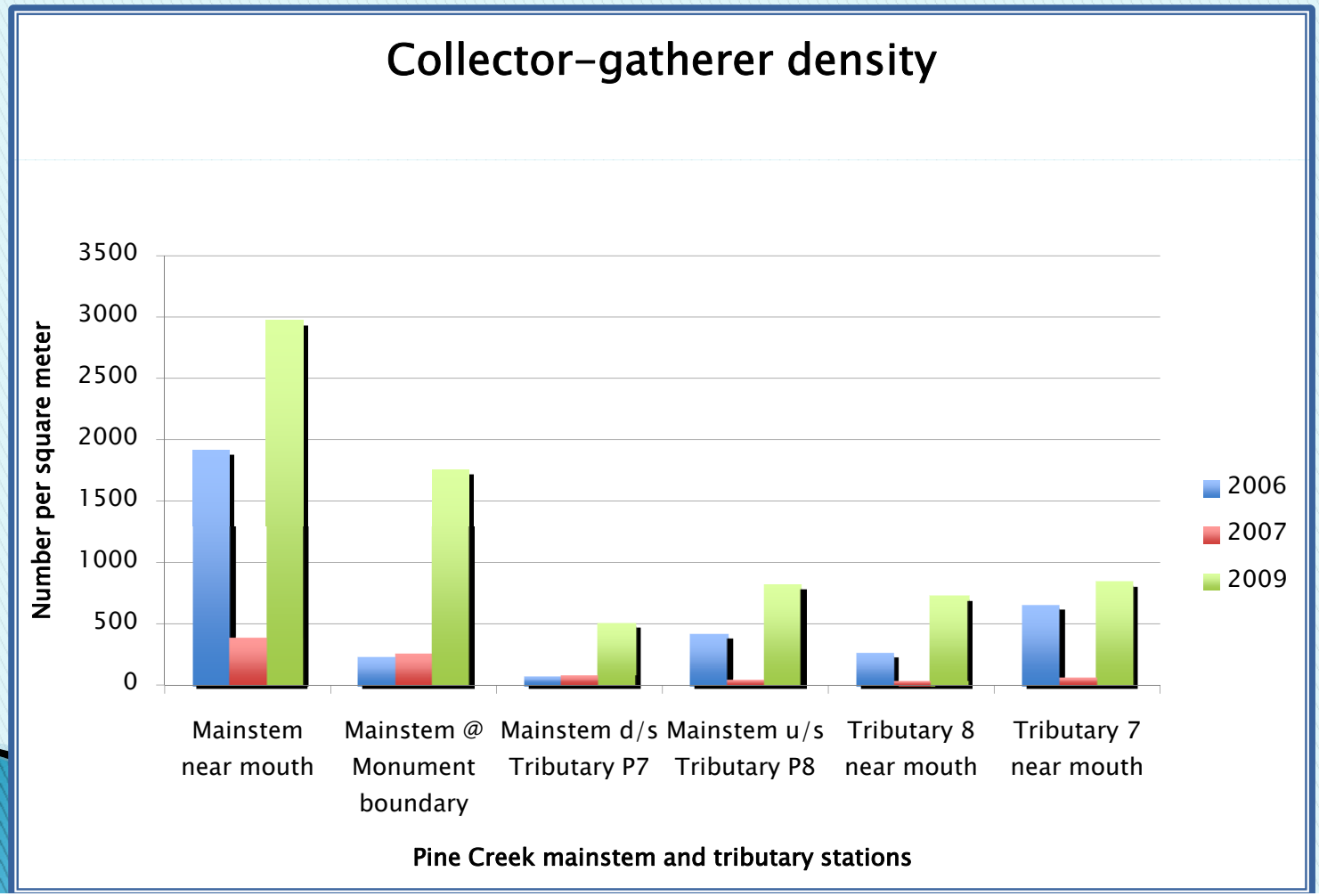


Algal scraper densities appear to have been enhanced by carcass enrichment and also perhaps from channel widening and opening effects of the November 2006 flood, which let more sunlight into the stream. P7, P8 and Pine Creek upstream of P8 did not widen during the flood

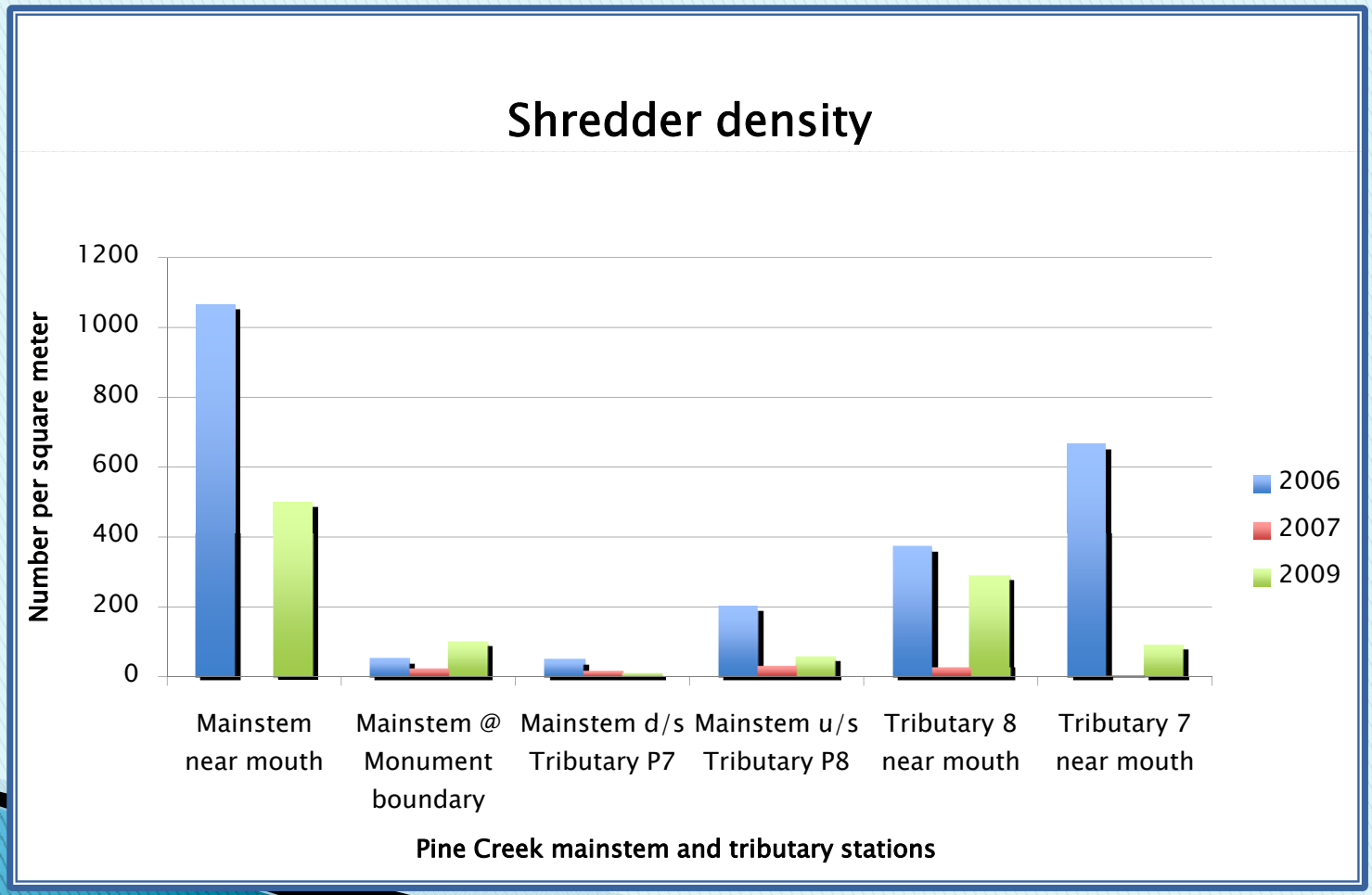


All Pine Creek stations had higher densities of collector-gatherers in 2009 than were found in both 2006 and 2007 (Table/Figure 11). Densities at the Tributary P7 control station increased by only 129% from 2006 to 2009, while the remaining enriched stations saw increases ranging from 155 to 794%. Collector-gatherer taxa exhibiting the most increase were segmented worms (Oligochaeta), midges (Chironomidae), and *Baetis* mayflies.

Increased algal production eventually leads to an increase in fine particulate organic matter, as algae dies and decays or is consumed and excreted by invertebrates. Greatest densities of collector-gatherers were seen in 2009 at the two lowest stations on the mainstem of Pine Creek. This pattern would be consistent with greater algal production occurring in upstream reaches (by some combination of enrichment and channel opening), followed by deposition of more fine particulate matter in the lower mainstem reaches, as the byproduct of this increased production was flushed downstream.



Shredder densities were at zero or nearly so at all stations in October 2007, following the November 2006 flood. The impact of this flood on the shredder community was catastrophic. Only the **Mainstem @ Monument** boundary station displayed a small increase in shredder densities by October 2009 over 2006. Shedder populations in Pine Creek appear to be still recovering from the 2006 flood nearly three years after this event occurred. No response to nutrient enrichment from salmon carcasses is evident. Enhancement of shredders through nutrient addition would follow an indirect pathway if any. Microbial communities on decaying organic matter that are responsible for much of the nutritive value to invertebrates, may be enhanced by an increased availability of soluble nutrients.



RESULTS

Results to date suggest that seeding is directly boosting algal production and in turn scraper densities at stations receiving direct seeding. Enrichment also appears to be secondarily boosting collector-gatherer densities at all enriched stations, with impacts magnified in the lower Pine Creek mainstem.

Effect of Salmon Carcass Seeding for Nutrient Enrichment on the Macroinvertebrate Community of Pine Creek, Mount St. Helens National Volcanic Monument, Washington

Progress Report February 2009

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Summary

Dams constructed on the Lewis River in the southern Washington Cascades have provided a barrier to anadromous salmon and steelhead trout migration for 80 years. Pine Creek in the upper Lewis River watershed above dams was historically an important spawning habitat for salmonids. As a result of dam relicensing agreements, anadromous salmonids populations are to be returned to the Pine Creek basin starting in 2012. Pine Creek is a cold, oligotrophic stream system with only moderate benthic invertebrate standing crops, and an important food source for juvenile anadromous and resident salmonids.

In anticipation of the 2012 reintroduction of runs, a project has been initiated to distribute salmon carcasses along the stream channel to boost nutrients and hopefully benthic invertebrate production. Carcass seeding has occurred in December 2006, 2008 and 2009, with several more years of seeding planned. Due to poor returns in 2007, carcasses were not available from the participating hatchery. Benthic invertebrate standing crops were assessed in October 2006 (baseline before carcass enrichment), October 2007 (1 year of enrichment) and October 2009 (2 years of enrichment), at four Pine Creek mainstem and one tributary station receiving enrichment, and one control tributary station that was not seeded with carcasses.

During the course of this project the Pine Creek basin experienced a major flood in November 2006 that caused extreme bedload movement throughout the basin and destruction of riparian vegetation along sections of the mainstem, but not at the tributary stations. Consequently, nutrient enrichment following the flood at mainstem stations may be coming from two sources, carcass seeding, and also from increased algal production due to the more open nature of the stream channel. Preliminary observations on standing crops of benthic invertebrates and how densities may be affected by salmon carcass nutrient enrichment are presented here. Several more years of monitoring are planned to track trends.

- The November 2006 flood caused a catastrophic decline of 65-92% in benthic macroinvertebrate densities at the six Pine Creek stations, as measured 11 months later in October 2007.

- By October 2009, nearly three years after the flood and after two years of carcass seeding, total macroinvertebrate densities had increased by about an order of magnitude over those seen in October 2007.

- Comparing October 2009 (after two years of enrichment) total macroinvertebrate densities with the October 2006 (baseline, pre-enrichment), densities were: 1.8 to 2.5 higher at the 4 stations receiving direct carcass seeding, lower (96 %) at the mainstem station furthest downstream that did not receive direct seeding, and lower (86 %) at the tributary control station that was not seeded.

- Major changes in invertebrate groups between the 2006 baseline year and 2009, include: substantial increases in segmented worm (Oligochaeta) densities at all stations; substantial increases in *Oligophlebodes*, an algal scraper caddisfly at most stations directly seeded; overall increase in algal scrapers at stations directly seeded; and a substantial increase in collector-gatherer (consumers of fine particulate organic matter) at the two mainstem stations furthest downstream.

- Results to date suggest that seeding is directly boosting algal production and in turn scraper densities at stations receiving direct seeding. Enrichment also appears to be secondarily boosting collector-gatherer densities at all enriched stations, with impacts magnified in the lower Pine Creek mainstem.

Introduction

Salmon carcasses have successfully been used to boost nutrient enrichment in streams in the Pacific Northwest (Bilby et al. 1998, Chaloner and Wipfli 2002, Stockner 2003). When Merwin Dam was completed in 1931, it cut off salmon runs to the upper Lewis River Watershed, removing an important source of nutrients for the system. Beginning in 2006, carcasses were introduced into the Pine Creek sub-watershed of the Lewis River Watershed to build up the nutrient level, boosting food production for juvenile bull trout. Bull trout are listed as a threatened species under the Endangered Species Act.

Merwin Dam was constructed on the North Fork of the Lewis River approximately 14 miles upstream from Woodland, Washington in 1931 to produce hydroelectric power. It is a complete barrier to anadromous fish, effectively cutting off over 170 miles of stream to salmon and steelhead. Species affected include spring and fall chinook, coho, chum salmon, and steelhead trout. Pine Creek, which is upstream from Merwin Dam, is one of two prime bull trout streams on the Gifford Pinchot National Forest. Stream temperatures are cold year round with 7 day summer peak temperatures of about 14 degrees Celsius.

Even though the Dam blocked passage of anadromous fish, some fish were trucked upstream and released into the river for several years after completion. All fish species were greatly reduced by Merwin Dam, and eventually only coho and a few chinook salmon were transported around the Dam. This practice was stopped altogether around 1957.

More recently however, as part of a habitat preparation project for reintroduction of salmon into the upper North Fork Lewis River system, approximately 2,000 coho per year have been released into Swift Reservoir since 2005. A few of these fish must have spawned in Tributary P8, because a small amount of juvenile coho have been observed in this tributary by Washington Department of Fish and Wildlife crews during bull trout surveys. Further, as part of the relicensing effort, PacifiCorp, Inc. (owners of Merwin, Yale and Swift Dams) has agreed to reintroduce salmon and steelhead above the reservoirs in 2012. A new 50 year operating license was issued for all three reservoirs in 2008.

The Pine Creek system was heavily affected by the eruption of Mount St. Helens in 1980 when a lahar flow scoured the length of the stream channel, ripping out riparian vegetation and dramatically changing the substrate of the system. A 37-ton boulder was deposited on Forest Road 25, approximately 30 feet above the normal stream level during the eruption. Additionally, the subsequent floods of 1996 and 2006 removed much of the system's newly established riparian vegetation.

Tributary P8 was also affected by the lahar flow. It is the most important spawning stream in the Pine Creek Tributary.

Project and monitoring objectives:

Pine Creek is a cold, oligotrophic stream system historically supporting salmon runs that returned nutrients to the stream system. Absence of returning salmon for 80 years and the nutrients their carcasses provide, may have depressed benthic macroinvertebrate production in the basin. Will the artificial addition of salmon carcasses significantly boost macroinvertebrate production and in turn boost production of both resident salmonids and anadromous salmonid juveniles when they are returned to the basin?

Study Site

Pine Creek originates on Mount Saint Helens in the southern Washington Cascades and flows to the SE for 20 kilometers before joining the Lewis River just upstream of the Swift Creek Reservoir (Figure 1). Snow runoff probably feeds the headwater, but much of the year Pine Creek is dry for miles until a spring about ½ mile below Forest Road 83, brings Pine Creek to its full flow within a short distance. This pattern continues at least into December when carcasses are flown in to the creek.

In 2005 Pine Creek had a level II stream survey performed on the first 7.5 miles of it. It was broken into 3 reaches. The lowest mile of the first reach is being subdivided into vacation cabin lots. Red Alder (*Alnus rubra*) is the dominant vegetation type in this section. The next mile is Forest Service managed lands and has larger conifers in its riparian overstory. Upstream from this point red alder is the dominant riparian vegetation. Reach 1 was from the confluence to tributary P8, Reach 2 from tributaries P8 to P10 and Reach 3 from tributary P8 to the end of survey. The substrate is composed of cobble intermixed with small and large boulders. Gradients averaged three to five percent and stream riffle widths varied from 36 feet in the lower reaches to 17 feet in the upper reach. The pool riffle ratio averaged 5/95 with very little large woody material in the system. Discharge was un-measureable due to high velocity and steep gradients. Pine Creek had a seven day maximum average of 14.4 degrees Celsius in 2005. There are some terraces in the flood plain of Pine Creek but it mainly has long (500 or more feet) steep stream banks beyond the terraces composed of ash from previous Mount St. Helens eruptions.

Tributary P8 had a level II stream survey performed on the lower 2.67 miles in 2005, as well. Red alder dominates the understory riparian vegetation and small conifers dominate the overstory. Substrate was composed mainly of cobble and small boulders and the gradient averaged 3.5 percent. Pool Riffle ratio is 20/80 and discharge was measured at 23.5 CFS. P8 had a seven day maximum average of 15.4 degrees Celsius in 2005. There are some terraces in the confluence area of P8 but it mainly has long (500 or more feet) steep stream banks beyond the terraces composed of ash from previous Mount St. Helens eruptions. Finally, it is much less open to sunlight than Pine Creek with a mean riffle width of 15.4 feet.

Tributary P7 was our control reach and had no carcasses distributed in it. Approximately 2.9 miles were surveyed in 2005. Three reaches were identified; with the uppermost reach a small segment that was considerably different than the lower two reaches. The riparian area was composed of red alder and Douglas fir. Substrate was cobble and small boulders and the average gradient was 3.6 percent in reach one and 8.6 percent in reach two. The pool riffle rate averaged about 45/55 over the first two reaches. Mean riffle width was about 15 feet. The seven day maximum average for P7 was 13.0 degrees Celsius in 2005. Discharge was measured at 2.4 CFS.

This pilot study was conducted between 2006 and 2009. A major flood in November 2006 caused extensive flushing, bed-load movement and scouring of substrates. A flood recurrence interval this event represents is not known, however 15.2 inches of precipitation fell in the headwaters of Pine Creek in 24 hours, which set a Washington State record.

During the course of the study, the water years (as measured from October 1-September 30) were:

October 2005-September 2006: typical flows with no major flood events
October 2006-September 2007: catastrophic flood event in November 2006
October 2007-September 2008: typical flows with no major flood events
October 2008-September 2009: typical flows with no major flood events

Methods

Salmon carcasses were distributed throughout Pine Creek beginning December 2006. A helicopter with a specially modified fire fighting bucket distributed most of the carcasses, however approximately 800 pounds were distributed by hand at the Monument boundary in 2006 and 2008. The helicopter carried 450 pounds per bucketful and had a release mechanism that controlled how fast the carcasses were released. The bucket was attached to the helicopter with 100 feet of long-line to enable maneuverability around riparian trees. Approximately 8,500 pounds were distributed over 2.3 mile of Tributary P8, another 10,000 pounds were distributed on Pine Creek for 2.5 miles above the confluence of P8 and another 6,500 pounds were distributed between the Monument Boundary and the confluence of P8 (Figure1.) for a total of 25,000 pounds. In 2007, carcasses were not distributed due to poor fish runs that did not allow the hatchery to provide carcasses. Carcasses were again distributed in 2008 with approximately 8,000 pounds distributed over 2.3 miles of Tributary P8, another 8,000 pounds were distributed on Pine Creek for 2.5 miles above the confluence of P8 and another 5,000 pounds were distributed between the Monument Boundary and the confluence of P8 for a total of 21,000 pounds. Carcasses were again distributed in 2009 with approximately 6,000 pounds in P8, 5,000 pounds in Pine Creek upstream of P8 and another 3,500 pounds distributed in Pine Creek upstream of the Monument Boundary for a total of 14,500 pounds. Carcasses distributed in 2009 were not part of this analysis because macroinvertebrate samples will be collected in October 2010.

Macroinvertebrate were sampled at 6 stations on Pine Creek in mid-October of 2006, 2007 and 2009 (Figure 1). The October 2006 sampling represents baseline conditions prior to carcass dispersal following a typical water year but just prior to the November 2006 flood that heavily impacted macroinvertebrate communities throughout the basin. The October 2007 sampling was 11 months after this major flood and 10 months after the initial December 2006 salmon carcass distribution.

Four stations were located along the mainstem of Pine Creek beginning near the mouth (Figure 1). The station located at Pine Creek **Mainstem near mouth** did not receive any direct placement of carcasses, though it may receive nutrients washed down from carcass placement that began 3.2 kilometers upstream at the **Mainstem @ Monument boundary** station. The **Tributary P8 near mouth** station is at the base of a major tributary that received carcass additions all three years, while the **Tributary P7 near mouth** station is a control station at the base of a major tributary that did not receive any carcass additions.

Because of budget constraints, macroinvertebrate sampling was limited to a single sample at each station. Samples were acquired from with a D-frame net, 500 micron mesh from three different points in riffle habitat to form a single composite sample representing 8 square feet of stream bottom. At each of the three riffle points sampled, the net was anchored to the stream bottom and an area 30 cm wide and extending 80 cm upstream was sampled. Armor layer rocks were brushed of invertebrates allowing dislodged invertebrates to be washed into the net, and then tossed aside. Sediment beneath the armor layer was stirred with feet to a depth of 5 cm, again allowing invertebrates to be washed into the net.

Samples were scope sorted at 6-12X magnifications. A random portion of the sample containing a minimum of 500 organisms was sorted and identified. Standard taxonomic effort in the identification of macroinvertebrates followed U.S. EPA Environmental Monitoring and Assessment Program protocols (www.epa.gov/emap/). Results presented here are converted to a full sample and square meter basis.

Results and Discussion

The objective of this pilot study was to determine if salmon carcass enrichment would have a dramatic and perhaps a year after year cumulative impact on macroinvertebrate standing crops in the Pine Creek basin. Given the results to date, it is unfortunate that a more quantitative and replicated sampling protocol was not used, and that sampling in more baseline years prior to carcass enrichment was not conducted to determine pretreatment variability in macroinvertebrate standing crops.

Total macroinvertebrate densities

Table/Figure 1 lists and illustrates total macroinvertebrate densities found at the six Pine Creek stations over the three years sampled. In 2006, prior to enrichment, total densities varied from 5961 m^2 at the more open station near the mouth to between about 1000-3000 m^2 at the upstream stations and tributaries. Densities in this range are typical for oligotrophic, forested, montane streams in the maritime Northwest (Wisseman, unpublished data). Stream water is cold, with limited nutrients derived from volcanic rocks.

The November 2006 flood in the basin appears to have caused a major resetting of the benthic macroinvertebrate community even 11 months later when the October 2007 samples were taken and 10 months after the first round of carcass placement. Macroinvertebrate densities at the six stations were 65-92% lower in 2007 than found in 2006. Pine Creek is a cold-water, montane stream that does not have a distinctive division between cold season and warm season communities. Essentially, there is only a cold adapted community that is present

in the stream in the larval or egg stage most of the year. The November 2006 flood appears to have caused mass mortality in most benthic taxa and their recovery in the system was slow. Warm adapted taxa are not naturally present to boost densities during the summer and early fall.

Macroinvertebrate sampling did not occur again until October 2009, about three years after the flood and after two salmon carcass enrichments in December 2006 and 2008. Total densities at all stations in October 2009 increased about an order of magnitude over those found post-flood in 2007. At the three mainstem stations that received direct carcass addition, total densities increased 2.1 to 2.5 times over densities measured in 2006 baseline year. Densities in Tributary P8 (enriched) were 1.8 times those found in 2006, while in Tributary P7 (not enriched) densities were lower in 2009, 86% of the 2006 level.

Total invertebrate densities at the **Mainstem near mouth** station were slightly lower (96%) in 2009 than 2006 after two years of carcass enrichment. The nearest carcass placement to this station was 3.2 kilometers upstream. The apparent lack of a boost in density provided by two years of carcass enrichment could be due to a number of factors that only tracking trends for several more years can answer. Possible explanations are:

1. There is a rapid uptake of nutrients from decomposing carcasses in upstream reaches, leaving little available to pass downstream for uptake at the station near the mouth.

2. Around 6000 total invertebrates per square meter as seen at this station in 2006 and 2009, and at **Mainstem u/s Tributary P8** in 2009 is about the maximum potential for macroinvertebrate standing crops in the basin, regardless of nutrient enrichment levels.

3. Nutrient enrichment is boosting macroinvertebrate populations, but recovery from the November 2006 is still progressing.

Total taxa richness

Forested montane streams in the Pacific Northwest with low human disturbance and moderate habitat complexity typically have 40-60 total taxa in benthic samples from riffle habitats when the standard taxonomic effort used in this study is applied (Wisseman, unpublished data). Total taxa richness at the six Pine Creek stations varied between 26 and 70 taxa between 2006 and 2009 (Table/Figure 2). That is a considerable range for one stream basin.

Discounting the 2007 data following major flooding the previous year, the mainstem stations on Pine Creek have relatively low taxa richness. The station near the mouth falls in the typical range with 49 and 57 total taxa in 2006 and 2009, respectively, but the three stations further upstream had only 31-42 taxa

during 2006 and 2009. This suggests that habitat complexity is not very high along most of the mainstem, and also near the mouth of Tributary P8 where total taxa richness was only 40 and 45 taxa in 2006 and 2009. Tributary P7 had a total taxa richness of 66 and 70 in 2006 and 2009, suggesting that habitat complexity is much higher in the stream reach near the mouth of this tributary.

The impact to benthic fauna from the November 2006 floods as assessed by the 2007 samples is very striking (Table/Figure 2). The mainstem stations lost between 1 and 9 taxa. The tributaries were impacted much greater, losing 17 taxa, or about one-third of the fauna at Tributary P8, and 38 taxa, over half the fauna at Tributary P7. The loss of a third to over half the fauna at these tributary stations can only be termed catastrophic. Taxa in all insect and non-insect groups were lost. Why the fauna at the mainstem stations fared better following the flood is not known. Perhaps there was less overall bed-load movement and more refugia for invertebrates to weather the flood, or recolonization during the 11 months between the flood and the October 2007 sampling may have been more rapid in mainstem than the tributaries.

By the October 2009 sampling, total taxa richness at all stations had recovered dramatically from the lows seen in 2007 (Table/Figure 2). Total taxa richness at all stations except Tributary P8 (-5 taxa) was slightly to moderately greater than seen in the 2006 baseline sampling, with increases in the total taxa richness of 2-8 taxa. All taxonomic groups increased in taxa richness at least at a few of the stations. The groups that added the greatest number of taxa and at the most stations were caddisflies (Trichoptera) and true flies (Diptera).

Non-insects including segmented worm (Oligochaeta) densities

Non-insect benthic macroinvertebrate taxa found in the Pine Creek basin are flatworms, round worms, segmented worms, several snails, seed shrimp and aquatic mites. Overall diversity of the non-insect fauna is low, with 0-4 taxa total found at any one site. Both mollusks and crustaceans are present but in very low abundance. Cold water, high stream gradient and low levels of calcium ions in the water limit these groups.

Non-insects occurred in low abundance at all Pine Creek stations in the baseline year 2006 before enrichment, making up between 2.7 and 10.4% of the benthic fauna (Table/Figure 3). They virtually disappeared from the system following the November 2006 floods, as measured 11 months later by the October 2007 sampling. Densities of non-insects rebounded in 2009 at all Pine Creek stations, and were 1.9 to 8.2 times higher than seen in the 2006 baseline year.

Oligochaeta (segmented worms) were the dominant non-insect taxa present and contributed the most to the 2009 bounce in densities among the non-insects (Table/Figure 4). It is well known that segmented worm populations respond positively and rapidly to organic enrichment (Brinkhurst and Gelder 2001).

Segmented worm densities ranged from 36-253 m^2 in 2006, the baseline year; 0-38 m^2 in 2007 after the flood; and rose to 304-1081 m^2 in 2009 after 2 years of enrichment.

Worm densities in 2009 at the **Tributary 7 near mouth** control site increased 2.4 times over those found in 2006, indicating that the flood itself may have stimulated worm populations, perhaps through deposition of fine sediment or increased algal production. Worm densities at the 5 stations enriched with carcasses were 2.2 to 9.2 times higher in 2009 than in 2006, with an average increase of 6.1 times. Worm populations at the enriched stations are probably responding to both flood disturbance and enrichment.

Worm densities climbed most dramatically between 2006 and 2009, nearly an order of magnitude, at the **Mainstem near mouth** station. The dramatic rise in densities at this station may indicate that nutrients from the salmon carcasses are spiraling downstream several miles below where they were placed.

Insect densities

Mayfly (Ephemeroptera) densities varied considerably between the Pine Creek stations and between years (Table/Figure 5). In the 2006 baseline year, densities were high at **Mainstem near mouth**, moderate at **Tributary 7 near mouth**, and low at the remaining stations. Densities in 2007 following the flood were low at all stations.

In 2009 mayfly densities were nearly the same as found in 2006 at all stations except **Mainstem @ Monument boundary**, where densities were 9.3 times higher in 2009 over 2006. This increase was due mainly to the baetid mayflies *Baetis bicaudatus* and *Baetis tricaudatus*, and to a lesser extent the heptageniid mayflies *Epeorus grandis* and *Rhithrogena*. *Baetis bi/tricaudatus* comprised 24% of the total community at the **Mainstem @ Monument boundary** station in 2009. High densities of this pair of sister species are usually found in stream reaches that have recently received considerable disturbance, whether the disturbance is physical in nature (substrate resorting and scour) or chemical (acute toxic episodes). High densities of *Baetis species* at this station in 2009 may indicate that the stream reach is still undergoing annual physical disturbance after the 2006 flood.

As of 2009, mayflies do not appear to be responding dramatically to the nutrient enrichment from salmon carcasses.

Stonefly (Plecoptera) density trends along the longitudinal axis of Pine Creek and between years was relatively similar to the mayflies (Table/Figure 6). This order of insects is composed mainly of species that are predators or shredders of detritus. In 2006, density in the mainstem of Pine Creek was lower than the tributary stations, except at the **Mainstem near mouth** station. Stoneflies are

most abundant and diverse in smaller, forested streams, and higher densities in the smaller tributary streams is consistent with this. Stonefly densities at the **Mainstem near mouth** station were three or more times higher than for any other station, with *Zapada species* (Nemouridae), particularly *Zapada cinctipes* being very abundant. This same genus was also abundant at this site in 2009. *Zapada species* are shredders of detritus. Considering their low abundance in the mainstem above the mouth, this suggests that detritus is a more abundant food source near the mouth of Pine Creek. Perhaps much of the detritus that enters the mainstem is flushed down and deposited near the mouth.

As with all other groups, stonefly density and richness displayed dramatic declines at all stations following the November 2006 flood, and had not rebounded by October 2007, even with the December 2006 addition of carcasses. Stonefly densities and richness recovered substantially by 2009, particularly in the tributaries, but appear not to have been augmented by two years of carcass addition. The three-fold increase in stonefly density at the **Mainstem @ Monument boundary** station in 2009 versus 2006 is due to the early recruitment of early instar Taeniopterygidae nymphs at his station in 2009.

Caddisflies (Trichoptera) were common to abundant at most Pine Creek stations (Table/Figure 7). Larvae of the various caddisfly species derive their nutrition from a variety of food sources. Those found in Pine Creek include predators, shredders of detritus, and filterers, with scrapers of algae being dominant.

Both richness and density of caddisflies plummeted at all stations in 2007. Recovery in density by 2009 was lower than 2006 at the two mainstem stations furthest downstream. Densities at the two mainstem stations further upstream and in both the enriched and control tributaries were higher in 2009 than in 2006, with densities at **Mainstem u/s Tributary P8** and **Tributary P8 near mouth** 2-3 times higher in 2009. **Mainstem u/s Tributary P8** total caddisfly density exceeded 5000 per square meter. That is a very high density for caddisflies in a mid-order, cold, montane, Pacific Northwest stream.

Much of the dynamic in caddisfly densities seen at Pine Creek from 2006-2009 was due to one species, *Oligophlebodes* probably *minutus*, whose larvae scrape algae (Table/Figure 8). *Oligophlebodes* is common and widespread throughout western North America, but is patchily distributed. It is not understood why it may be common in a stream like Pine Creek, but then be absent or rare in the next ten adjacent drainages. The increase in density of this species at the two upper mainstem stations and in Tributary P8 in 2009 is probably in partial response to two years of carcass enrichment, indicating that algal production may have been significantly enhanced in these stream reaches. The November 2006 flood may have also contributed to an increase in algal production by widening and opening the channel to more sunlight.

Midge (Diptera: Chironomidae) densities in 2006 were high at the **Mainstem near mouth** and **Tributary P7 (control)** stations (Table/Figure 9), perhaps because these are lower gradient stations where fine particulate organic matter, the food of most midges, is more abundant. Densities at all stations plummeted in 2007, then recovered substantially only at the two lowest mainstem stations.

Feeding Groups

Algal scrapers were common at all stations in 2006 and displayed a relatively narrow range in densities between stations (Table/Figure 10). Again, densities plummeted in 2007 following the flood. Scraper density was only slightly higher in 2009 than 2006 at the Tributary P7 control station (not enriched), while at the enriched stations densities were moderately to substantially higher in 2009 except at the **Mainstem near mouth** station. The spike in scraper density in 2009 at **Mainstem u/s Tributary P8** is due mainly to the caddisfly scraper *Oligophlebodes* (above).

Algal scraper densities appear to have been enhanced by carcass enrichment and also perhaps from channel widening and opening effects of the November 2006 flood.

Collector-gatherers consume fine organic particles (living and dead) in or on surface sediments. All Pine Creek stations had higher densities of collector-gatherers in 2009 than were found in both 2006 and 2007 (Table/Figure 11). Densities at the Tributary P7 control station increased by only 129% from 2006 to 2009, while the remaining enriched stations saw increases ranging from 155 to 794%. Collector-gatherer taxa exhibiting the most increase were segmented worms (Oligochaeta), midges (Chironomidae), and *Baetis* mayflies.
Increased algal production eventually leads to an increase in fine particulate organic matter, as algae dies and decays or is consumed and excreted by invertebrates. Greatest densities of collector-gatherers were seen in 2009 at the two lowest stations on the mainstem of Pine Creek. This pattern would be consistent with greater algal production occurring in upstream reaches (by some combination of enrichment and channel opening), followed by deposition of more fine particulate matter in the lower mainstem reaches, as the byproduct of this increased production was flushed downstream.

Shredders of detritus consume decaying leaves, needles and woody material that enter the stream. Most of the shredders in Pine Creek are stoneflies. In 2006 shredders were most abundant at the **Mainstem near mouth** station and at the mouth of Tributaries P7 and P8 (Table/Figure 12). Shredder densities were low at the remaining mainstem stations in all years, perhaps because these reaches are higher gradient and narrower channels have more hydraulic power to flush detritus downstream. The higher densities of shredders near the mouth of Pine Creek and the mouths of the tributaries, is probably a result of more detritus being deposited and retained in these reaches, acting as detritus sinks.

Shredder densities were at zero or nearly so at all stations in October 2007, following the November 2006 flood. The impact of this flood on the shredder community was catastrophic. Only the **Mainstem @ Monument** boundary station displayed a small increase in shredder densities by October 2009 over 2006. Shedder populations in Pine Creek appear to be still recovering from the 2006 flood nearly three years after this event occurred. No response to nutrient enrichment from salmon carcasses is evident. Enhancement of shredders through nutrient addition would follow an indirect pathway if any. Microbial communities on decaying organic matter that are responsible for much of the nutritive value to invertebrates, may be enhanced by an increased availability of soluble nutrients.

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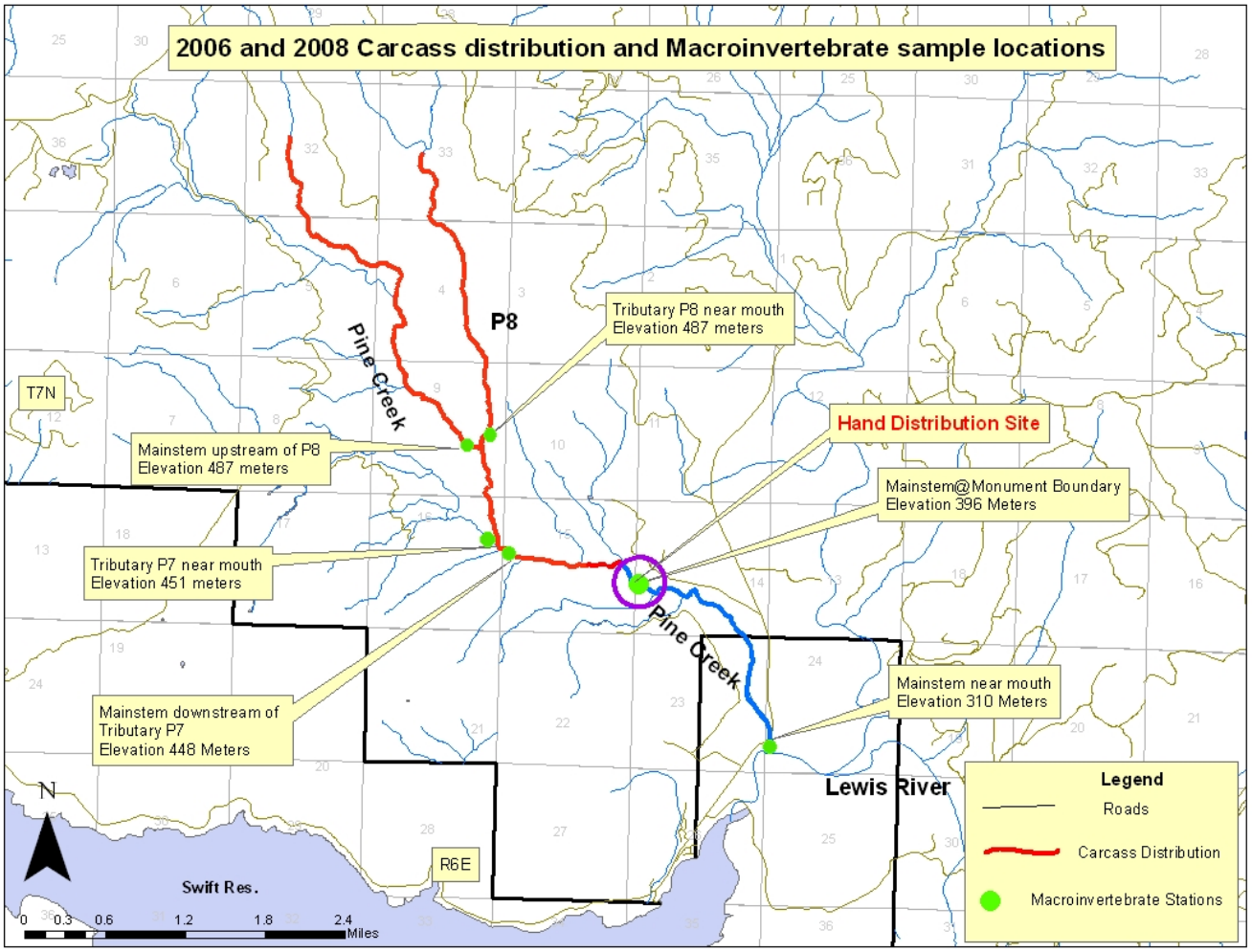


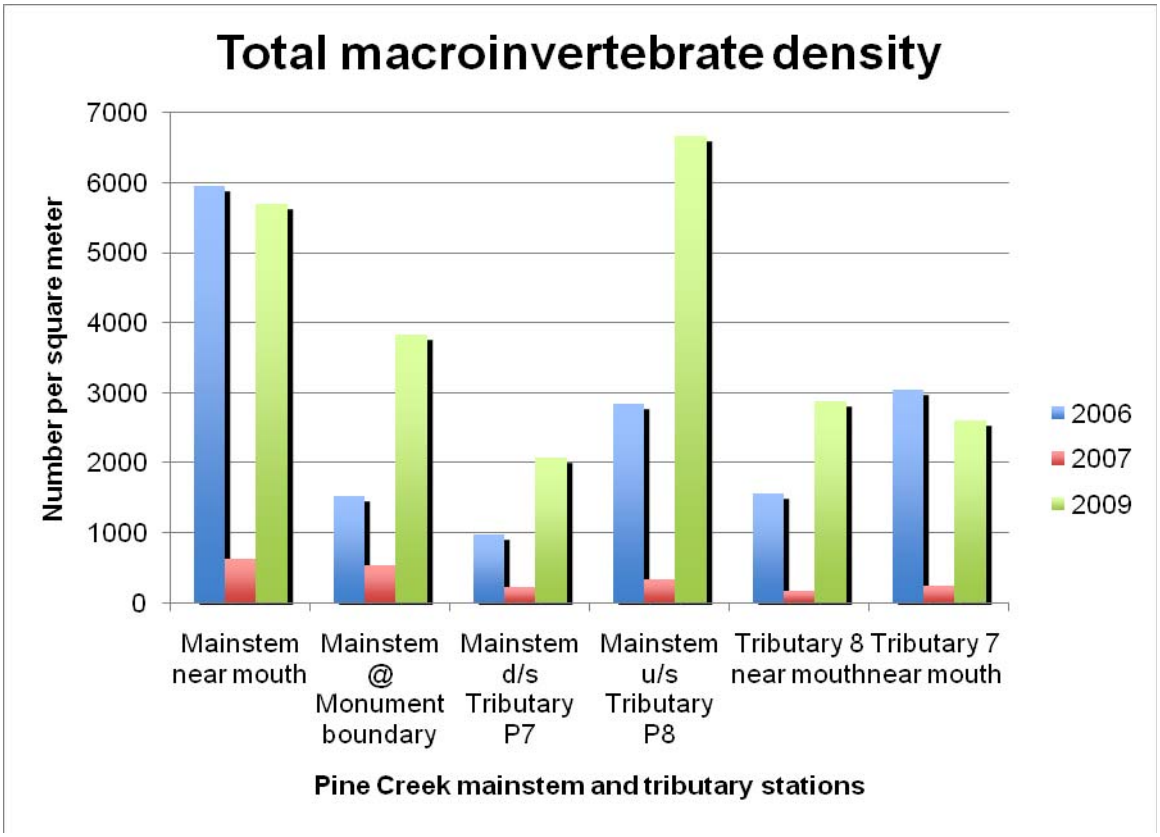
Figure 1. 2006 and 2008 Carcass Distribution and Macroinvertebrate Sample Locations

Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October invertebrate sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 1
Total invertebrate density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	5961	620	5705	Carcass enriched
Mainstem @ Monument boundary	1528	533	3833	Carcass enriched
Mainstem d/s Tributary P7	970	225	2076	Carcass enriched
Mainstem u/s Tributary P8	2841	328	6660	Carcass enriched
Tributary 8 near mouth	1566	162	2878	Carcass enriched
Tributary 7 near mouth	3034	236	2604	Control, not enriched



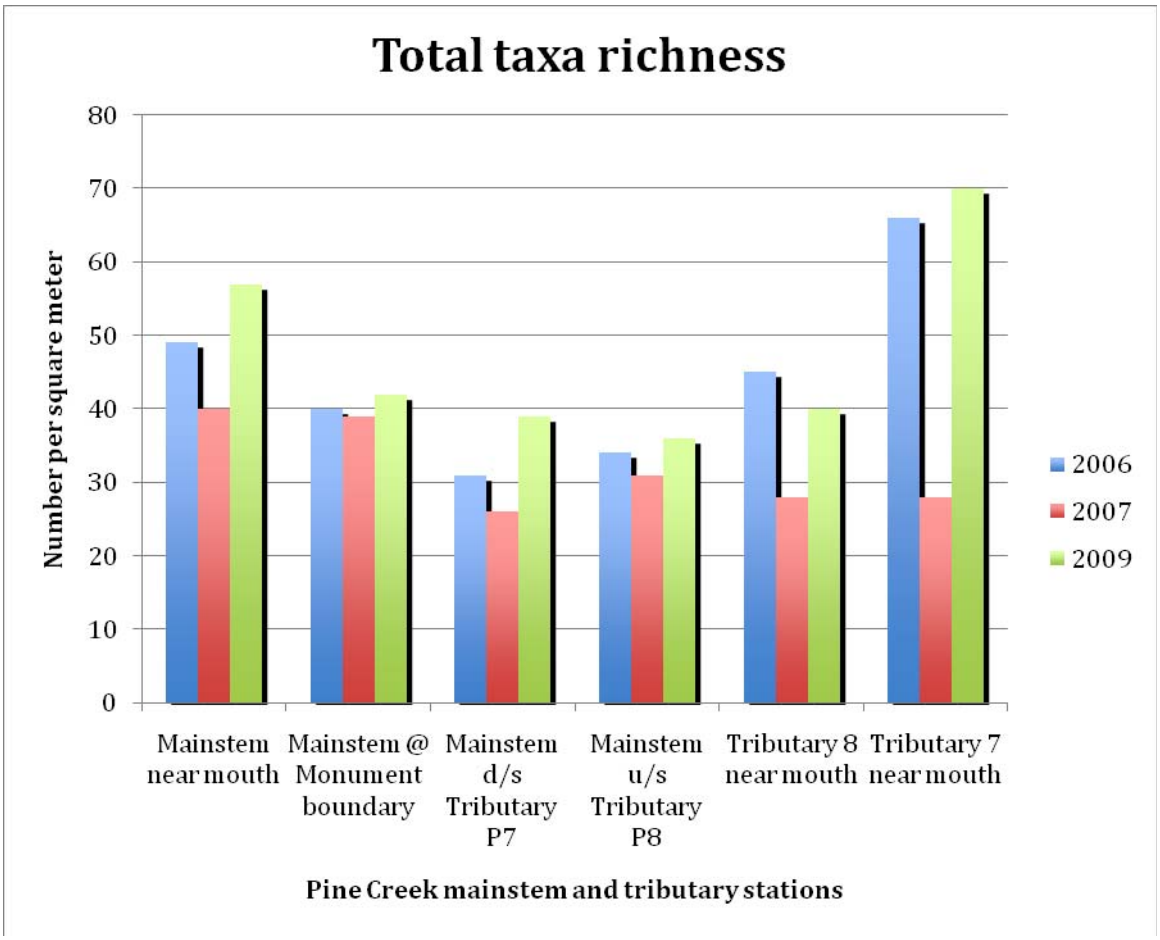
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 2

Total taxa richness

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	49	40	57	Carcass enriched
Mainstem @ Monument boundary	40	39	42	Carcass enriched
Mainstem d/s Tributary P7	31	26	39	Carcass enriched
Mainstem u/s Tributary P8	34	31	36	Carcass enriched
Tributary 8 near mouth	45	28	40	Carcass enriched
Tributary 7 near mouth	66	28	70	Control, not enriched



Pine Creek Salmon Carcass Enrichment Study

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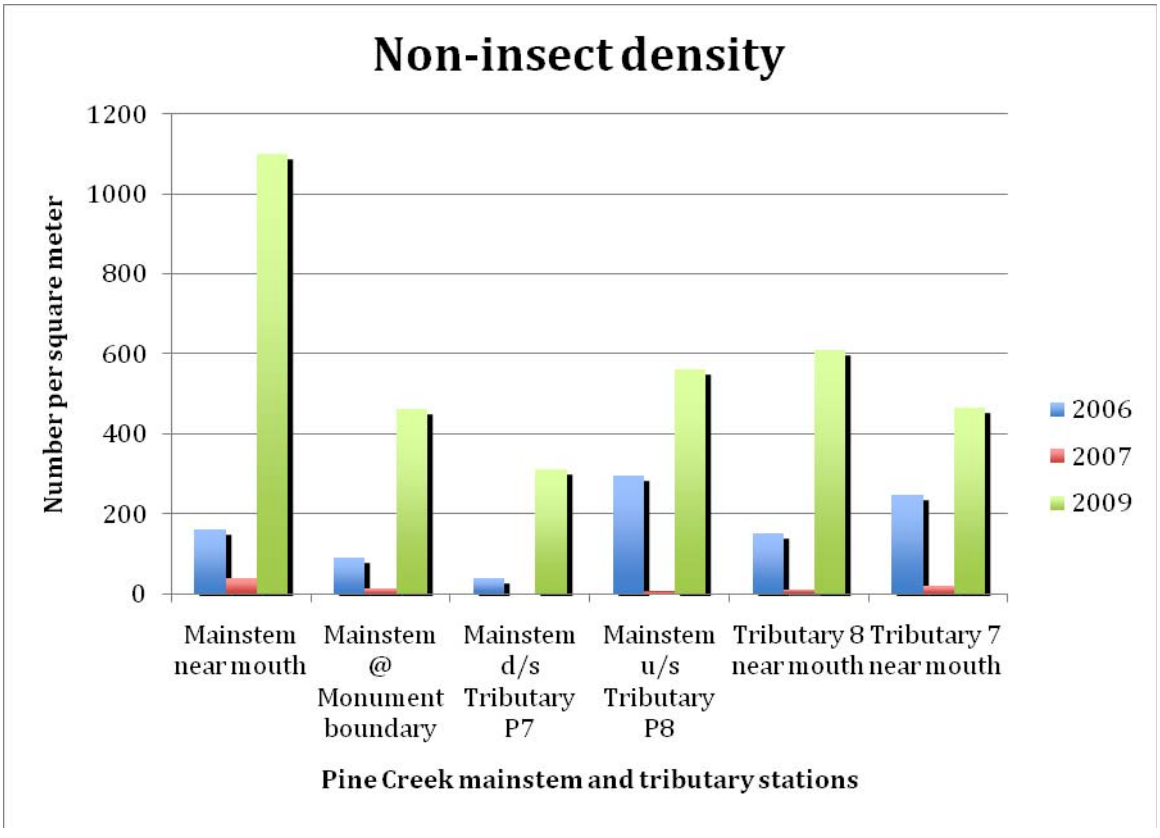
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 3
Non-insect density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	161	39	110	Carcass enriched
Mainstem @ Monument boundary	89	13	460	Carcass enriched
Mainstem d/s Tributary P7	38	0	311	Carcass enriched
Mainstem u/s Tributary P8	295	8	562	Carcass enriched
Tributary 8 near mouth	151	10	608	Carcass enriched
Tributary 7 near mouth	248	20	465	Control, not enriched

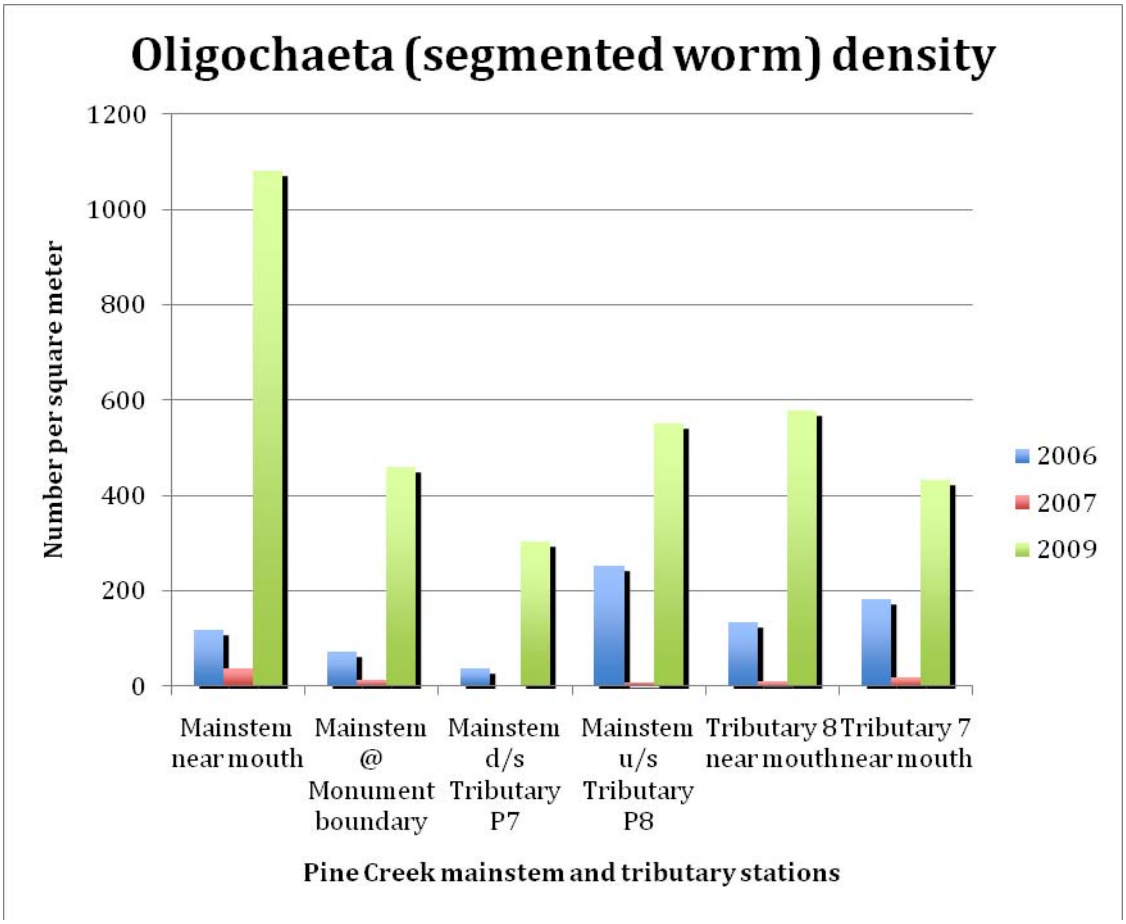


Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 4
Oligochaeta (worm) density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	118	38	1081	Carcass enriched
Mainstem @ Monument boundary	73	12	460	Carcass enriched
Mainstem d/s Tributary P7	36	0	304	Carcass enriched
Mainstem u/s Tributary P8	253	8	551	Carcass enriched
Tributary 8 near mouth	135	9	578	Carcass enriched
Tributary 7 near mouth	183	19	433	Control, not enriched

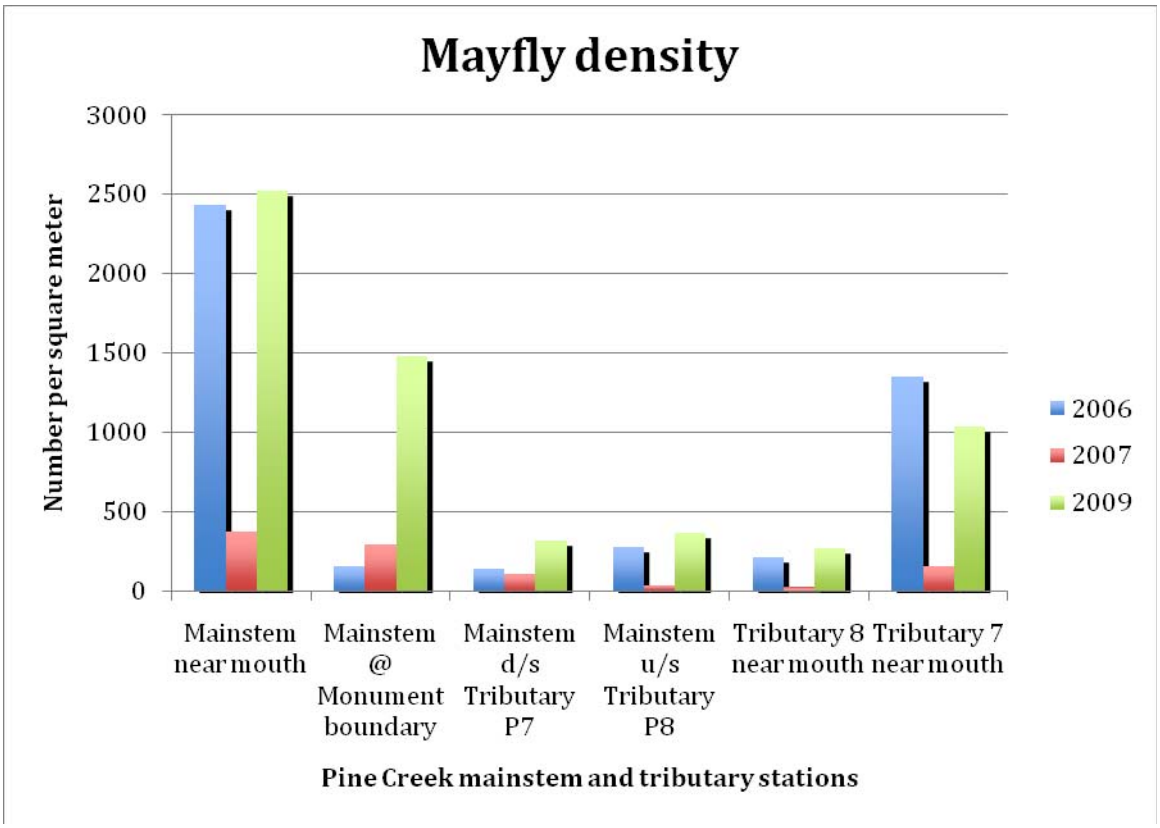


Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 5
Mayfly density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	2433	378	2518	Carcass enriched
Mainstem @ Monument boundary	159	292	1477	Carcass enriched
Mainstem d/s Tributary P7	138	105	320	Carcass enriched
Mainstem u/s Tributary P8	281	32	369	Carcass enriched
Tributary 8 near mouth	215	27	266	Carcass enriched
Tributary 7 near mouth	1351	153	1036	Control, not enriched



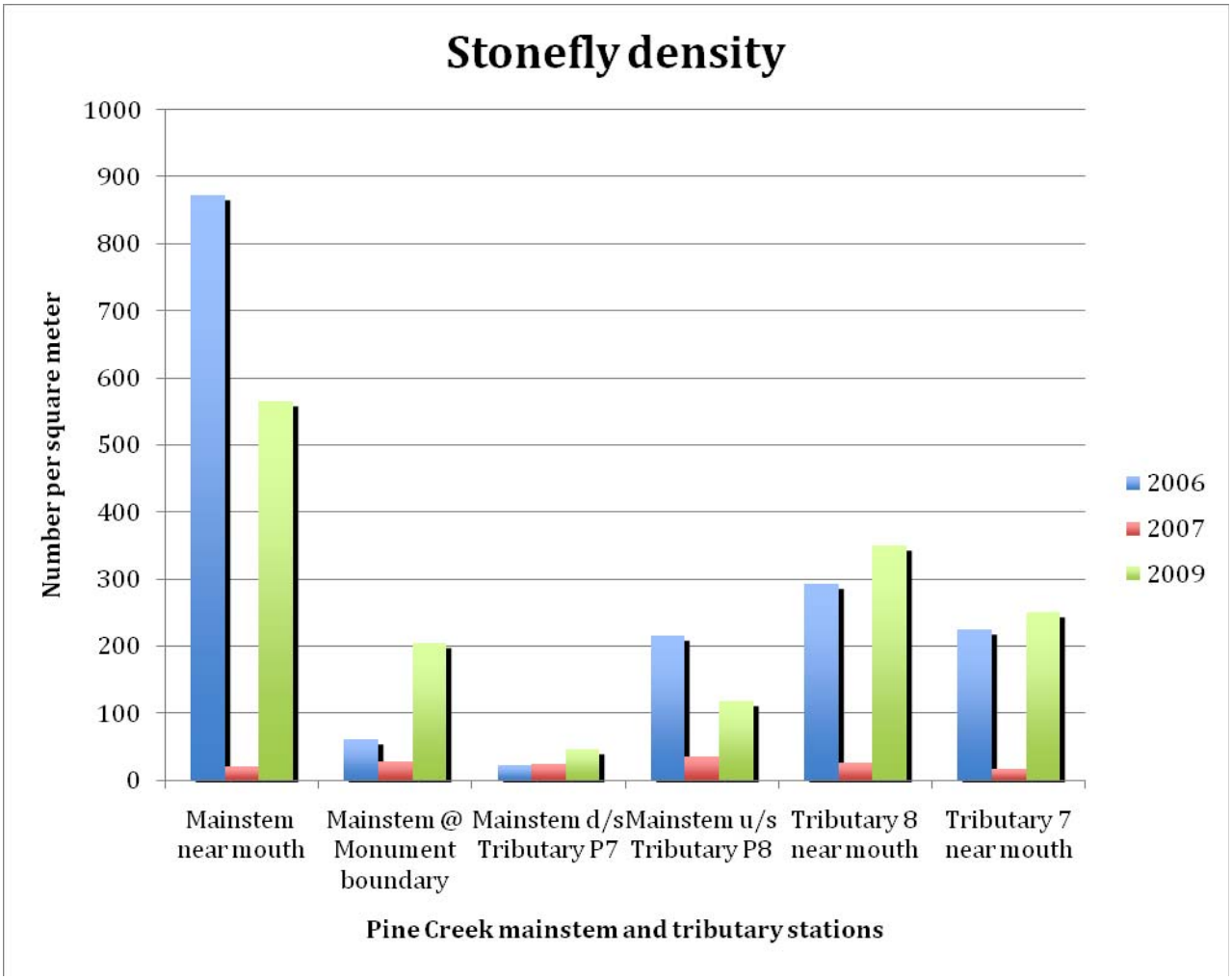
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 6

Stonefly density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	873	21	565	Carcass enriched
Mainstem @ Monument boundary	61	28	204	Carcass enriched
Mainstem d/s Tributary P7	23	24	46	Carcass enriched
Mainstem u/s Tributary P8	216	36	118	Carcass enriched
Tributary 8 near mouth	293	26	349	Carcass enriched
Tributary 7 near mouth	225	16	250	Control, not enriched



Pine Creek Salmon Carcass Enrichment Study

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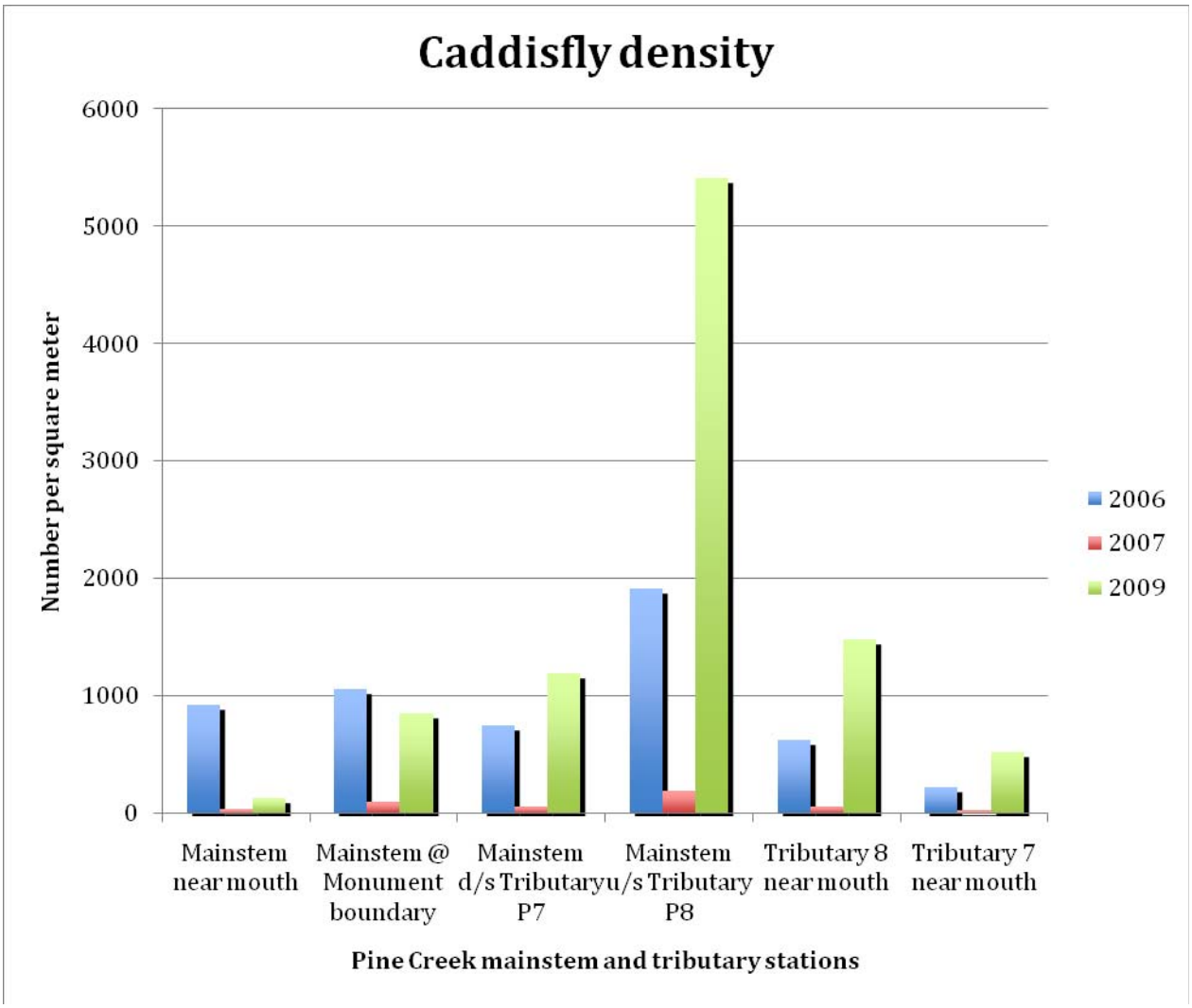
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 7
Caddisfly density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	926	37	132	Carcass enriched
Mainstem @ Monument boundary	1061	98	847	Carcass enriched
Mainstem d/s Tributary P7	749	55	1189	Carcass enriched
Mainstem u/s Tributary P8	1909	194	5404	Carcass enriched
Tributary 8 near mouth	628	54	1479	Carcass enriched
Tributary 7 near mouth	225	25	519	Control, not enriched



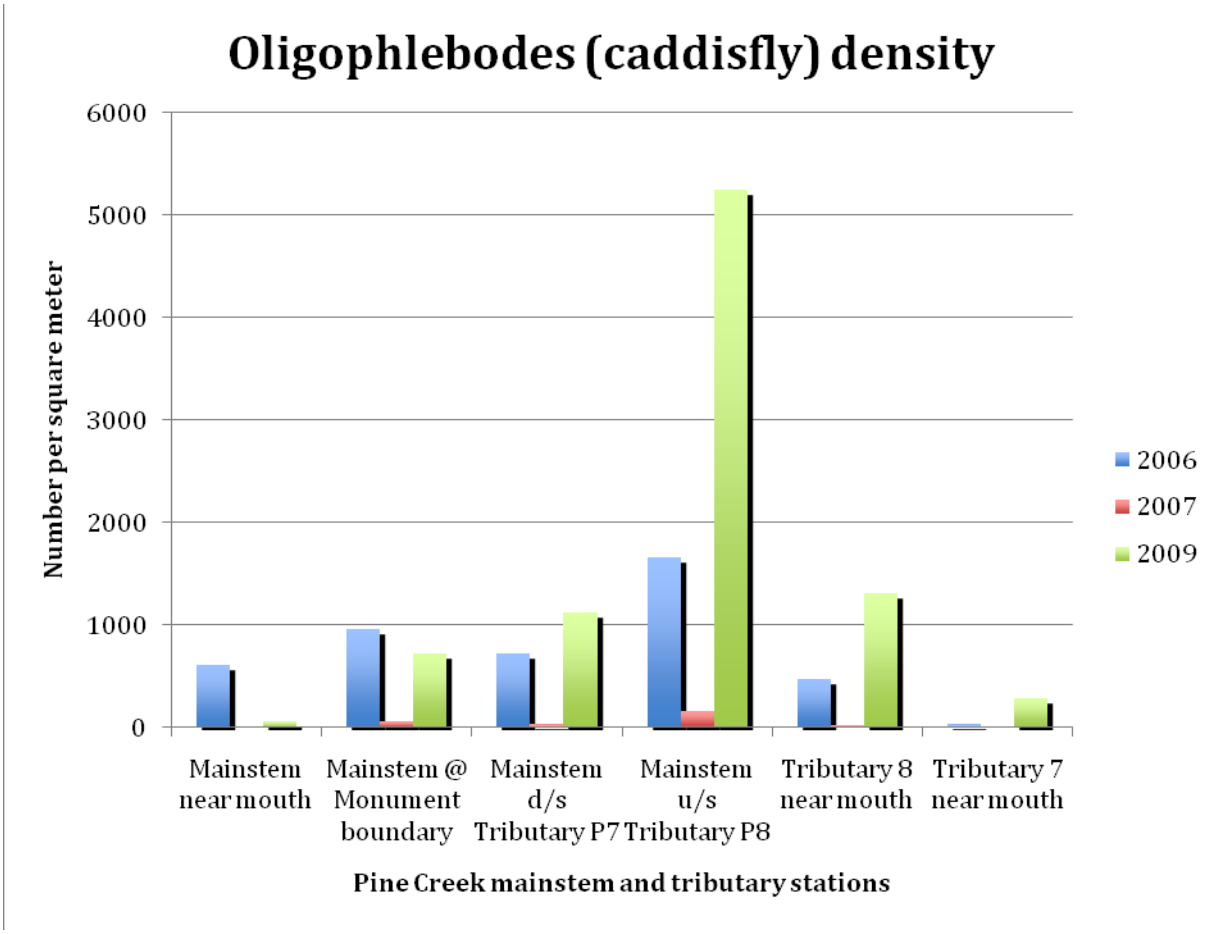
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 8

Oligophlebodes (caddisfly) density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	603	9	56	Carcass enriched
Mainstem @ Monument boundary	960	54	724	Carcass enriched
Mainstem d/s Tributary P7	720	35	1125	Carcass enriched
Mainstem u/s Tributary P8	1662	155	5251	Carcass enriched
Tributary 8 near mouth	468	20	1307	Carcass enriched
Tributary 7 near mouth	27	1	285	Control, not enriched



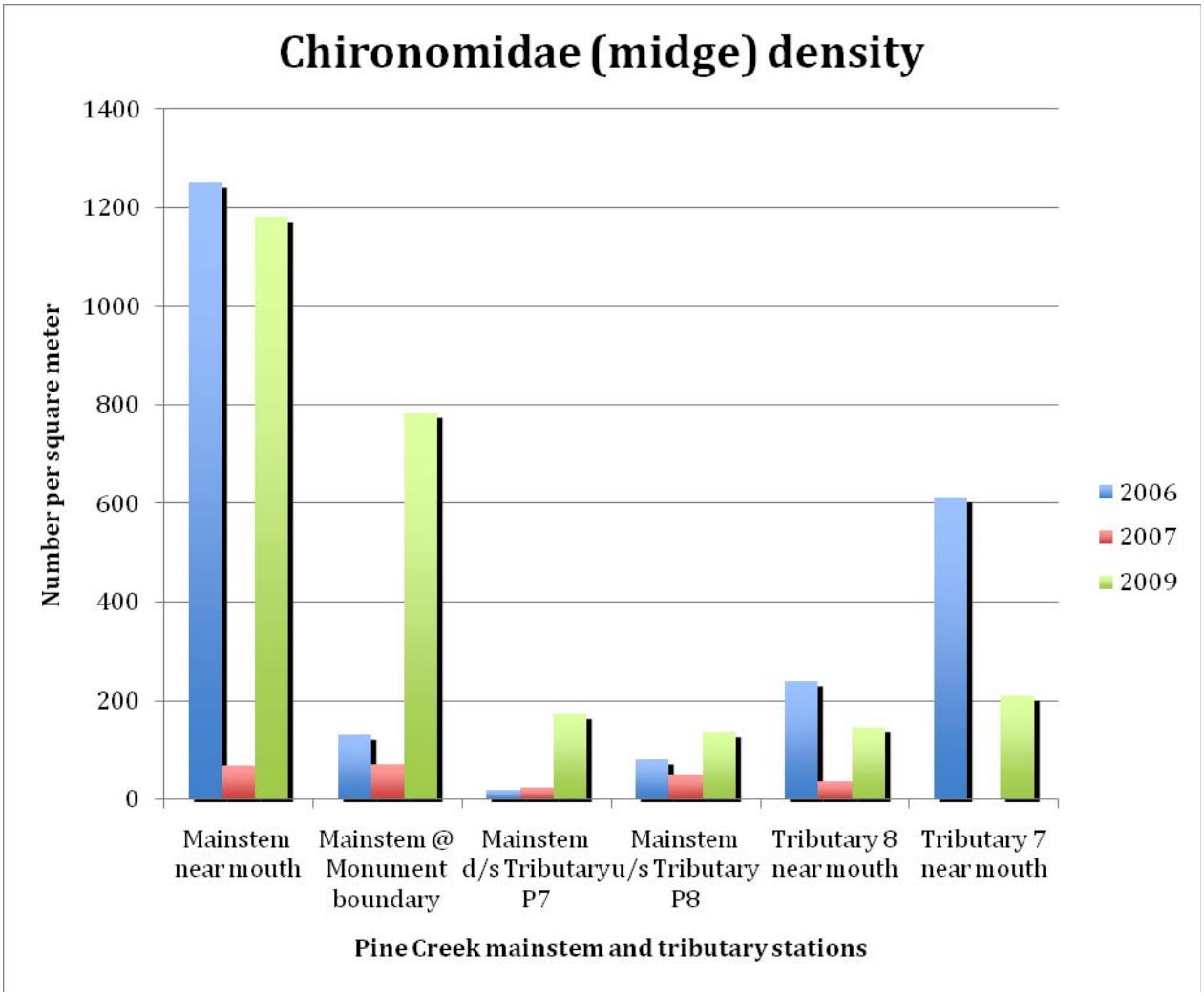
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 9

Chironomidae midge density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	1250	69	1181	Carcass enriched
Mainstem @ Monument boundary	130	71	783	Carcass enriched
Mainstem d/s Tributary P7	18	24	173	Carcass enriched
Mainstem u/s Tributary P8	81	49	135	Carcass enriched
Tributary 8 near mouth	239	35	145	Carcass enriched
Tributary 7 near mouth	613	2	210	Control, not enriched



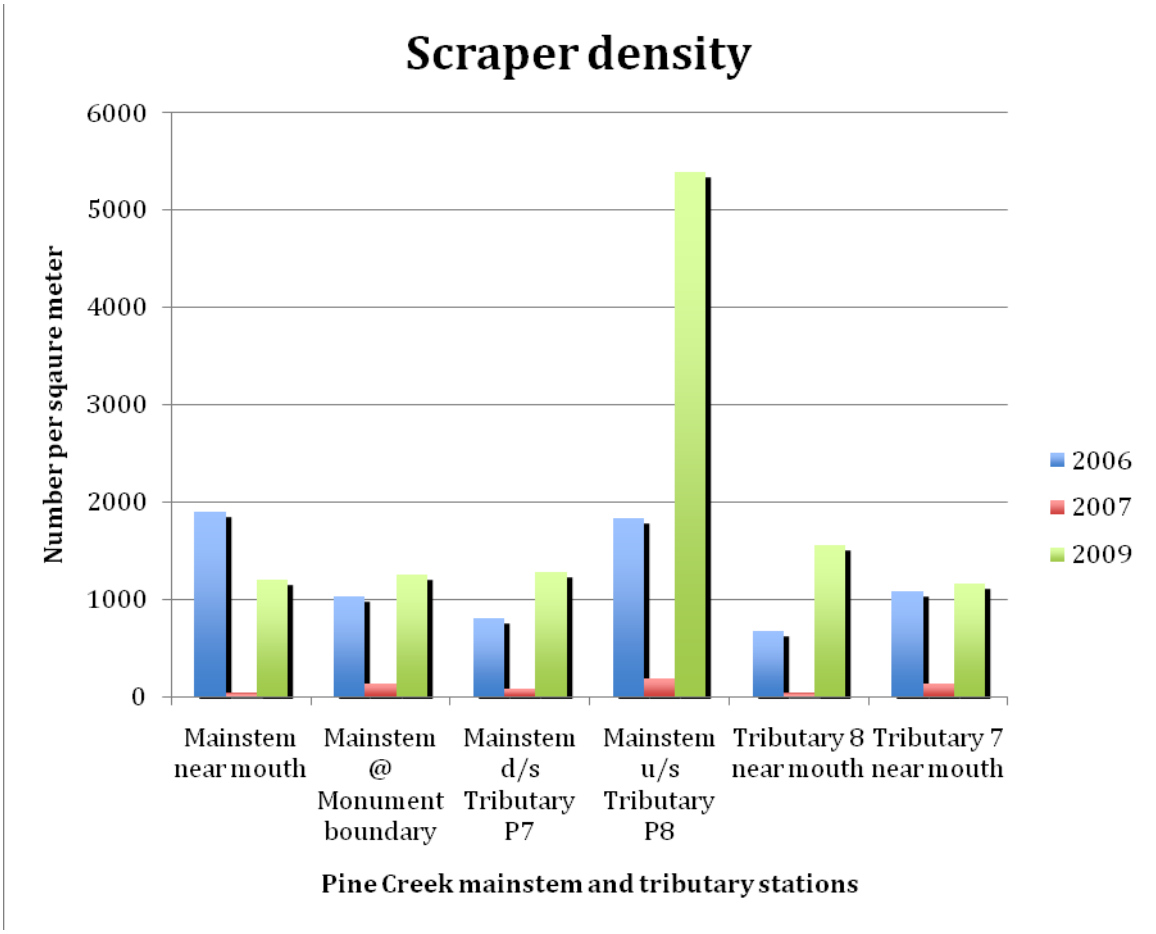
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 10

Scraper density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	189	37	1203	Carcass enriched
Mainstem @ Monument boundary	102	136	1248	Carcass enriched
Mainstem d/s Tributary P7	811	78	1276	Carcass enriched
Mainstem u/s Tributary P8	1835	193	5388	Carcass enriched
Tributary 8 near mouth	681	48	1560	Carcass enriched
Tributary 7 near mouth	1086	137	1157	Control, not enriched

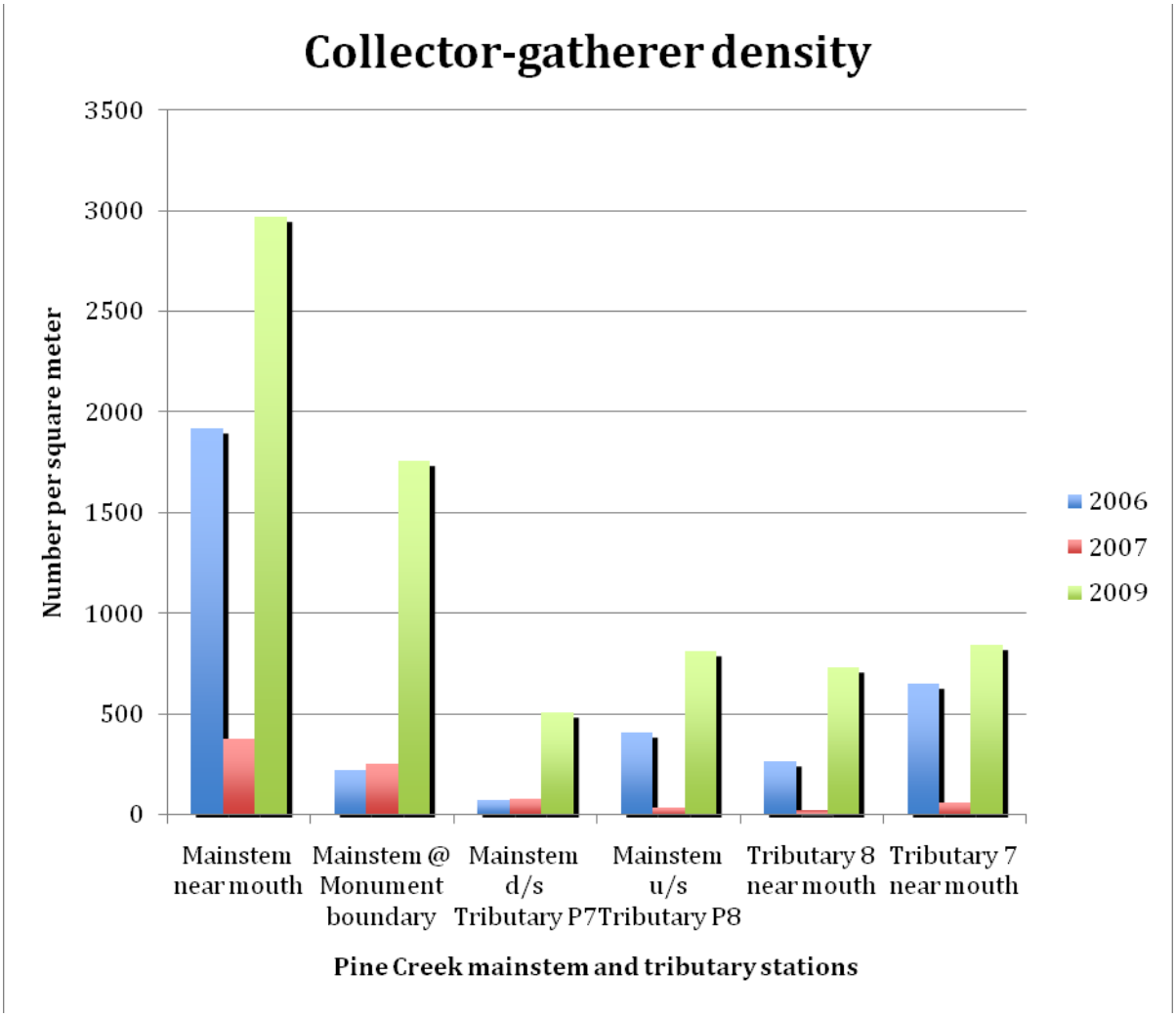


Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 11
Collector-gatherer density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	1917	378	2972	Carcass enriched
Mainstem @ Monument boundary	221	250	1754	Carcass enriched
Mainstem d/s Tributary P7	69	76	506	Carcass enriched
Mainstem u/s Tributary P8	410	33	812	Carcass enriched
Tributary 8 near mouth	264	25	729	Carcass enriched
Tributary 7 near mouth	651	57	842	Control, not enriched



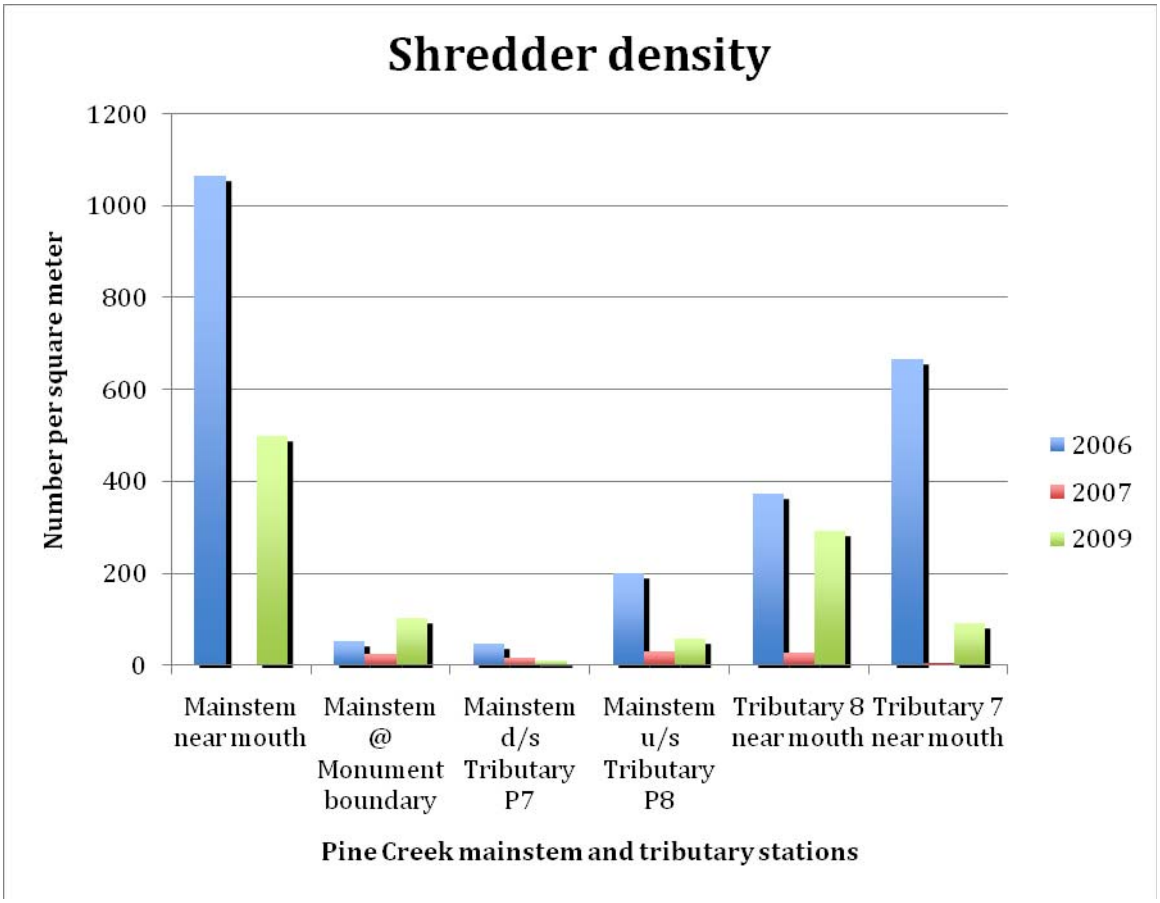
Pine Creek Salmon Carcass Enrichment Study

WA: Mount St. Helens National Volcanic Monument
Mid-October sampling, multipoint composite sample, riffle habitat, 500 micron mesh.
Analysis by Aquatic Biology Associates, Inc., Corvallis, OR

Table/Figure 12

Shredder density per square meter

Stations	Years			Treatment
	2006	2007	2009	
Mainstem near mouth	1066	0	500	Carcass enriched
Mainstem @ Monument boundary	53	23	102	Carcass enriched
Mainstem d/s Tributary P7	48	15	11	Carcass enriched
Mainstem u/s Tributary P8	200	29	57	Carcass enriched
Tributary 8 near mouth	374	27	291	Carcass enriched
Tributary 7 near mouth	667	4	92	Control, not enriched



Lewis River RM 13.5

2010 Lewis River ACC Project Proposal

LOWER COLUMBIA FISH ENHANCEMENT GROUP

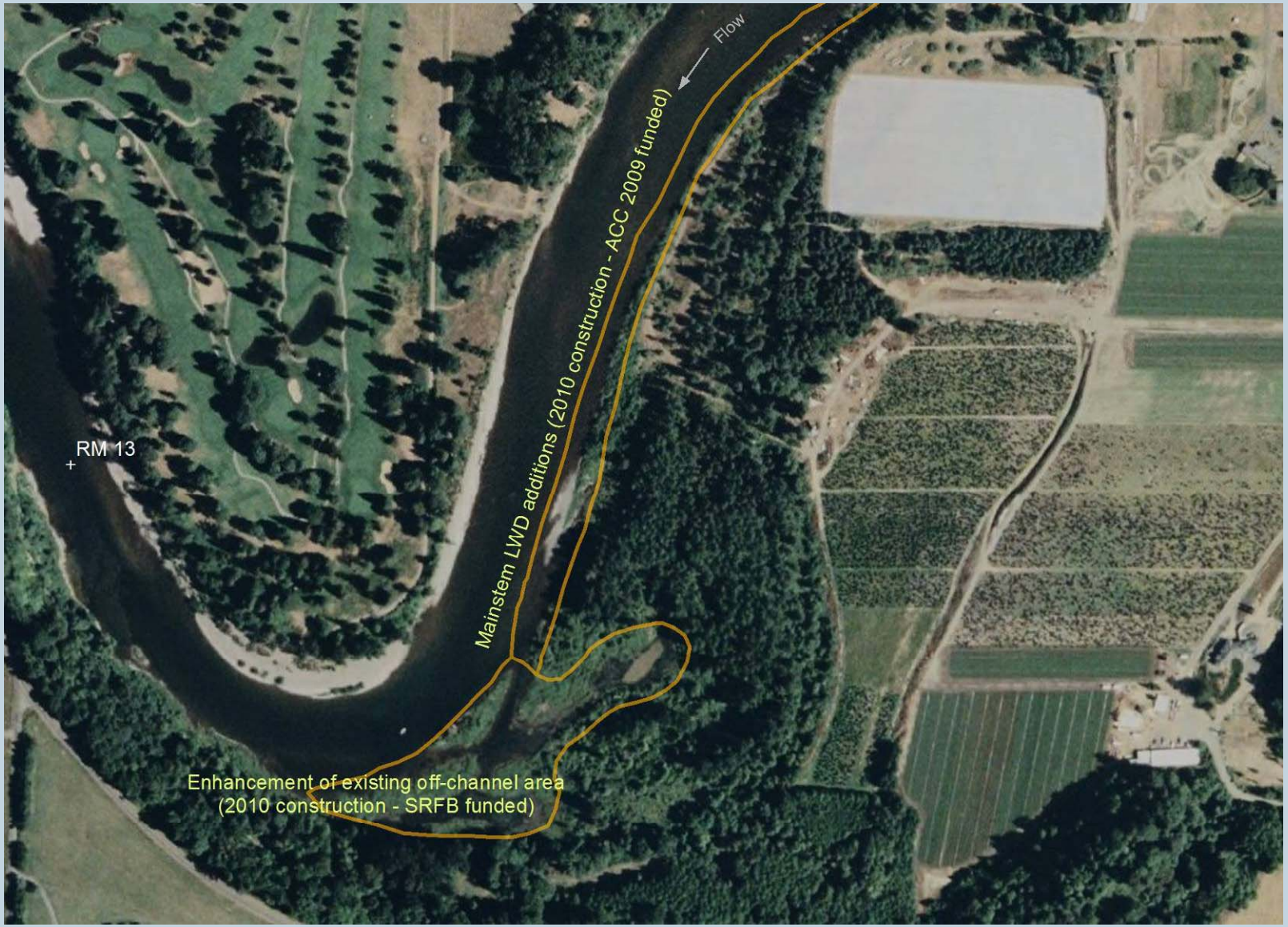
inter·fluve

Lewis River RM 13.5

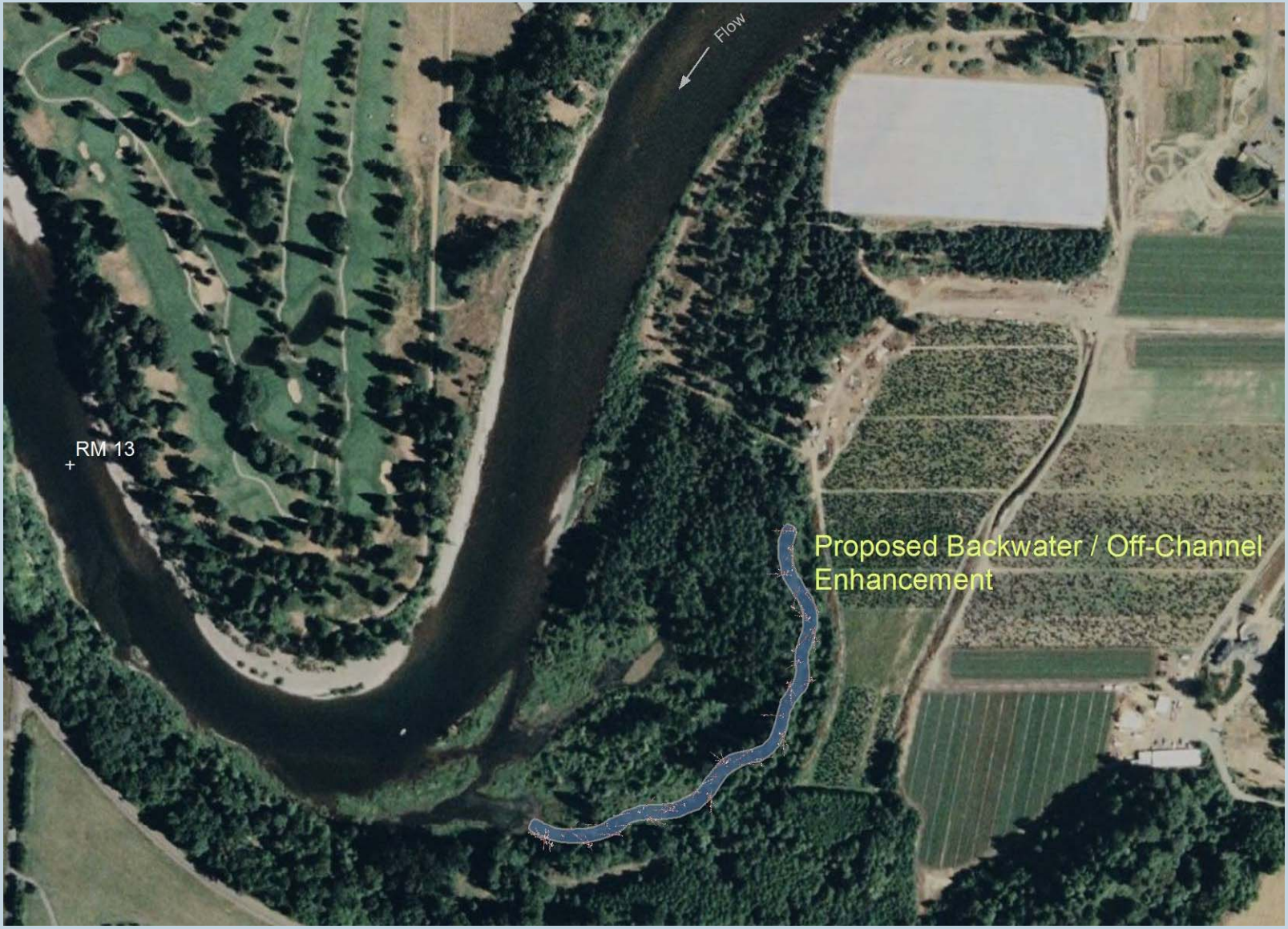
- Objectives
  - Create 1,500 lineal feet (approximately 42,000 ft^2) of connected off-channel habitat.
  - Coho, steelhead, resident trout, and Chinook rearing/holding
  - Restore fish passage to tributary and off-channel area
  - Add complexity wood for local scour and habitat cover and complexity
  - Riparian restoration

Lewis River RM 13.5

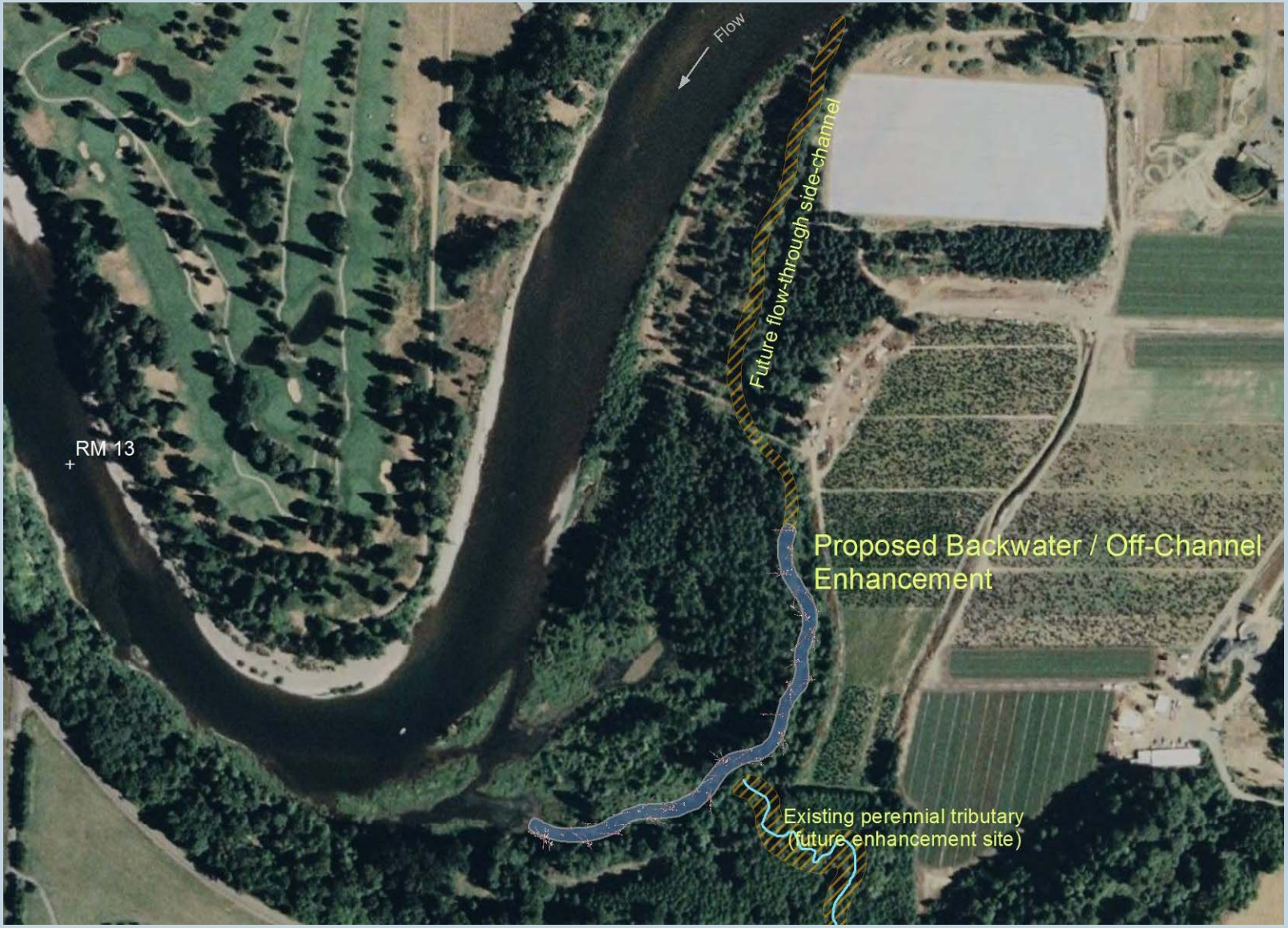
Lewis River RM 13.5



Lewis River RM 13.5



Lewis River RM 13.5



Lewis River RM 13.5

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- Objectives
  - Create 1,500 lineal feet (approximately 42,000 ft^2) of connected off-channel habitat.
  - Coho, steelhead, resident trout, and Chinook rearing/holding
  - Restore fish passage to tributary and off-channel area
  - Add complexity wood for local scour and habitat cover and complexity
  - Riparian restoration

Lewis River RM 13.5

- Scope and Budget
  - Design funding provided by SRFB
  - LWD Materials have already been obtained and stockpiled at the site
  - Permitting already underway
  - Construction costs >90% of budget

Lewis River RM 13.5

	ESTIMATED HOURS BY RESOURCE				LABOR COSTS BY RESOURCE					DIRECT COSTS BY ITEM			
	Executive Director	Project Manager	Staff	Operations Director	Executive Director	Project Manager	Staff	Operations Director	Total	Trans.	Supplies	Contractual	Total
					$50.00	$50.00	$50.00	$50.00					
Task 1: Coordination, Management, and Reporting													
Coordination and oversight (Tony Meyer)	60				$3,000				$3,000				
Project management (Pete Barber)		200				$10,000			$10,000				
Contract administration and reporting (Tammy Weisman)				60				$3,000	$3,000				
SUB TOTAL	60	200		60	3,000	10,000		3,000	16,000				
TASK 1.0 ESTIMATE $16,000									$16,000				
Task 2: Construction													
Earthwork (excav, haul, grading)												$92,400	$92,400
LWD placement (130 pieces)												$32,500	$32,500
Erosion control and de-watering												$15,000	$15,000
Revegetation (2 acres)												$16,000	$16,000
LCFEG construction assistance			200				$10,000		$10,000				
SUB TOTAL			200				10,000		10,000			155,900	155,900
TASK 2.0 ESTIMATE $165,900									$10,000				$155,900
Task 3: Construction Support and Oversight (design team)													
Construction staking and layout												$4,700	$4,700
Construction oversight												$13,200	$13,200
Assistance during contracting												$2,640	$2,640
Permitting coordination												$5,280	$5,280
SUB TOTAL												25,820	25,820
TASK 3.0 ESTIMATE $25,820													$25,820
Task 4: Monitoring													
Implementation monitoring												$5,000	$5,000
SUB TOTAL												5,000	5,000
TASK 4.0 ESTIMATE $5,000													$5,000
TOTAL ESTIMATE **$212,720**									**$26,000**				**$186,720**

Eagle Island Project Identification and Design

Overview

Participants

- Eagle Island Technical Oversight Group

  (LCFRB, WDFW, PacifiCorp, Cowlitz Tribe, Clark County)

- Consultant Team

  (Inter-Fluve, Stillwater Sciences, Berger Abam)

Eagle Island Project Identification and Design

Existing Conditions

Data Sources

- Habitat surveys
- Fish juvenile rearing
- Fish spawning
- Geomorphology analysis
- Reach priorities

Conditions

- Used for Chinook rearing
- Chinook and steelhead spawning
- Dynamic channel adjustment area
- Affected by mining and development
- Hydrologic alterations
- Low levels of LWD
- Low pool frequency

Eagle Island Project Identification and Design

Project Objectives

- Promote **channel complexity and habitat-forming processes**.
- Increase the abundance and complexity of **off-channel and side-channel habitat**.
- Increase **pool habitat** quality and quantity.
- Increase the quality and complexity of existing **channel margin habitat** used for juvenile salmonid rearing and adult holding.
- **Increase LWD quantities** to greater than 57 pieces/100 meters (25 percentile historical modeled LWD frequency, Interfluve et al. 2008) to increase the availability of rearing and holding cover, complexity, and velocity refuge.
- **Restore a native** streambank, riparian, wetland, and floodplain **vegetation community** to provide stability, shade, wildlife habitat, and future LWD recruitment.

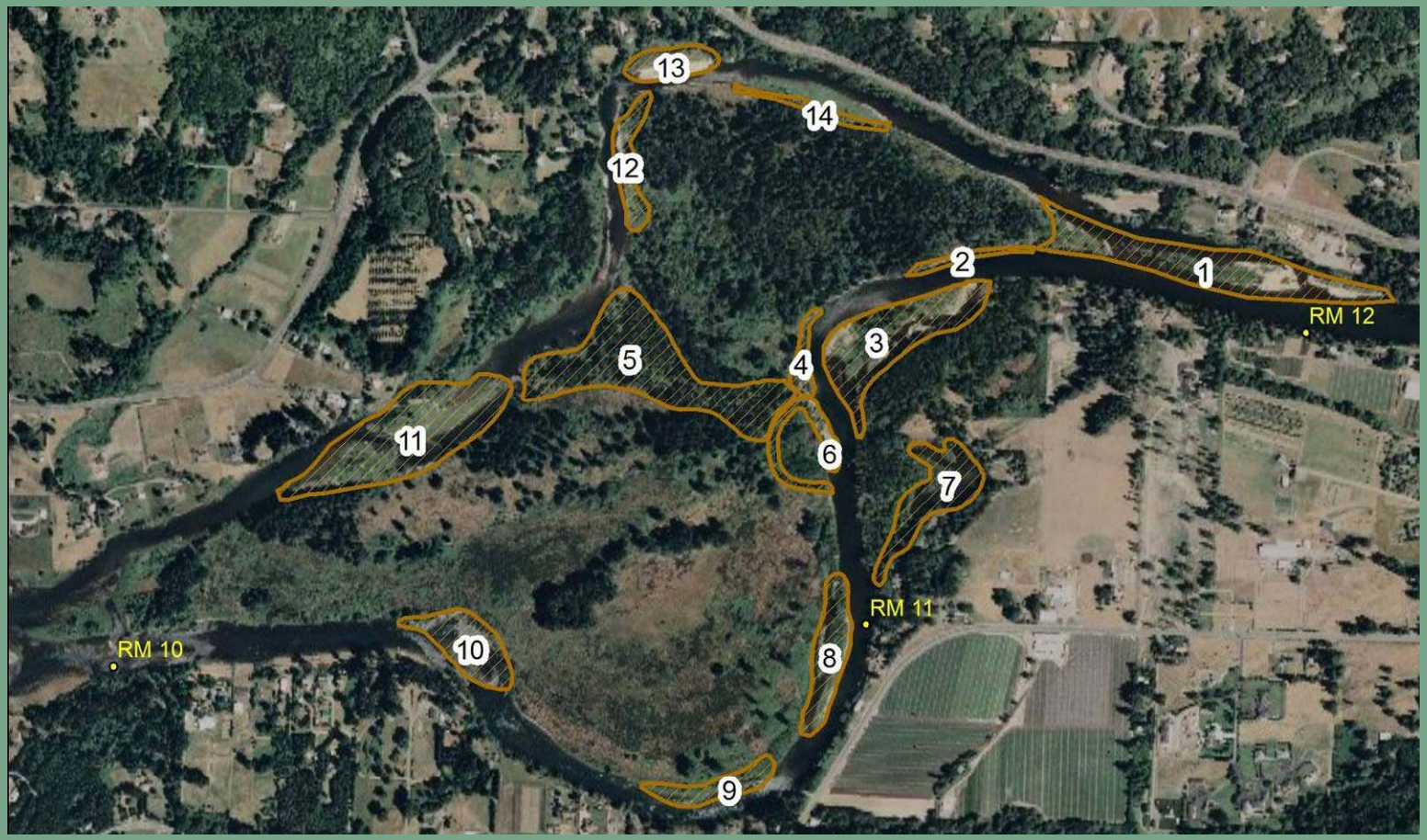
Eagle Island Project Identification and Design

Site Investigations / Project ID

- Inter-Fluve, Stillwater Sciences, Berger Abam Staff
- Looked at recommendations from previous studies
- Boat and foot-based site visits to look for opportunities
- Used historical aerial photos and LiDAR data to help ID sites
- Site descriptions and opportunities

Eagle Island Project Identification and Design

All Project Opportunities



Eagle Island Project Identification and Design

Top Three Project Opportunities

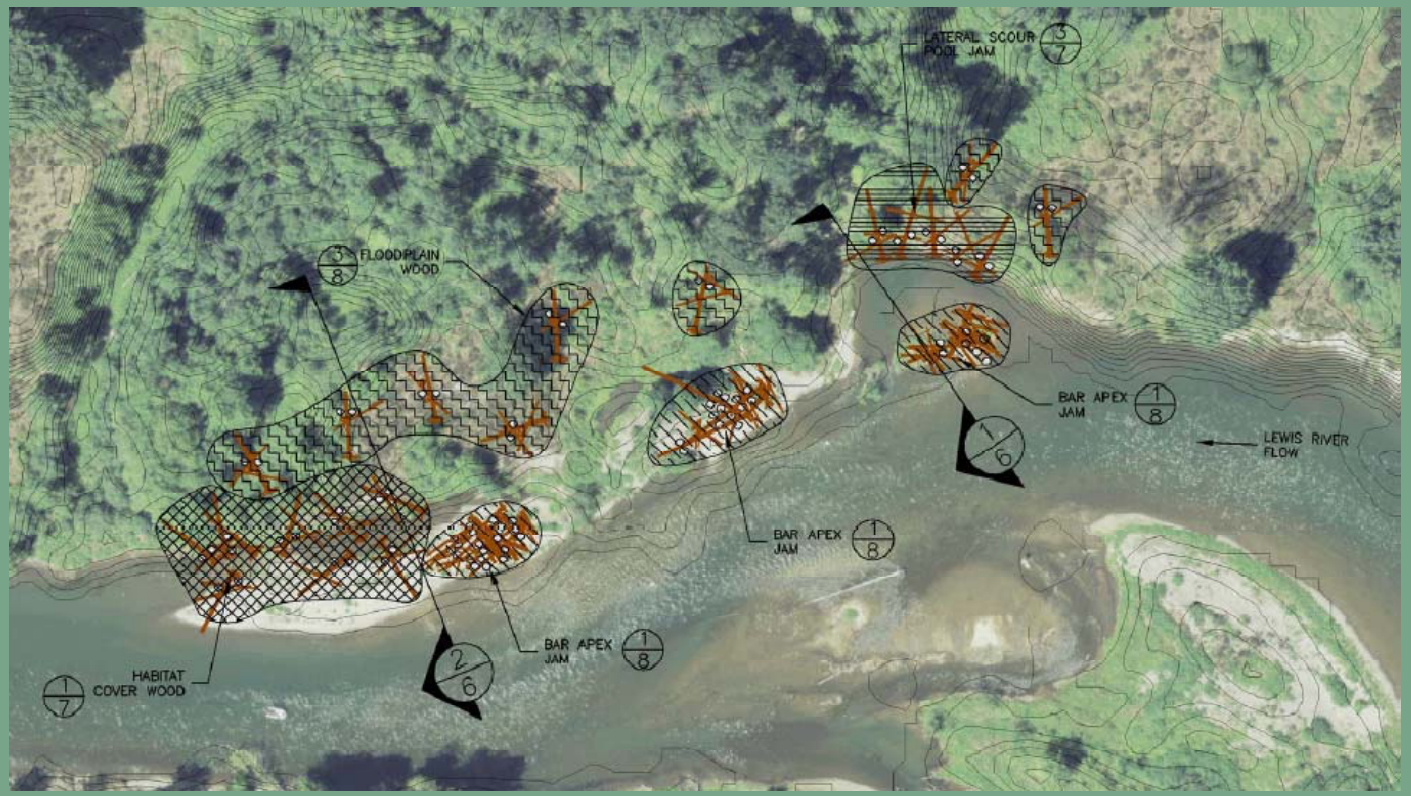
Eagle Island Project Identification and Design

Topographical Survey

Eagle Island Project Identification and Design

30% Designs (Site A, B, & C)

- Hydraulics & Geomorphology
- Vegetation surveys
- LWD buoyancy and scour
- Feedback from TOG
- Plan views & cross-sections
- Design details & typicals
- Access details
- Specifications
- Planting plan
- Materials requirements
- Engineer's cost estimate
- Design narrative



Eagle Island Project Identification and Design

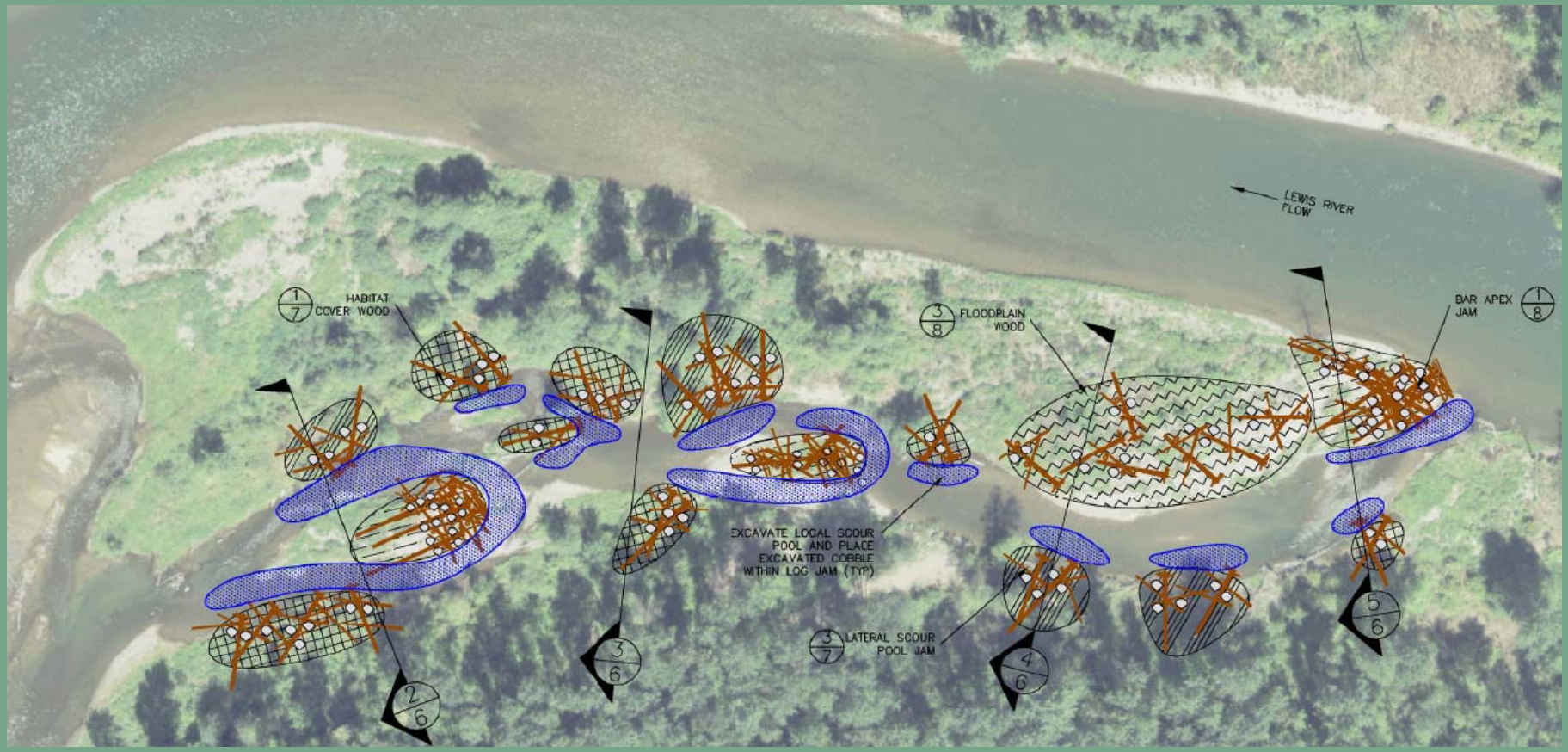
90% Design – Site A

Eagle Island Project Identification and Design

90% Design – Site A

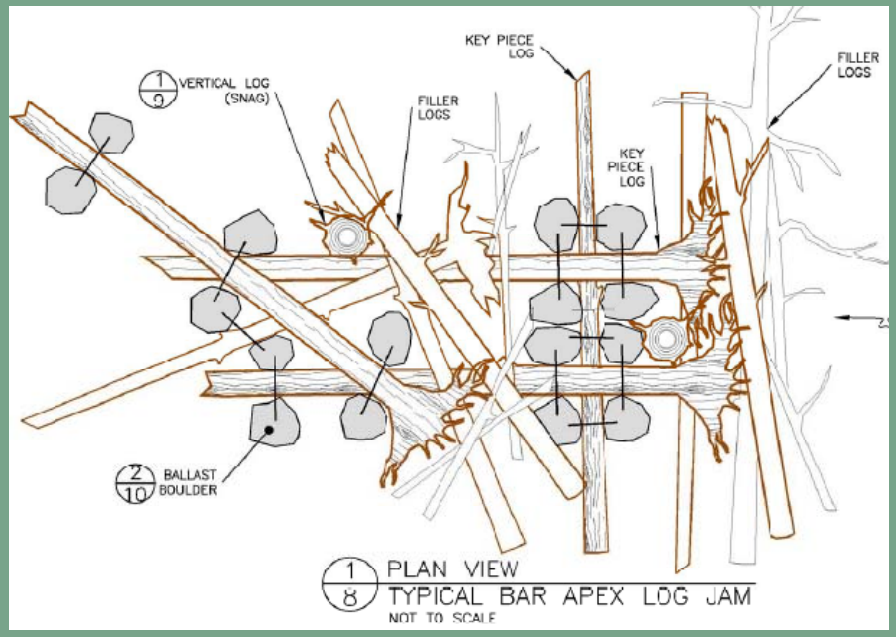
Eagle Island Project Identification and Design

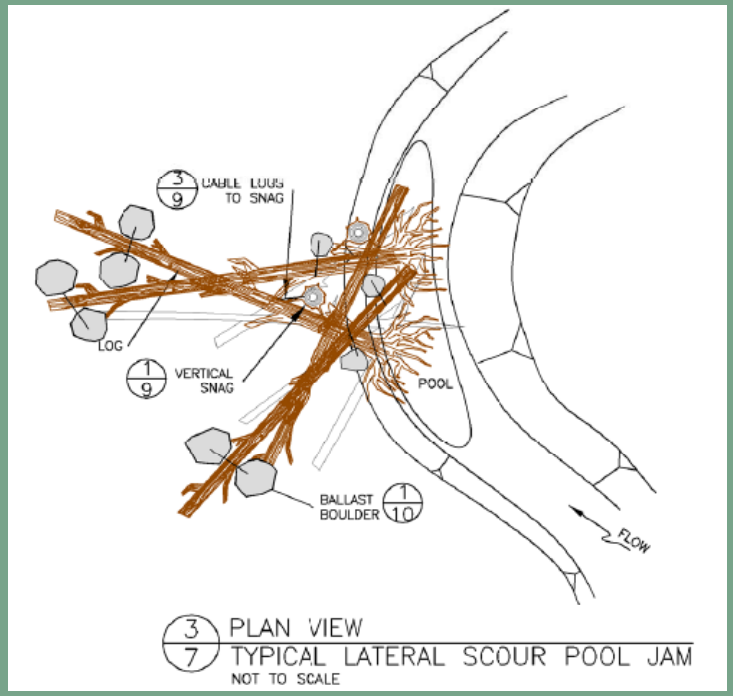
90% Design – Site A



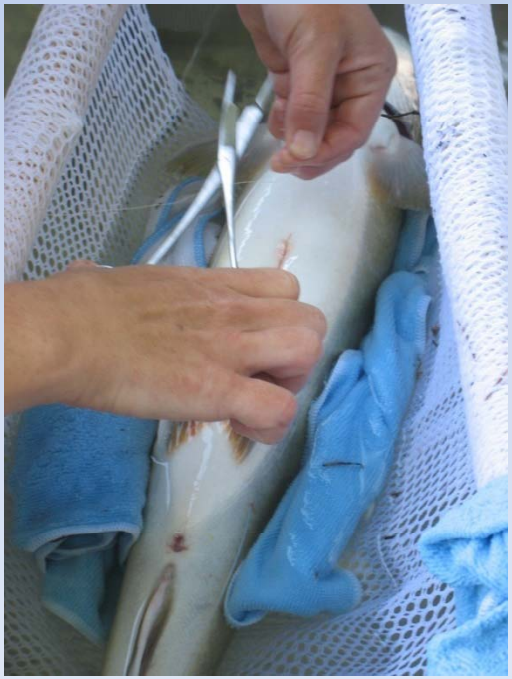
Eagle Island Project Identification and Design

90% Designs





Bull Trout Population Structure and Habitat Use in Tributaries to Swift Reservoir and the NF Lewis River



Project Manager:
Michael Hudson
Fish Biologist
US Fish and Wildlife Service
Columbia River Fisheries Program Office
Vancouver, WA

Problem

- With respect to funding “on the ground” activities to benefit bull trout in the Lewis River basin:
  - Lack of clear direction on types of projects to implement

Problem

Lewis River License Implementation
Lewis River Aquatics Fund - Bull Trout
Sections 7.5, 7.5.1, 7.5.3, 7.5.3.1 & 7.7

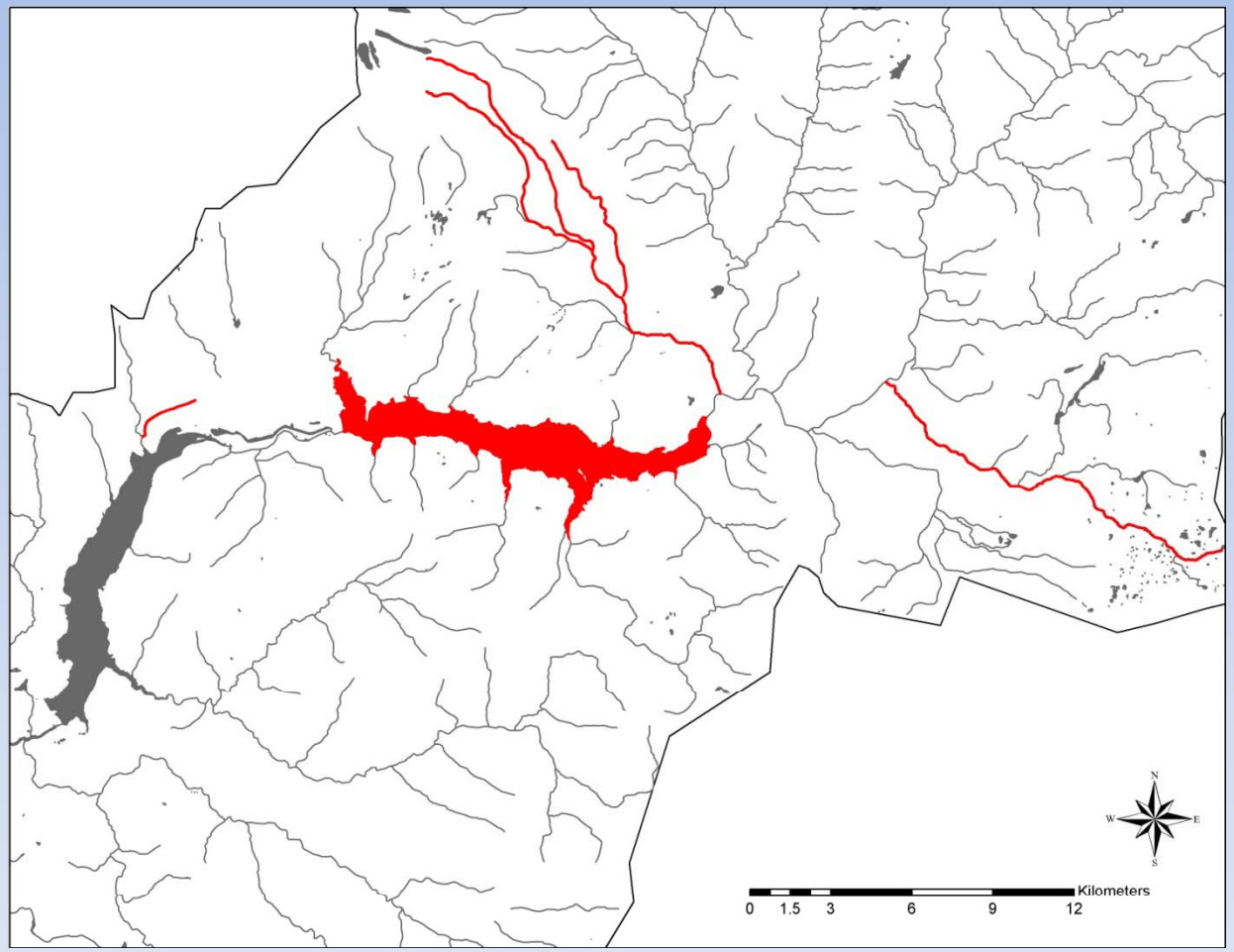
Funding Start Date: 4/30/05

Release Date	Funds Received	Expense	Interest	Balance	Notes
12/31/05				$ 161,327.11	Contributions in 2004 dollars, adjusted for inflation.
4/30/06	$ 106,086.01				
11/30/06		$ 37,889.08			Pine Creek Nutrient Enhancement - USDA FS
12/31/06			$ 19,176.61		
4/30/07	$ 163,897.54	$ 25,000.00			Pine Creek Instream & Floodplain Structures for Bull Trout and Steelhead - USDA FS
7/31/07		$ 20,000.00			Rush Creek Gravel Restoration - USDA FS
8/21/07		$ 43,150.00			2007 Pine Creek Nutrient Enhancement - USDA FS
12/31/07			$ 27,400.40		
4/30/08	$ 112,673.98				
7/3/08		$ 25,000.00			2008 Panamaker Crk. Rd Close & Culvert Removal - PacifiCorp *
3/25/09	$ 19,269.66				Return of funds: Rush Creek Gravel Restoration - USDA FS
3/31/09	$ 23,493.72				Return of funds: Pine Creek Instream & Floodplain Structures for Bull Trout and Steelhead - USDA FS
		Total Spent to Date:	$ 151,039.08		
		Balance Remaining:	$ 482,285.95		

Problem

- With respect to funding “on the ground” activities to benefit bull trout in the Lewis River basin:
  - Lack of clear direction on types of projects to implement
  - Lack of clear direction on locations of those projects to most benefit the recovery of this species

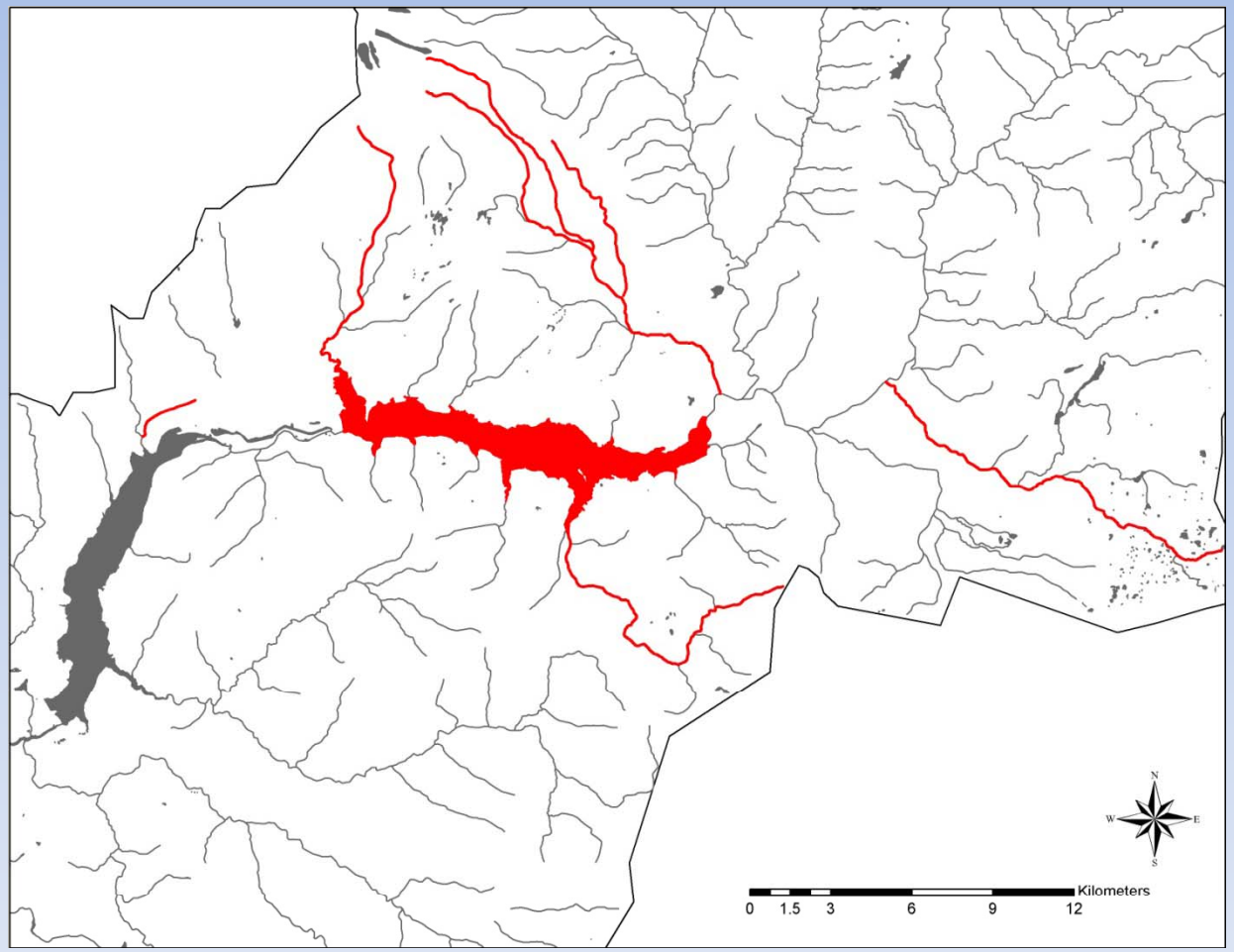
Problem



Problem

- Recent surveys have resulted in the capture of juvenile bull trout in additional tributaries
  - Swift Creek
  - Drift Creek

Problem



Problem

- Recent surveys have resulted in the capture of juvenile bull trout in additional tributaries
  - Swift Creek
  - Drift Creek
  - Muddy River?
- Distribution of bull trout and duration of use within these streams is poorly understood
  - How are these tributaries being used?
  - Are we currently limiting the geographic scope of projects?

Background

- Radio telemetry is commonly used to understand habitat use by bull trout (i.e., Jakober et al. 1998; Muhlfeld and Marotz 2005)
  - Cutthroat trout (i.e., Hilderbrand and Kershner 2000)
  - Razorback sucker (i.e., Tyus 1987)
  - Paddlefish (i.e., Zigler et al. 2003)
- Pallid sturgeon (Hurley et al. 2004)
  - Identified areas of highest use and preferred habitat
  - Recommended that preferred habitat areas should be given consideration for future projects aimed at creating pallid sturgeon habitat because they may be necessary for recovery of the species

Background

- Population structure using genetic analysis
  - Approach is well documented in bull trout
  - USFWS-Abernathy Fish Technology Center
    - Has conducted most of recent bull trout genetic analysis
    - Will be used on this project
  - Ties into other existing work to characterize genetic structure of bull trout in Cougar, Pine and Rush creeks

Goal and Objectives

- Describe bull trout population structure, distribution and temporal use of tributary habitats associated with Swift Reservoir and the NF Lewis to provide direction in future habitat improvement projects.
  - Describe spatial, temporal and functional use of tributary habitat by bull trout life stages
    - Provide a geographic focus and help define objectives for future habitat projects
  - Describe bull trout population structure
    - Assist in prioritizing these projects

Objectives

- Consistent with Aquatics Fund objectives
  - Benefits Federally listed bull trout
  - Does not impact reintroduction of anadromous species
  - Provides direction for future enhancement to fish habitat
- Implements actions and associated tasks identified in the draft Recovery Plan (USFWS 2002)

Objectives

- Implements actions identified in the Lewis River Bull Trout Action Plan (USFWS 2008)
- Provides guidance and information for prioritized measures to benefit bull trout and salmon identified in the Lower Columbia Salmon Recovery 6-Year Habitat Work Schedule and Lead Entity Habitat Strategy (LCFRB 2009)

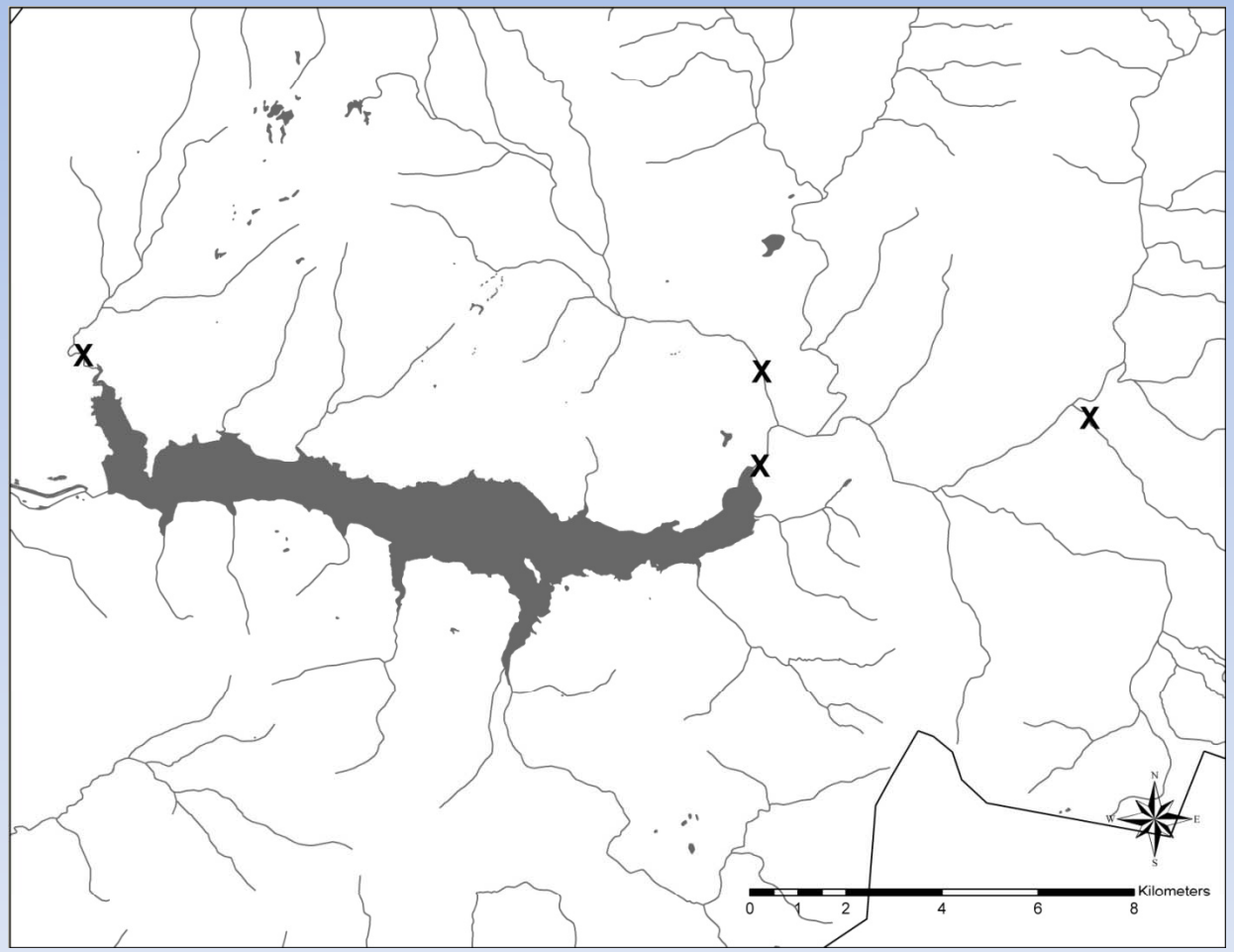
Tasks

- Secure funding – May/June 2010
- Purchase radio tags and monitoring equipment – June 2010
- Install monitoring equipment – August 2010
- Collect and radio tag bull trout – August 2010
- Monitor/track radio tagged bull trout – September 2011
- Analyze data and compile annual and completion reports – February 2011/2012

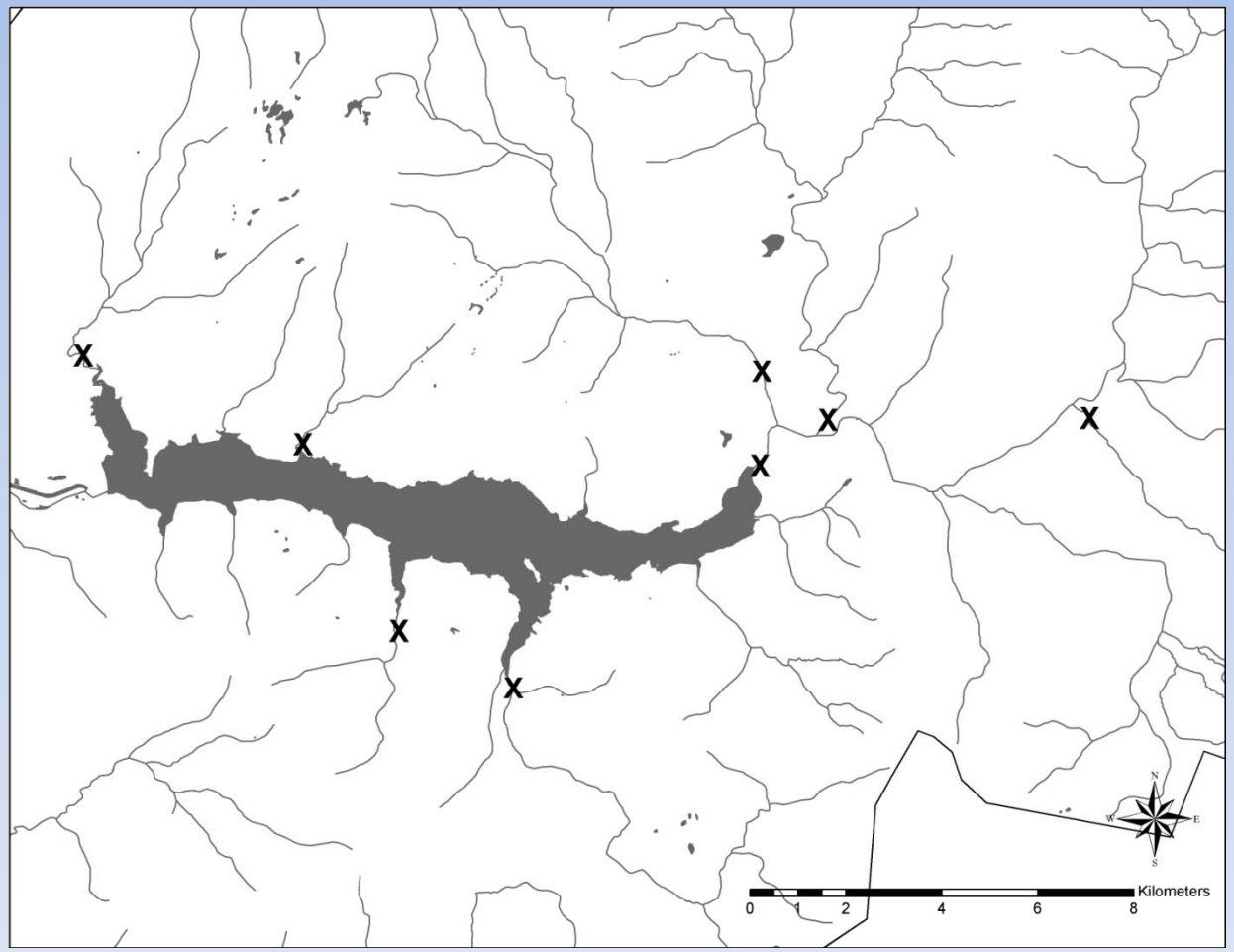
Methods

- Capture juvenile and adult bull trout using electrofishing and nets from Swift, Drift, Range and Marble creeks
- Radio tags will be surgically implanted in up to 40 fish with transmitters that have at least a one year life span
- Remote monitoring equipment will be set up and maintained near the mouths of these tributaries and the Muddy River

Methods



Methods



Methods

- Data will be downloaded approximately every 10 days
- Antennas will provide entry/exit time for fish using these tributaries (temporal use)

Methods

- Mobile tracking will be conducted approximately every 10 days to determine spatial/functional use of tributaries by bull trout
  - Spatial
    - Where are fish located in stream?
  - Functional
    - What type of habitat?
    - What time of year?

Methods

- Genetic samples will be collected at the time of tagging
- Samples analyzed by AFTC
- Genetic profiles of each fish will be compared to baseline being established for Cougar, Pine and Rush creeks
- Results will provide quantitative likelihood that tagged fish originated from one of these populations

Specific Work Products

- Annual report – Winter 2010/2011
- Completion report – Winter 2011/2012
- Findings will provide guidance toward geographic scope and objectives of future proposed habitat improvement projects to benefit bull trout
- Preliminary information will be available for funding cycle that begins in Fall 2011
- Monitoring will continue beyond CY2011

- Permits, Partners, Budget, and Cost Share are covered in proposal
- Any questions?

Low Impact Hydro Certification

As it relates to the Lewis River Hydro Projects

Purpose of Low Impact Certification

- To provide market incentive to reduce impacts of hydro generation
- To provide a credible and accepted standard for consumers to use in evaluating hydropower

What is LIHI?

- A non-profit entity governed by a Board with majority membership from environmental organizations
- Initiated by American Rivers, Green Mountain Energy and CRS/Green-e
- Formed in response to:
  - Deregulation at the state level
  - Emergence of “green power” programs and products
  - Concerns over assertion that all hydro is “green”
  - Concerns with the “small hydro” standard for green labeling

LIHI Program Focus

- Develop criteria to identify existing hydropower dams whose impacts are low relative to other hydropower facilities – 'Low impact' does not mean no impact
- Applies to existing dams only
- General standards:
  - Most recent (post 1986) FPA Amendments
  - Most stringent=most environmentally protective
  - Resource agency acceptance=state, tribal or federal
  - Recommendation=formal recommendation in relevant administrative proceeding
  - Settlement Agreement can serve as the standard

LIHI Criteria Areas

- River flows
- Water Quality
- Fish Passage and Protection
- Watershed Protection
- T&E Species Protection
- Cultural Resources Protection
- Recreation Use and Access
- Not recommended for Removal

River Flow

- Provide river flows that are healthy for fish, wildlife, and water quality
- A certified facility must comply with recent resource agency recommendations for flows

Water Quality

- Water quality in the river is protected
- Facility must demonstrate that it is in compliance with state water quality requirements by producing recent Clean Water Act Section 401 Certification
- Facility must demonstrate that it has not contributed to a state finding that the river has impaired water quality under CWA Section 303(d)

Fish Passage and Protection

- Facility must provide effective fish passage for riverine, anadromous and catadromous fish and also protect fish from entrainment
- Facility must be in compliance with recent mandatory prescriptions regarding fish passage
- If anadromous fish historically passed through the facility area but are no longer present, the facility must show that it has made a legally binding commitment to provide future fish passage recommended by a resource agency

Watershed Protection

- Sufficient action has been taken to protect, mitigate and enhance environmental conditions
- Facility must be in compliance with resource agency recommendations and FERC license terms regarding watershed protection and enhancement

T&E Species Protection

- The facility does not negatively impact state or federal endangered species
- For T&E Species present in the facility area, the owner/operator must demonstrate compliance with the species recovery plan and any requirements for authority to “take” the species under federal or state laws

Cultural Resource Protection

- Facility does not inappropriately impact cultural resources
- Cultural resources must be protected through compliance with FERC license provisions

Recreation Use and Access

- Facility provides free access to the water and accommodates recreational activities on the public's river
- Facility must be in compliance with terms of its FERC license

Northwest Projects that have been certified

- Tieton dam, Washington
- Lake Chelan dam, Washington
- Pelton-Roundbutte, Oregon
- Nisqually Project, Washington

Projects already certified by LIHI

Tieton Dam, WA

Owner: US Bur. Reclamation
198,000 ac-ft
13.6 mW
Species:
Bull trout
Kokanee
Rainbow Trout
Cutthroat trout
Steelhead
Spring Chinook

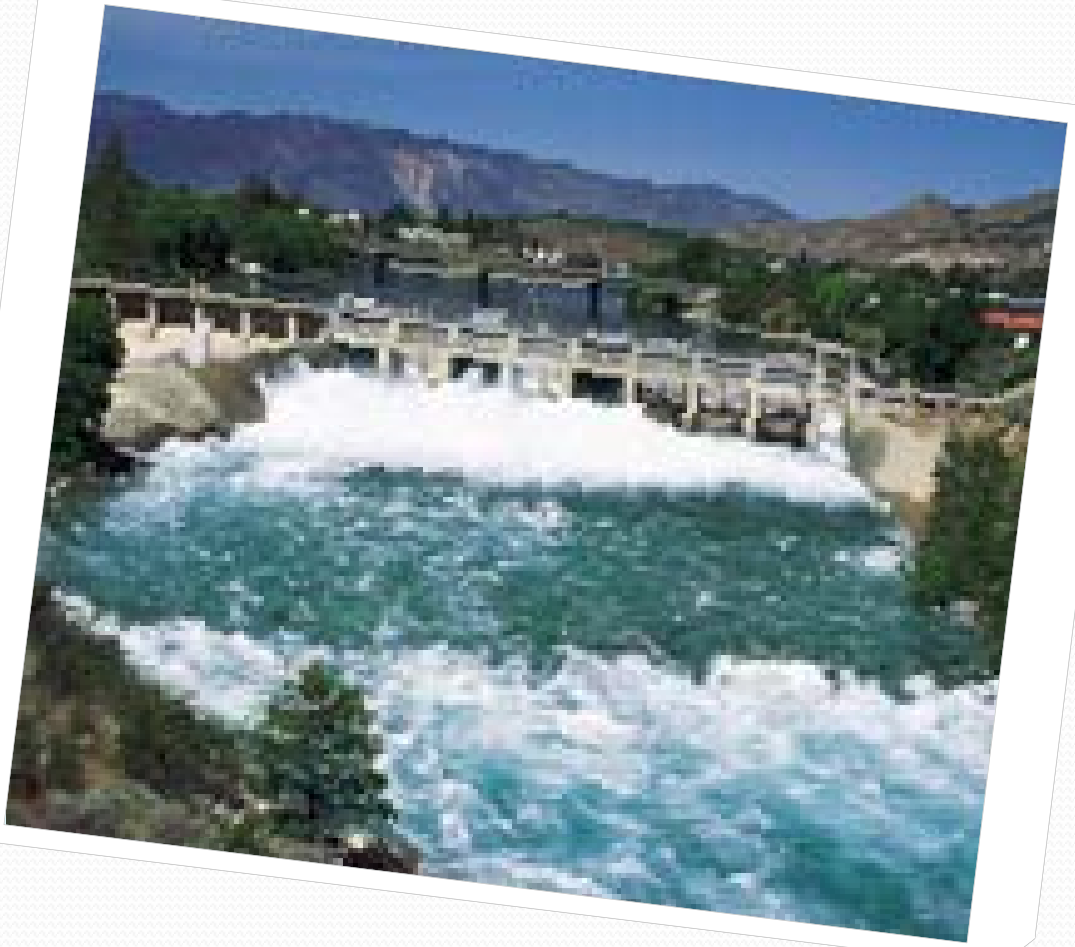
Uncontested

Projects already certified by LIHI

Lake Chelan, WA

Owner: Chelan Co. PUD
677,000 ac-ft
48 mW
Species:
Bull trout
UCR steelhead
UCR spring Chinook

Uncontested



Projects already certified by LIHI

Pelton-Roundbutte, OR

Owner: Portland General Elec.
535,000 ac-ft
366.8 mW
Species:
Bull trout
Kokanee
Fall/spring Chinook
Steelhead

Uncontested

Projects already certified by LIHI

Nisqually, WA

Owner: Tacoma Electric
114 mW
3,065 acres
Species:
Chinook
Coho
Bull trout

Uncontested

Why does PacifiCorp want LIHI Certification?

- The Oregon renewable energy portfolio standard (Senate Bill 838) and Utah Energy resource Carbon Emission Reduction Initiative (SB 202) require large utilities to rely on renewable energy sources to provide a certain percentage of their retail sales
- Initially the requirement is 5 percent by 2011. This gradually increases to 25 percent by 2025
- Three ways to meet requirement:
  - Low impact hydro facilities – up to 50 average megawatts
  - Efficiency upgrades
  - New facilities operation since January 1995
- The best and most timely method for PacifiCorp to meet SB 838 and SB 202 is low impact certification

How does PacifiCorp Benefit from Certification?

- PacifiCorp meets OR SB 838 and UT SB 202
- PacifiCorp could market the power produced as a renewable resource choice for consumers but not until the facilities have received a Green-e certification
- Green-e certification is an expensive process that PacifiCorp is not currently pursuing
  - Annual renewal fees are steep (>$28,000 annually)

How does PacifiCorp Qualify for Low Impact Hydro Certification?

- A multi-agency/party Settlement Agreement
- CWA Section 401 Certifications
- Fish Passage Plan
- Land Purchases, Shoreline Management Plan, Wildlife Habitat Management Plan
- Entrainment Reduction, Raptor roost and nest surveys with protection plans
- Historic Resources Management Plan
- Recreation Management Plan and facility upgrades

Settlement Agreement

- Twenty-six Parties to the Settlement Agreement with the goal of "Including measures to protect and enhance fish, wildlife, and other ecological resources affected by the Lewis River Projects while providing other beneficial uses, including hydroelectric generation, flood management, and recreation" (SA 1.2)

River Flow

- PacifiCorp is implementing and monitoring agreed upon flows downstream of Merwin and in the Swift bypass reach
- PacifiCorp is meeting ramping and plateau requirements
- All operational changes (except emergencies) consider aquatic life as a first step

Water Quality

- PacifiCorp is meeting Clean Water Act Section 401 Water Quality Certification requirements which include the following:
  - Meeting instream flow requirements
  - Meeting Total dissolved gas requirements
  - Providing temperature, TDG and spill abatement plans

Fish Passage and Protection

- PacifiCorp is meeting all milestones related to Phase I of the Fish Passage requirements
- The SA calls for eventual passage at all the projects
- PacifiCorp has implemented bull trout interim passage measures and the Yale Entrainment reduction net

Watershed Protection

- PacifiCorp established watershed enhancement funds including the Aquatics Fund, and three Land acquisitions funds per the SA
- PacifiCorp has developed and is implementing a Wildlife Habitat Management Plan
- PacifiCorp voluntarily developed and is implementing a Shoreline Management Plan for the three reservoirs

T&E Species Protection

- PacifiCorp is in compliance with relevant recommendations from recovery plans developed for the threatened species present in the project area
- NMFS and USFWS issued BiOps for the Lewis River Project operations and PacifiCorp is in full compliance with both
- The FERC licenses include the terms and conditions of the BiOps

Cultural Resource Protection

- PacifiCorp is in compliance with the cultural resource requirements of the SA and is operating under the Historic Properties Management Plan

Recreation Use and Access

- PacifiCorp is in compliance with recreation access, accommodations and facility conditions in the SA and the FERC license
- PacifiCorp has recently completed a Master Plan to upgrade the recreation facilities

Why Should the Lewis River Projects be Certified?

- PacifiCorp is working hard to meet the SA and license requirements
- The comprehensive SA package insures steadily improving environmental conditions and re-establishment of natural runs of anadromous salmon and steelhead
- PacifiCorp has a fifty-year commitment to maintain a quality environment for terrestrial and aquatic species, recreation users, cultural preservation and flood management