Priest Rapids Coordinating Committee

Wednesday, October 29, 2014
9:00 – 2:00
SeaTac Radisson Hotel
Audio: 1-800-977-8002 Bridge: 45582544
https://grantpud.webex.com/grantpud/j.php?MTID=m3050f8f5182b6caafb34510f58f0210e

PRCC Members

Scott Carlon/Justin Yeager (Alt), NMFS
Bob Rose, YN
Jeff Korth, C. Andonaegui (Alt), P. Verhey (Alt) WDFW
Curt Dotson, Tom Dresser (Alt), GCPUD
Jim Craig, USFWS
Kirk Truscott, CCT
Tom Skiles, CTUIR
Denny Rohr, Facilitator

Meeting Agenda

I. Welcome and Introductions

II. Meeting Minutes Approval – September 24, 2014

III. Agenda Review

IV. Action Items Review – September 24, 2014

V. Update of Wanapum Dam Activities (T. Dresser)

VI. Survival/Behavioral Studies Draft Report -- John Skalski, Skalski Statistical Services; Mark Timko, Blue Leaf Environmental (C. Dotson)

VII. Review of Schedule for Avian Predation Reporting – November 19th Meeting Schedule (C. Dotson, D. Rohr)

VIII. Potpourri (D. Rohr)

IX. Updates

A. Inland Avian Predation Activities (C. Dotson)

B. Priest Rapids Bypass Operation (C. Dotson, T. Dresser)

C. Hatchery Activities (T. Dresser)

1. Carlton Acclimation Facility

2. Nason Creek Acclimation Facility

3. Priest Rapids Hatchery Modifications

4. Penticton Hatchery

D. Hatchery Permits (Section 10 for Summer Chinook and Section 7 Consultation for Bull Trout. (T. Dresser)

E. NNI Funded Projects

1. Real Time Research Avian Study (C. Dotson)

   ** Including "Comprehensive Assessment of Total Smolt Mortality in Relation to Avian Predation on the Mid- and Lower Columbia River: Spatial and Temporal Analysis of Reservoir-Specific Smolt Losses"

2. Supplementary Tags and Tagging for Assessment of Predation Losses of Subyearling Chinook Salmon in the lower Hanford Reach and Upper McNary Reservoir (C. Dotson)

3. Upper Columbia Fish Screen Monitoring Program Phase I Contract Extension (J. Korth)

4. Upper Columbia Fish Screen Monitoring Program Phase II – (J. Korth)

5. Lower Wenatchee Instream Flow Enhancement Project Phase II – (J. Korth)

6. Mid-Columbia River Intake Screen and Diversion Assessment (T. Dresser)

7. Methow Valley Irrigation District (MVID) Instream Flow Improvement Project (T. Dresser)

F. Committee Reports (D. Rohr)

G. NNI and Habitat Funds Report (D. Rohr)

H. Other

X. Review of Next Month's Agenda Topics (D. Rohr)

Next Meeting – To Be Discussed (November 19, 2014)

Grant County
PUBLIC UTILITY DISTRICT
Excellence in Service and Leadership

Priest Rapids Coordinating Committee Meeting

Wednesday, October 29, 2014
SeaTac Radisson Hotel

PRCC Members

Scott Carlon, Justin Yeager, NMFS
Bob Rose, YN
Jeff Korth, C. Andonaegui, P. Verhey, WDFW
Curt Dotson, Tom Dresser GCPUD
Jim Craig, USFWS
Kirk Truscott, CCT
Tom Skiles, CTUIR
Denny Rohr, Facilitator

Attendees

Scott Carlon, NMFS
Bob Rose, YN (Via phone)
Kirk Truscott, CCT (Via phone)
John Skalski, University of Washington
Leah Sullivan, Blue Leaf Environmental
Curt Dotson, GCPUD
Debbie Williams, GCPUD (Via phone)
Jeff Korth, WDFW
Tom Skiles, CTUIR
Jim Craig, USFWS (Via phone)
Mark Timko, Blue Leaf Environmental
Kyle Hatch, Blue Leaf Environmental
Tom Dresser, GCPUD
Denny Rohr, Facilitator

Decision Summary:

1. PRCC members agreed that an extension of time be granted to PNNL for the JSATS Subyearling Study in the Hanford Reach.
2. PRCC members approved moving the 2016 sockeye survival study to 2015.

Action Items:

1. Dotson will distribute the PowerPoint presented by Blue Leaf Environmental.
2. Survival study reports will be distributed prior to the November 19th PRCC meeting.
3. Dotson will draft an SOA moving the 2016 sockeye survival study to 2015.

Final Meeting Minutes

I. Welcome and Introductions

II. Meeting Minutes Affirmation and Approval:

A. September 24, 2014 – Approved

III. Agenda Review – Dotson asked that the Pacific Northwest National Laboratory (PNNL) Statement of Work regarding the Hanford Reach Fall Chinook Protection Program, and the 2016 sockeye survival study, be added to the agenda.

IV. Action Items Review – September 24, 2014 Meeting – Craig approved the August 27, 2014 PRCC meeting minutes.

V. PNNL Statement of Work Extension – Dotson explained that PNNL has requested that the contract be extended from November 2014 to December 31, 2014 in order to complete reporting requirements on the NNI co-funded JSATS Subyearling Study in the Hanford Reach. No additional funds or change of scope were requested, it is merely an extension of time for report writing. PRCC members agreed that an extension of time be granted to PNNL.

VI. 2016 Sockeye Survival Study - Dotson recommended moving the sockeye JSATS behavioral/survival study scheduled for 2016, up to 2015 because of the noticeable decrease in NOAA Science Center sockeye passage (PIT tag) survival estimates seen in 2014, and address others' questions of whether the Priest Rapids' newly constructed Fish Bypass was a factor in their lower sockeye survival estimate. PRCC members approved moving the 2016 sockeye survival study to 2015. Dotson will draft an SOA moving the 2016 sockeye survival study to 2015.

VII. Update of Wanapum Dam Activities (C. Dotson) – Grant PUD provided an update on issues at Wanapum Dam resulting from the fracture. The update described the successful passage of lamprey, ongoing cleaning of aquatic vegetation from the fish ladder pump screens, and the status of installation of tendons in the monolith piers. Spawning ground surveys in the Hanford Reach started on 10/19/14, and reverse load factoring will be in effect from 10/15/14 to 11/23/14. Development of a refill plan continues. The plan will allow the pool to be operated from 558' to 562'. Although the target refill time has not been determined, it is expected to occur between October and December 2014. Prior to implementation, the refill plan must be approved by the Board of Consultants and FERC.

VIII. Survival/Behavioral Studies Draft Report - John Skalski, Skalski Statistical Services; Mark Timko, Blue Leaf Environmental (C. Dotson) – Kyle Hatch, Blue Leaf Environmental, presented a PowerPoint "Grant County PUD 2014 Steelhead and Yearling Chinook Acoustic Tag Study" (attached) that summarized preliminary draft results of the 2014 spring acoustic-tagged steelhead and yearling Chinook study in the Priest Rapids Project (see attached draft). 2014 was the inaugural season of passage at the Priest Rapids Fish Bypass (PRFB), and passage issues created by the Wanapum fracture were discussed. Less than 10% of both species used the Wanapum fish bypass, (which passed 4 kcfs) but both species of study fish utilized the PRFB. Because of water flows, Wanapum Dam has operated in fish mode since the fracture occurred. The final report is due in mid-November. Dotson will distribute the PowerPoint presented by Blue Leaf Environmental.

John Skalski, University of Washington, presented a PowerPoint "Spring 2014 Survival Results for Yearling Chinook Salmon and Steelhead at Wanapum and Priest Rapids Dams" (attached) summarizing preliminary survival results. The final report is not complete, but will be distributed prior to the November 19th PRCC meeting.

IX. Review of Schedule for Avian Predation Reporting – November 19th Meeting Schedule (C. Dotson, D. Rohr) – Reports are still being drafted. Dan Roby, Oregon State University, and

Allen Evans, Real Time Research will present findings of PIT-tagged steelhead and yearling Chinook smolts tagged and released into the Rock Island tailrace to evaluate avian predation. Of the 28 satellite tagged Caspian terns tagged on Goose Island, 24 tags are still producing information. It's anticipated that the tags will collect data until June/July 2015. 23 birds are presently over-wintering in Mexico and one at the Salton Sea (CA). Updates will be provided on Goose Island, as well as what's anticipated for Northwest Rocks.

X. Hanford Reach Fall Chinook Protection Program – Dresser explained that the Hanford Reach Fall Chinook Protection Program Agreement (HRFCPPA), dated April 19, 2004, replaced the 1988 Vernita Bar Agreement which provided critical elevation for spawning areas and protection pre-hatch, post-hatch. THE HRFCPPA provided additional flow protections during rearing because of stranding and entrapments. Every year, on October 15th, Grant PUD initiates reverse load factoring in order to set flow bands for the initiation of spawning below 50k. This target assures that redds will remain covered with water at all times. Once 5 redds between 36k and 50k, and 31 redds above 65k are counted, initiation of spawning is established. Once initiation of spawning is set, Grant PUD tracks temperature units (TU). When 1000 TU is reached, emergence occurs and rearing protection flows are then developed.

Signatories to the ten year HRFCPPA are NOAA Fisheries, WDFW, USFWS, YN, Chelan PUD, Douglas PUD, the Colville Tribes and Bonneville Power Administration. Ten years following the effective date of the HRFCPPA, any party may petition to reopen the agreement. There are also additional requirements related to the Hanford Reach that were required under the 401 Certifications issued by WDOE, one of which included a flow fluctuation study. All information is due to FERC in April 2015.

XI. Updates

A. Inland Avian Predation Activities (Goose Island / NW Rocks Follow Up) (C. Dotson) – The Army Corp of Engineers will hold an avian predation workshop in Walla Walla on 12/3/2014.

B. Priest Rapids Bypass Operation (C. Dotson) – Bay 22, which has an ice/trash sluice gate, is being used for adult fallback, the other two gates are closed.

C. Ladder Operations at Wanapum Dam – On 11/17/14, left bank ladder at Wanapum and the right bank ladder at Priest Rapids will be dewatered for maintenance. On 11/17/14, additional equipment used for the Wanapum drawdown will be removed from the Wanapum left bank ladder. The left bank ladder will remain dewatered until the end of December. Equipment will be removed from the Wanapum right bank ladder after the pool raise occurs. The opposite bank ladders will be in full criteria during the period the other bank ladder is taken out of operation.

D. Wild Broodstock Collection Event – On October 25th, over 300 ad-present fish were caught via rod/reel in the Hanford Reach, during the annual wild broodstock collection event. The purpose of this event is to catch wild broodstock for the Priest Rapids Hatchery.

E. Hatchery Activities (C. Dotson, J. Korth)

1. Carlton Acclimation Facility – No update provided.

2. Nason Creek Acclimation Facility – PRCC members were invited to the dedication ceremony on November 13, 2014.

3. PR Hatchery Modifications – Korth reported that hatchery staff has been happy with the volunteer trap operations this year.

4. Penticton Hatchery – No update provided.

F. Hatchery Permits (Section 10 for Summer Chinook and Section 7 Consultation for Bull Trout – No update provided.

G. NNI Funded Projects

1. Real Time Research Avian Study (C. Dotson) – Draft results will be forthcoming.

   ** Including "Comprehensive Assessment of Total Smolt Mortality in Relation to Avian Predation on the Mid- and Lower Columbia River: Spatial and Temporal Analysis of Reservoir-Specific Smolt Losses."

2. Supplementary Tags and Tagging for Assessment of Predation Losses of Subyearling Chinook Salmon in the lower Hanford Reach and Upper McNary Reservoir (C. Dotson) – Battelle is analyzing data; a draft report will be forthcoming.

3. Upper Columbia Fish Screen Monitoring Program Phase I Contract Extension (J. Korth) – No update provided.

4. Upper Columbia Fish Screen Monitoring Program Phase II – (J. Korth) – No update provided.

5. Lower Wenatchee Instream Flow Enhancement Project Phase II – (J. Korth) – No update provided.

6. Mid-Columbia River Intake Screen and Diversion Assessment – Korth reported that Danny Didricksen, WDFW, will be utilizing a diving contract Grant PUD already has in place for this project. Didricksen hopes to have divers in the water by 11/10/14.

7. Methow Valley Irrigation District (MVID) Instream Flow Improvement Project (T. Dresser) – Dresser reported that Trout Unlimited is progressing with this project and that Grant PUD has received invoices for land appraisals.

H. Committee Reports (C. Dotson) – Distributed via email.

I. NNI and Habitat Funds Report (C. Dotson) – Distributed via email.

XII. Review of Next Month's Agenda Topics (D. Rohr) – Further discussion of Survival/Behavior Study Reports; Avian Predation presentation by Dan Roby/OSU and Allen Evan/Real Time Research.

XIII. Next Meeting November 19, 2014, SeaTac Radisson Hotel. All agreed the December meeting will be changed to the 17th due to the Christmas Holiday.

DRAFT MEMORANDUM
TO: Curt Dotson, Public Utility District No. 2 of Grant County (Grant PUD)
FROM: Leah Sullivan *(on behalf of Blue Leaf Environmental)*
DATE: October 24, 2014
SUBJECT: Summary of Grant PUD 2014 preliminary, draft results

The purpose of this memorandum is to summarize the preliminary draft results from the Grant PUD 2014 spring acoustic-tagged steelhead and yearling Chinook that were released and monitored through the Priest Rapids Project (hereafter Project) area. All juvenile salmonids were tagged with unique JSATS and PIT tags (Lotek *Model L-AMT-1.421* JSATS acoustic transmitter, 11.1 x 5.5 x 3.7mm, 0.32 g in air, three second burst; Biomark PIT tag, 12 mm). Results include estimates of migration egress and survival through the Project area, dam, and by reach, as well as residence times and route passage estimates at Wanapum and Priest Rapids dams (proportion that passed through each available route, fish passage efficiency through non-turbine routes, and relative survival by route).

Survival estimates are shown by species and Project area; Wanapum Development is defined as the Wanapum Reservoir and dam and the Priest Rapids Development is defined as the Priest Rapids Reservoir and dam. Three-dimensional positions of fish in the forebay of Priest Rapids Dam at or near the new top-spill bypass were finalized for spatial analysis by Teknologic Engineering on October 23, 2014. Analysis of these results has just begun and were not available for inclusion in this document.

Release Quantities

Steelhead (run-timing relative to DART index 8th to 92nd percentile)

- Rock Island: 399
- Wanapum: 771
- Priest Rapids: 550

Yearling Chinook (run-timing relative to DART index 12th to 89th percentile)

- Rock Island: 398
- Wanapum: 769
- Priest Rapids: 549

Project Survival

Steelhead

- Wanapum Development: 92.94 (SE 1.40%)
- Priest Rapids Development: 96.13 (SE 0.98%)
- Joint Wanapum-Priest Rapids Project: 89.34 (SE 1.63%)

Yearling Chinook

- Wanapum Development: 94.48% (SE 1.28%)
- Priest Rapids Development: 96.12% (SE 0.87%)
- Joint Wanapum-Priest Rapids Project: 90.82% (SE 1.48%)

Dam (Concrete) Survival

Summary of dam (concrete) survival point estimates of steelhead and yearling Chinook at Wanapum and Priest Rapids dams. Asterisk indicates where treatment fish (i.e. fish detected in the forebay of Wanapum Dam passing downstream) survived at higher rates than control fish released 0.5km downstream of the dam.

	Ricker Survival Estimates	
Year	Wanapum	Priest Rapids
Steelhead		
2014	0.978	0.985
2010	*1.013	0.997
2009	*1.025	0.983
2008	0.995	0.952
Chinook		
2014	0.988	0.971

Reach Specific Survival

Reach survival is averaged for release groups in areas of mixing (i.e., between Priest Rapids Dam and Vernita Bridge, reach specific survival is averaged for all three groups of fish released in the tailraces of Rock Island, Wanapum, and Priest Rapids dams and was at or above 95.6% for both species.

Reach	River Mile	Survival	
		Yearling Chinook	Steelhead
Rock Island tailrace to Crescent Bar	453-441	0.9875	0.9986
Crescent Bar to Sunland Estates	441-428	0.9934	0.9957
Sunland Estates to Wanapum	428-416	0.9876	0.9575
Wanapum to Mattawa	416-408	0.9885	0.9844
Mattawa to Priest Rapids	408-397	0.9926	0.9764
Priest Rapids to Vernita Bridge	397-388	0.9781	0.9770
Vernita Bridge to White Bluffs	388-368	0.9848	0.9607
White Bluffs to Hanford Reach	368-339	0.9872	0.9741

Egress Travel Times

Steelhead

- Migration rates were markedly faster for all reaches relative to historical rates
- Cumulative median migration rate from the Rock Island tailrace to Wanapum Dam was 20.7 hr; a 55.5% decrease over the average median in 2006-2010, 2011.
- Egress rates between Mattawa and Priest Rapids Dam recorded a noteworthy decrease (Δ-18.0% at 13.2 hr).
- Migration to in-river sites immediately below the dams varied
    - migration to Vernita Bridge decreased (Δ-14.3%, 1.8 hr)
    - Mattawa more closely followed historical trends (Δ-1.8% at 2.6 hr)
    - Median travel times of 5.4 hours (Vernita Bridge to White Bluffs) and 8.5 hours (White Bluffs to the Hanford arrays)

Yearling Chinook

- Migration rates were similar to 2006-2010 median averages.
- Migration from Wanapum Dam to Mattawa slightly increased by 4.8% at 3.3 hr, while migration to Vernita Bridge did not deviate from previous years (Δ0.0% at 2.0 hr).
- Only notable variation in travel time was between Priest Rapids Dam and Vernita Bridge where a 13.0% increase at 23.4 hr was documented. Median migration rates in the lowest reaches of the study were documented at 7.1 hr (Vernita Bridge to White Bluffs) and 19.2 hr (White Bluffs to the Hanford arrays).

Forebay Residence Times

In general, median forebay residence time for both species at both dams was shorter than in historical studies and median residence time at Priest Rapids Dam was longer than that at Wanapum Dam for both species.

Steelhead

- Wanapum Dam: median forebay residence time was 0.48 hr from the BRZ to forebay and 0.14 hr in the immediate forebay.
- Priest Rapids Dam: median of 0.72 hr within the BRZ to forebay area, and only 0.14 hr in the immediate forebay.

Yearling Chinook

- Wanapum Dam: slightly shorter median residence time at Wanapum compared to steelhead - 0.34 hr BRZ-forebay and 0.06 hr in the immediate forebay.
- Priest Rapids Dam: median residence time was a similar to steelhead, 0.72 hr in the BRZ to forebay area and 0.12 hr in the immediate forebay.

Fish Passage Efficiency (FPE) / Passage Route Proportions

Steelhead

- Wanapum Dam – FPE: 55.3% (SE 2.6%)
  - Bypass: 9.9%
  - Spillway: 45.3%
  - Powerhouse (incl. gatewell collection): 44.8%
- Priest Rapids Dam – FPE: 69.2% (SE 1.4%)
  - Top-Spill: 47.2%
  - Spillway: 27.0%
  - Powerhouse (incl. gatewell collection): 30.9%

Yearling Chinook

- Wanapum Dam – FPE: 35.0% (SE 2.5%)
  - Bypass: 7.5%
  - Spillway: 27.5%
  - Powerhouse (incl. gatewell collection): 65.0%
- Priest Rapids Dam – FPE: 65.2% (SE 1.4%)
  - Top-Spill: 38.1%
  - Spillway: 26.9%
  - Powerhouse (incl. gatewell collection): 34.9%

Behavior and Survival Analysis of Juvenile Steelhead and Yearling Chinook Salmon through the Priest Rapids Project in 2014

Kyle B. Hatch, Mark A. Timko, Leah S. Sullivan, Jim D. Stephenson,
Nicole L. Ogan, Suzanne E. Rizor, Corey D. Wright, and Cindy A. Fitzgerald
Blue Leaf Environmental, 2301 West Dolarway Road, Suite 3, Ellensburg, WA 98926, USA

John R. Skalski, Richard L. Townsend, and James A. Lady
Columbia Basin Research, Puget Sound Plaza 1325 4th Ave, Suite 1820, Seattle, WA 98101-2509, USA

Draft Report

14 November 2014

BLUE LEAF
ENVIRONMENTAL

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Behavior and Survival Analysis of Juvenile Steelhead and Yearling Chinook Salmon through the Priest Rapids Hydroelectric Project in 2014

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Draft Report

14 November 2014

Abstract

Acoustic telemetry studies were conducted in 2014 during continued assessment of juvenile steelhead (*Oncorhynchus mykiss*) downstream migratory survival and behavior through the Priest Rapids Project (Project area refers to the Wanapum and Priest Rapids dams and reservoirs), a hydroelectric Project that is owned and operated by Public Utility District No. 2 of Grant County, Washington on the Mid-Columbia River. Yearling Chinook salmon (*O. tshawytscha*), which were evaluated and found to have met survival performance standards between 2003 and 2005 were re-evaluated in 2014. Juvenile Salmon Acoustic Telemetry System (commonly referred to as JSATS) technology was used to address the study objectives. Acoustic transmitters were surgically implanted into 1,720 steelhead and 1,716 yearling Chinook salmon; fish were released in paired releases within the tailraces of Rock Island, Wanapum, and Priest Rapids dams between 30 April and 28 May 2014. Spatial data was collected in a series of detection arrays between Rock Island Dam (RM 453) and the Hanford Reach (RM 337). Array detection efficiencies at all sites were high, estimated between 97.7% and 100%. Additional emphasis was placed on the behavior of fish as they approached and passed downstream of Priest Rapids Dam at or near the new Priest Rapids Fish Bypass (PRFB) with additional two- and three-dimensional autonomous receivers that were arranged to track study fish directly upstream of the PRFB. Passage survival was estimated at 92.9% (SE 1.4%) for steelhead and 94.5% (SE 1.3%) for yearling Chinook salmon through the Wanapum Development (Wanapum Dam and Reservoir). Survival was higher for both species through the Priest Rapids Development (Priest Rapids Dam and Reservoir) with steelhead at 96.1% (SE 1.0%) and yearling Chinook at 96.1% (SE 0.9%) survival. The overall Project survival (both dams and reservoirs) was estimated at 89.3% (SE 1.6%) for steelhead and 90.8% (SE 1.5%) for yearling Chinook salmon. Steelhead survival estimates in the Wanapum Development fell slightly below the requirements established in the 2008 NMFS Biological Opinion of 93% by 0.06%, but were met in the Priest Rapids Development and the total Project estimates. Compared to previous studies completed in 2008-2010, the Project area was significantly altered by two events during the 2014 telemetry study. First, in the Wanapum Development, a fracture in the spillway of Wanapum Dam required a 28 ft decrease in the Wanapum Reservoir elevation (forebay elevation averaged 543 ft in 2014; typical operating elevation in 2008-2010 studies was 571 ft), resulting in increased spill at the Wanapum Dam and an 80% reduction in flow at the Wanapum Fish Bypass (WFB). The WFB operated at a reduced flow of 4 kcfs in 2014, whereas in previous studies it was typically operated at 20 kcfs. This decrease in flow at the WFB resulted in the bypass being selected by only 9.9% of the steelhead and 7.5% of yearling Chinook salmon that passed the dam in 2014; for comparison, in previous studies, up to 77% of the juvenile steelhead selected the WFB. The second change in the 2014 Project area was the operation of the new PRFB commenced (April 2014) at Priest Rapids Dam in the Priest Rapids Development, offering smolts a non-turbine passage route that consisted of three spill bays (20-22) that operated at an average total flow of 25.2 kcfs. The PRFB collected 47% of steelhead and 38% of yearling Chinook salmon. Tracking densities of tagged fish that passed through the PRFB indicated that most of the bypass collected fish were originally

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upstream of the powerhouse, near turbine units 1 and 2. Additional approach analysis of fish moving into the forebay at the hazard barrier also supported that fish upstream of the spillway were intercepted and passed at spill bays 1-18 while those fish upstream of the powerhouse were more likely to pass through either the powerhouse or the PRFB. Yearling Chinook salmon were more likely to pass through the powerhouse than steelhead, which was anticipated as yearling Chinook salmon in previous three-dimensional tracking studies traveled at deeper depths than steelhead. Based on the 2014 study results, it is anticipated that the PRFB collection efficiency will increase considerably when the spillway is closed during future spring out migrations.

Introduction

Wanapum and Priest Rapids dams and the two reservoirs upstream of each dam in the Mid-Columbia River define the Priest Rapids Hydroelectric Project (Project), a Project that is owned and operated by Public Utility District No. 2 of Grant County (Grant PUD). Over the past several decades, Grant PUD has been addressing environmental concerns on the Mid-Columbia River related to the survival and condition of fish passing through the physical structures, and the riverine environment that has evolved and continues to vary with time. At each of the dams, Grant PUD has improved downstream passage conditions for juvenile salmonids with the installation of new, fish friendly turbines and bypass structures, along with optimization of operations of existing turbines during the spring and summer out-migration period. Grant PUD has also researched, monitored, and sought to facilitate changes in environmental conditions that favor smolt survival through the Project. In addition to water quality monitoring, Grant PUD maintains a northern pikeminnow (*Ptychocheilus oregonensis*) removal program, avian predation hazing, and has installed avian deterrents (bird wires) below each dam to decrease the risk of predation in the tailrace area. Moreover, Grant PUD actively supports and is directly involved with avian predation monitoring at known nesting colonies of Caspian terns (*Hydroprogne caspia)* and various gull species on the Columbia River Plateau. The PUD is also involved in piscivorous fish predation studies of species that include walleye (*Sander vitreus*), northern pikeminnow, and smallmouth bass (*Micropterus dolomieu*).

To improve passage at Wanapum Dam, a surface top-spill fish bypass was completed in 2008 to provide safe and effective downstream passage for juvenile migrants. This surface flow alternative, the Wanapum Fish Bypass (WFB), has proved successful in passing up to nearly 80% of the downstream migrants. With parallel objectives to the WFB, the Priest Rapids top-spill fish bypass or PRFB was operational for its inaugural season during the 2014 spring outmigration. Prior to the construction of this top-spill bypass structure, a prototype bulkhead at Priest Rapids Dam was installed, tested and modified annually between 2006 and 2010 to maximize a design that would effectively collect and pass smolts. Passage efficiency results were mixed during early trials (2006 and 2007), but collection efficiency increased annually as fish behavior became better understood and flow was augmented at or near the prototype to attract smolts. In 2010, fish collection at the prototype bypass peaked and collected 57% of migrating steelhead (*Oncorhynchus mykiss)*.

Passage effectiveness was measured at both dams in two ways: by the proportion of fish that selected a particular passage route, and more importantly, by the ultimate survival rate after selecting that passage route (Timko et al. 2007a, 2007b; Sullivan et al. 2008; Timko et al. 2010; Timko et al. 2011). Columbia and Snake River hydropower facilities are federally regulated to meet established survival standards for juvenile salmonids migrating through their respective Projects. More specifically, for Grant PUD, the survival requirements include juvenile passage survival of 95% at each dam (concrete survival), 93% through a single development (one dam and reservoir, e.g., Priest Rapids Reservoir and Dam) and 86.5% through the entire Project (both developments combined). An arithmetic mean of three consecutive years (for each species) is used to determine if the survival standard has been met. These particular Performance Standards (passage survival rates) that need to be met for the Priest Rapids Project were established for Grant PUD under the “Reasonable and Prudent Alternatives” (RPAs) in the National Marine Fisheries Service (NMFS) 2004 Biological Opinion for the Priest Rapids Project (NMFS 2004) and were

adapted into the "Terms and Conditions" of the 2008 NMFS Biological Opinion (BiOp) (NMFS 2008). These same survival standards are required for species of salmonids that are not listed under the ESA and are required under the 2006 Priest Rapids Project Salmon and Steelhead Settlement Agreement (SSSA) (Grant PUD 2006). Both of these documents' (BiOp and SSSA) requirements were incorporated into the Federal Energy Regulatory Commission's (FERC) license that was issued to Grant PUD for the operation of the Priest Rapids Project on 17 April 2008 (FERC 2008).

To measure the survival of downstream migrant juvenile steelhead, Grant PUD conducted annual survival studies between 2008 and 2010 using mark-recapture acoustic telemetry techniques and continued with a related predation study in 2011. Each year, paired smolt releases (treatment and control groups) were introduced into the tailraces of Rock Island, Wanapum, and Priest Rapids dams and survival was evaluated by downstream acoustic tag detection arrays. During these studies, concrete survival (95%) of steelhead was met at both dams; however steelhead survival through both the development (93%) and project survival (86.5%) have yet to be met consistently (Timko et al. 2007a, 2007b; Sullivan et al. 2008; Timko et al. 2010; Timko et al. 2011; Thompson et al. 2012). During three years of consecutive studies in 2003-2005 survival of downstream migrant yearling Chinook salmon (*O. tshawytscha*) were tested, and survival goals were met with a three-year weighted average of 86.6% (86.6% in 2003, 86.4% in 2004, and 86.9% in 2005) (Anglea et al. 2004, 2005a and 2005b). In this 2014 study, the survival standards for yearling Chinook salmon, previously met using PIT tags, were revisited to confirm that survival standards are still being met.

In this document, we present the findings of Project passage survival and behavior of steelhead and yearling Chinook salmon at the Wanapum and Priest Rapids developments in 2014. Paired-release survival estimates using treatment and control groups are provided for both species at each development, Wanapum Reservoir/Dam and Priest Rapids Reservoir/Dam, and through the entire Project. In addition to comparisons of interspecies survival in the Project, migration rates, forebay residence times, approach patterns, and passage behavior are presented with a focus on passage behavior at the PRFB.

Methods

Study Site

The Project includes Priest Rapids Dam (River Mile, 'RM' hereafter, 397), constructed in 1956-1961, and Wanapum Dam (RM 416), constructed in 1959-1963. The two dams are located on the Mid-Columbia River, between Rock Island Dam (RM 453) and the Hanford Reach (Figure 1). Figure 1 illustrates the position of the Wanapum Reservoir as the pool between Rock Island and Wanapum dams, and the Priest Rapids Reservoir as the pool between Wanapum and Priest Rapids dams. Both hydropower facilities are maintained and managed by Grant PUD.

Wanapum Dam operates 10 Kaplan turbine units that were recently replaced with a new, advanced design by Voith Siemens for the Department of Energy Advanced Hydro Turbine Program, with a generating capacity of 1092 megawatts (MW). During spring and summer migration periods, the turbine units are operated in a 'fish mode' that generally consists of a 15.7 kcfs operation ceiling that minimizes turbine passage injury and mortality. Located south of the powerhouse is the Wanapum Fish Bypass (WFB) which provides a non-turbine passage route for migrating juvenile salmonids. The WFB (completed in 2008) is a 290 ft long chute designed to collect smolts and pass a maximum laminar flow of 20 kcfs over Wanapum Dam, gradually decelerating entrained fish without shear and minimizing total dissolved gas in the tailrace. South of the WFB, the spillway joins the future turbine unit slots at a 45 degree angle extending to the southwest. The spillway is comprised of 12 Tainter gates that pass submerged flow at 65 ft below the surface of the river (Timko et al. 2010).

Priest Rapids Dam operates 10 Kaplan turbine units along the northeast end of the hydropower structure with a combined generating capacity of 956 MW. The spillway is now comprised of 19 Tainter gates and runs from the southwest end of the dam towards the middle of the river (Figure 2). In 2014, a surface-flow, top-spill bypass, also referred to as the Priest Rapids Fish Bypass ('PRFB' hereafter), was completed to provide a non-turbine passage route for migrating juvenile salmonids. The PRFB was

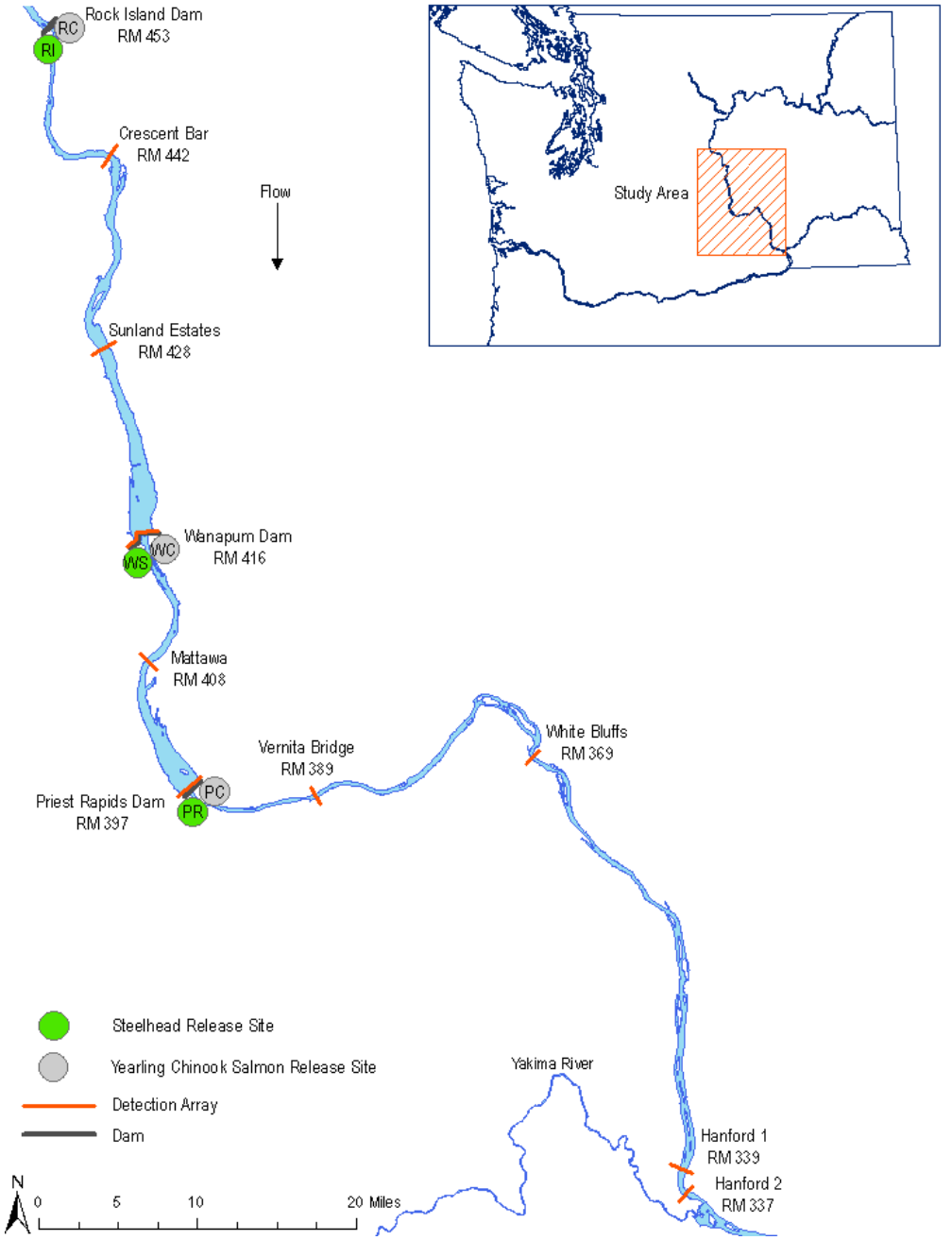

Figure 1. Study area from Rock Island Dam tailrace (RM 453) to RM 337, 45 miles upstream of McNary Dam. Location of steelhead releases are shown in green at Rock Island Dam (RI), Wanapum Dam (WS) and Priest Rapids Dam (PR) tailraces. Yearling Chinook salmon release locations are shown in grey at Rock Island Dam (RC), Wanapum Dam (WC) and Priest Rapids Dam (PC) tailraces. Detection arrays (orange bars), dams (grey bars), as well array identification and configuration are depicted.

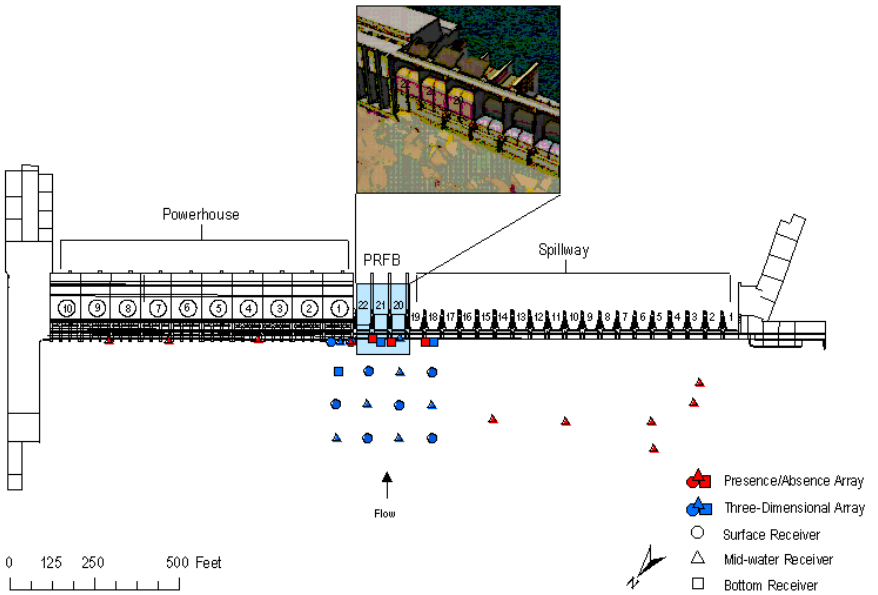

Figure 2. Schematic of Priest Rapids Dam is shown with the corresponding receiver deployment locations. Two independent detection arrays are depicted in red and blue as well as the relative receiver elevation. Fish bypass image courtesy of Jacobs Engineering.

designed to use Tainter gates 20, 21 and 22 which are the three spill bays closest to the powerhouse (Figure 2). The crest height of each spillway was raised approximately 35 ft (depth of water at the crest is just under 14 ft) and the three individual chutes are 40 to 44 ft wide.

JSATS Tags and Data Collection

Salmonids were surgically implanted with a Lotek *Model L-AMT-1.421* JSATS acoustic transmitter (11.1 x 5.5 x 3.7mm, 0.32 g in air, three second burst at 416.7 kHz) and a Biomark PIT tag (12 mm). JSATS acoustic tags were received from the manufacturer in three separate tag lots throughout the study period. To avoid potential effects of variability in the quality of manufactured tag lots, tags were randomly selected from each lot for tag-life testing (proportional to the total number of tags received per lot) and were pre-assigned to tag-life release groups prior to activation. The remaining tags were randomized, assigned to release groups, and subsequently selected for surgical implantation into study fish. Replacement tags were randomized during the study. All tags for each treatment and control release group were activated simultaneously to ensure equal tag activation time across experimental groups.

Nine river-spanning arrays comprised of 84 Teknologic Autonomous Receivers ('receivers' hereafter) collected data from tagged fish during their downstream migration. From upstream to downstream, the arrays included: Crescent Bar (3 receivers), Sunland Estates (4), Wanapum Dam (16), Mattawa (4), Priest Rapids Dam (37), Vernita Bridge (4), White Bluffs (4), Hanford 1 (4), and Hanford 2 (4) (Figure 1; Appendix A, Figures A.2 – A.5). It is noteworthy that various receivers throughout the study area were replaced mid-season due to equipment malfunction (e.g., data collection space maximized, battery power expired, or logger damaged by debris (Appendix A, Table A.5).

Acoustic receivers at the in-river arrays were deployed from a research boat by davit arm and were anchored to the river bottom by concrete and rebar anchors. A large zinc-coated ring held the tie-ups to the anchors and served as the attachment point for acoustic release units (InterOceans *Model 111-D* acoustic releases) (Appendix A, Figure A.1). Acoustic releases were controlled by a surface command unit that allowed remote sonic-mechanical release of the anchor system, similar to Thompson

et al. 2012. At both dams, receivers were deployed in two separate arrays; one along the Boat Restricted Zone (BRZ or Hazard Barrier) and the second in the immediate forebay of the dam. Acoustic receivers at the BRZ of each dam were suspended from the hazard barrier between shock-absorbing tethers and large weights at overlapping detection range intervals. Receivers deployed on the dam face were installed either by a diver into a fixed bracket or from the deck on a pier nose cage mount.

The forebay array at Priest Rapids Dam was configured to enable three-dimensional (3D) tracking of tagged fish near the PRFB. The setup consisted of a combination of *Teknologic 2/3D Autonomous Receivers* that were deployed at varied depths offshore of the dam and directly on the upstream face of the dam to provide spatial positioning estimates in the x, y, and z planes (Figure 2). All autonomous 3D receivers were equipped with a beacon tag that transmitted periodic pings that allowed for post hoc synchronization of receiver time and location. All other detection arrays at the dams were designed to provide only presence/absence data rather than spatial positioning.

At the completion of data collection, the receivers were recovered and the raw data were downloaded from each receiver's memory card to a data server using Teknologic software *Autonode uSD Extractor,* where the data was then processed, filtered and analyzed accordingly. The filtering methods were based on the US Army Corps of Engineers protocols that have been used on previous JSATS studies by various researchers in the Columbia River Basin (Skalski et al. 2010a, 2010b; Thompson et al. 2012). Three-dimensional positioning in the forebay of Priest Rapids Dam, near the PRFB, was completed by Teknologic Engineering. The position of tagged fish was estimated in 2D (x, y) and 3D (x, y, z) using Teknologic's 2/3D detection proprietary processing software. Generally speaking, positioning was resolved based on the time of arrival that a tag was detected on five or more nodes with a minimum of two nodes anchored to the face of the dam that were deployed on multiple planes with defined locations (x, y, and z by node pressure sensors or measured during diver installation). The differences in time of arrival in combination with the known deployment locations of each receiver provided sufficient information to solve for the three unknowns (x, y, and z) using a process of simultaneous equations. Positioning was refined with upper and lower elevation boundaries (e.g., the highest forebay elevation during the 2014 study was 489 ft and therefore no fish could have been detected at any higher elevation, i.e., "out of water").

Collection and Surgery

Downstream migrating run-of-river steelhead and yearling Chinook salmon smolts were collected at Wanapum and Priest Rapids dams by dip-netting from the wheel gate slots ('gatewell' hereafter) as in previous studies (Sullivan et al. 2009; Timko et al. 2010, 2011). Gatewells are water-filled vertical columns that extend from the ceiling of each turbine intake to the intake deck of the dam. Since 1977, smolts have been collected from the gatewells in the dams of the Priest Rapids Project, which has been an effective and reliable source of fish for behavioral and survival studies (Park and Farr 1972; Timko et al 2010). Depending on the fish species and particular dam, a documented 1% to 6% of smolts become temporarily entrained in the gatewells (Sullivan et al. 2009; Timko et al. 2010; O'Connor 2012).

In 2014, all gatewell-dipped fish were transported to the west bank of Wanapum Dam for sorting. After initial sorting in a light MS-222 solution by species, size, and physical condition, selected fish were held in recirculating ambient river water for 24 hr prior to surgery to ensure robustness. Immediately before surgery, fish were removed from holding tanks and placed into an anesthetic bath (MS-222 at 60-80 mg/L) until loss of equilibrium occurred, at which time they were transferred to a surgical table and administered MS-222 through a gravity-fed tube for the duration of the surgical procedure. Fish under 15 g were excluded because they were too small to meet the recommended maximum 3% tag burden (tag to body-weight ratio).

Acoustic tags and passive integrated transmitters (PIT) were implanted into fish through an incision made along the mid-ventral line; incisions were closed by two 5-0 Vicryl PLUS coated sutures. All study fish were held for 24 hr prior to release to ensure tag retention and post-surgery survival. Fish handling was conducted by LGL Limited. Detailed culling and surgical guidelines can be referenced in the LGL Limited Standard Operating Procedures that were provided in Appendix A of Timko et al. 2010.

Release and Study Design

Acoustic-tagged steelhead and yearling Chinook salmon were released by helicopter in the tailraces of Rock Island, Wanapum, and Priest Rapids dams. Steelhead release groups were designated RI, WS, and PR, while yearling Chinook salmon release groups were RC, WC, and PC, respectively (Figure 1). Approximately 1 hr prior to helicopter lift-off, fish were moved into specialized "fly-tanks" supplied with ambient river water and tags were verified to ensure they were operational. Water flow was stopped 10 min prior to departure, at which time fly-tanks were moved to the flight pad and oxygen tanks attached to the fly-tanks were turned on. Once fly-tanks were transported to the release point, the release of fish was triggered from the cockpit of the helicopter by a thumb switch that was connected to the fly-tank suspended below. Fish were released no higher than 10 ft from the surface of the river; release distance was observed by a person on shore.

To estimate passage survival at Wanapum and Priest Rapids dams (and reservoirs) release-recapture methods were used (Zabel et al. 2005; Skalski et al. 2011; Timko et al. 2011; Thompson et al. 2012). Paired treatment-control groups were released at successive dams and were used in conjunction to measure dam and reservoir (development) passage using JSATS acoustic detection arrays. Wanapum Dam and Wanapum Reservoir were tested with treatment and control groups released in the tailraces of Rock Island (RI/RC) and Wanapum (WS/WC) dams (Figure 1 and Figure 3). Priest Rapids Dam and Priest Rapids Reservoir were tested with treatment and control groups released in the tailraces of Wanapum (WS/WC) and Priest Rapids (PR/PC) dams (Figure 1 and Figure 3). Steelhead were released in 19 replicate groups (n=1,720) and Chinook salmon were released in 21 replicate groups (n=1,716) at each release location (Appendix B, Table B.1). There were fewer steelhead replicates due to a delay in collecting sufficient steelhead migrants during the early season. Lastly, release quantities varied to mimic the bell shaped curve of the natural migration of fish (more fish were released during the middle of the study as compared to the beginning and end of the study Appendix B, Table B.1).

Survival Analysis

The primary survival analyses cited in this report were conducted by Columbia Basin Research (CBR) and are presented in Skalski et al. (2014). The survival of fish passing through the Wanapum Development included the proportion of fish passing through the Wanapum Reservoir and dam that were detected at either Mattawa or at Priest Rapids Dam. Survival through the Priest Rapids Development included the proportion of fish passing through the Priest Rapids Reservoir and dam that were detected downstream at Vernita Bridge or White Bluffs. Project survival included both dams and reservoirs and was the product of the Wanapum Development survival multiplied by the Priest Rapids Development survival. Reach survivals and tag detection probabilities were estimated by Skalski et al. (2014).

Additionally, *Ricker* survival estimates were calculated to estimate concrete survival at each dam. The *Ricker* survival equation was as follows:

$$\frac{[(\#\text{ treatment fish detected downstream}) / (\#\text{ treatment fish released}^{1})]}{[(\#\text{ control fish detected downstream}) / (\#\text{ control fish released})]}$$

In the case of concrete survival, treatment fish were those detected passing the dam and control fish were those released in the tailrace of each dam. For a fish to have survived passage at Wanapum Dam, a positive acoustic detection at Mattawa or Priest Rapids Dam forebay was required. For a fish to have survived passage at Priest Rapids Dam, a positive acoustic detection at Vernita Bridge or White Bluffs was required

Behavioral Analysis

In addition to estimates of survival, a number of techniques were used to analyze the dataset for behavioral trends. The effectiveness of the fish bypass was measured by fish passage efficiency (FPE), or the ratio of the number of fish selecting the WFB or the PRFB as compared to other passage routes. Passage route designations used a study

[1] Quantities of treatment fish released refers to a 'virtual release' in which fish detected immediately above Wanapum or Priest Rapids dam (i.e. the forebay) were used to populate this equation.

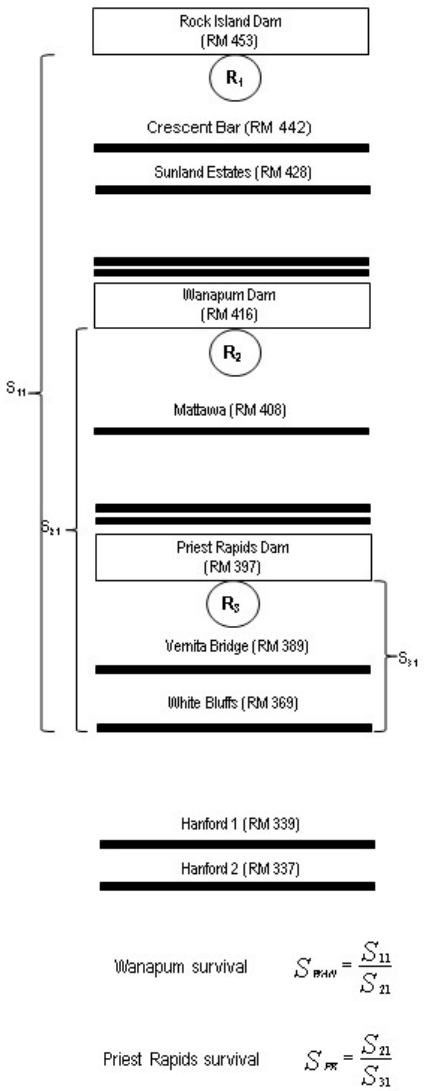

Figure 3. Survival study design is illustrated to depict release and detection locations throughout the Project, with particular emphasis on the estimation of survival through each development. Black bars represent detection arrays.

fish's final detection history in conjunction with relative detection amplitudes to conclude route selection.

Two and three dimensional tracking was conducted at Priest Rapids Dam for thorough quantitative assessment of fish passage behavior at or near the PRFB. The position data were used to evaluate Fish Collection Efficiency (FCE); a metric to estimate passage success of fish that enter a defined zone of influence (ZOI). In this case, FCE was defined as the proportion of fish that entered a zone extending 300 ft from the center of the PRFB (arc of 180°) and passed through the PRFB.

To illustrate trends in where fish that passed at the PRFB were collected from, normalized density plots of unique fish that passed through the forebay were generated. Densities figures were created using a grid of 10 ft x 10 ft two-dimensional cells or bins in the forebay and percentages were determined by the number of individual fish that entered each bin. The normalized density plots illustrate where fish were in the forebay before passage selection occurred. Relative percent passage (RPP) figures were also created by species using the same grid, but were calculated as the proportion of fish that entered each 10 ft x 10 ft bin, and then passed through the PRFB verses other routes. A contour was then created around the normalized density and RPP data for each bin in 10 percent increments to show areas of high and low use by fish.

Various other analyses were performed to quantify fish behavior including: migration travel rates, approach distribution, and forebay residence times (Timko et al. 2007a, 2007b, 2010, 2011; Sullivan et al. 2009).

Results

Project Operations

The survival and behavior studies conducted in 2014 occurred during atypical Project operations. The Wanapum Reservoir was lowered and the forebay of Wanapum Dam was decreased by approximately 28 ft to an average elevation of 543 ft; typical forebay operation elevations are at an average of 571 ft. The drop in elevation occurred prior to the start of these studies to alleviate water pressure on a spillway fracture that was observed on February 27, 2014. A summary of project operations in the spring of 2014 are shown in Figure 4.

During the 2014 spring field studies, the average flow through the WFB was 4 kcfs, a marked decline from the average flow in 2008-2011 of approximately 20 kcfs (Figure 4). Discharge from the Wanapum Dam powerhouse was also decreased in 2014; the average powerhouse discharge was 114 kcfs, which was approximately 60% of maximum operation. For comparison, between 2006 and 2010, the minimum

average spring powerhouse discharge was recorded at 108 kcfs (2010, notably a low water flow year) and a maximum average spring powerhouse discharge was 136 kcfs (2007). During the 2014 study, the average total spill (across all spill bays, but excluding the bypass) was 58 kcfs, which was generally higher than the average spill discharge during prior behavior studies that ranged from 7 kcfs (2009) to 70 kcfs (2006 and 2008). Average total discharge for Wanapum Dam was 179 kcfs in 2014. From 2006 to 2010, the average total discharge during field studies ranged from 134 kcfs in 2009 to 220 kcfs in 2011.

The combined average flow over the PRFB was 25.2 kcfs, with an average of 8.4 kcfs at each of the three spill bays (Figure 4). The average flow at the PRFB in 2014 was similar to the total flow of the prototype bypass configurations that were evaluated in 2010 where the maximum combined average flow through four spill bays was 25 kcfs (Spill Bay 19 and 20 as top-spill and Spill Bay 21 and 22 as bottom-spill). Additionally, the average powerhouse and total project discharge at Priest Rapids Dam in 2014 was 121 and 193 kcfs, respectively. Similar to Wanapum Dam, the discharge at Priest Rapids Dam in 2014 fell within the historic ranges of operation flows during survival and behavior studies conducted in 2006-2010. Average powerhouse discharge ranged from 101 kcfs (2010) to a maximum of 154 kcfs in 2007. The average total spill recorded in 2014 was 70 kcfs, which excludes the bypass. The average total spill for prior field studies ranged from 3-5 kcfs (2007, 2009-2010) to the highest discharges recorded in 2006 and 2008 of 26-27 kcfs. The average total project discharge in 2006-2010 ranged from 132 kcfs (2009) to 209 kcfs (2008).

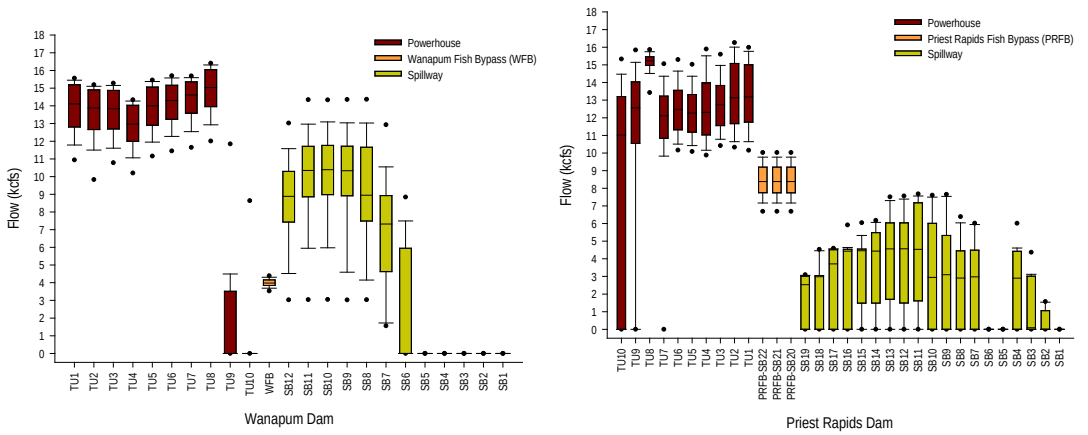

Figure 4. Project operations summarized at each dam, Wanapum Dam (left) and Priest Rapids Dam (right), and categorized by powerhouse (turbine units, TU, 1-10), fish bypass, or spillway (spill bays, SB). Box plots illustrate 5th and 95th percentiles and highlight the median, 25th and 75th percentiles of flow (kcfs).

Environmental Conditions

Environmental conditions including Total Dissolved Gas (TDG) saturation, river flow as a function of tailwater elevation, and temperature were monitored from 28 April to 23 June, 2014 downstream of Rock Island, Wanapum and Priest Rapids dams as well as at Pasco, Washington (RM 330), which is located seven miles downstream of the Hanford 2 detection array. Daily median conditions for 2014 are depicted along with the 10-year average conditions, in Figures Figure 5 and Figure 6, allowing for comparison. Data were procured from the Columbia River DART website and Grant PUD dam operation records. In general, TDG, river flow, and temperature at all sites were higher in 2014 than the 10-year average. However, there was a sharp decline in TDG and flow at all sites in early June followed by a return to 10-year average conditions by the end of the month.

TDG saturation peaked at all sites between 29 May and 3 June, 2014. The highest TDG saturation was recorded downstream of Wanapum Dam on 1 June at 126% with peaks at Rock Island and Priest Rapids dams (at 123%) aligned with peaks in river flow. The highest recorded TDG saturation at Pasco,

WA during the study period was 117%. For comparison, the 10-year average TDG saturation at all sites was consistently below 120%.

River flow in 2014 was consistently above the 10-year average. Peak flow in 2014 was 233 kcfs below Rock Island Dam, 216 kcfs below Wanapum Dam, 241 kcfs below Priest Rapids Dam, and 237 kcfs at Pasco, WA. Flows peaked at all sites on 1 June. These peaks in flow were followed by a sharp decline to a low occurring on 15 June at all sites, ranging from 116 kcfs at Rock Island Dam to 123 kcfs at Pasco, WA. In contrast, the 10-year average flow trends upward throughout the study period, ranging from 132 kcfs downstream of Rock Island Dam in late April to 238 kcfs at Pasco, WA in late June.

Water temperatures in 2014 were slightly above the 10-year average, ranging from 7.7 to 16.8°C over the course of the field study. The 10-year average values over the same period of time were similar and ranged from 7.9 to 15.5 °C.

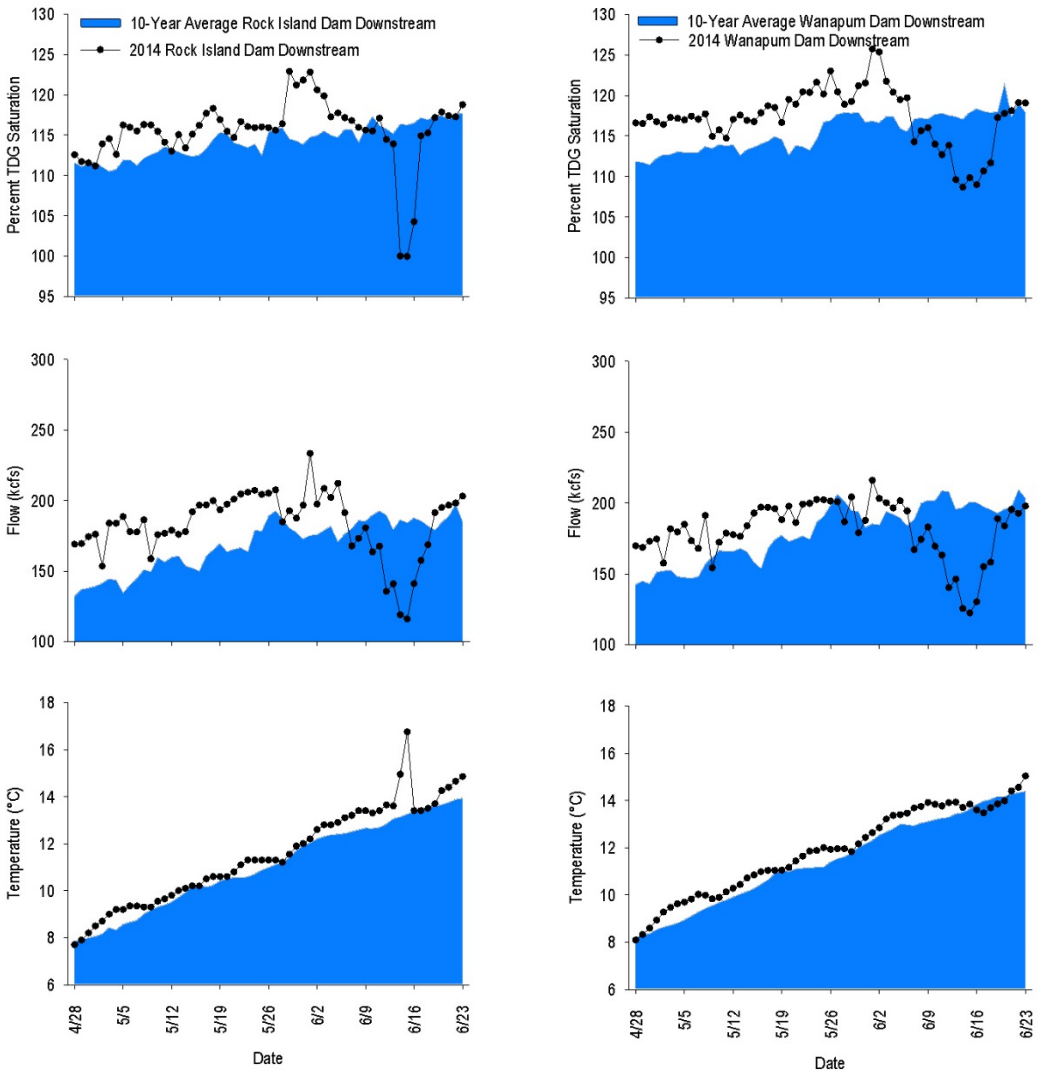

Figure 5. Daily median water quality values downstream of Rock Island and Wanapum dams are shown from 28 April – 23 June, 2014 along with the 10-year average which is depicted in blue (data source*: www.cbr.washington.edu/dart/dart.html* and *Grant PUD dam operations*).

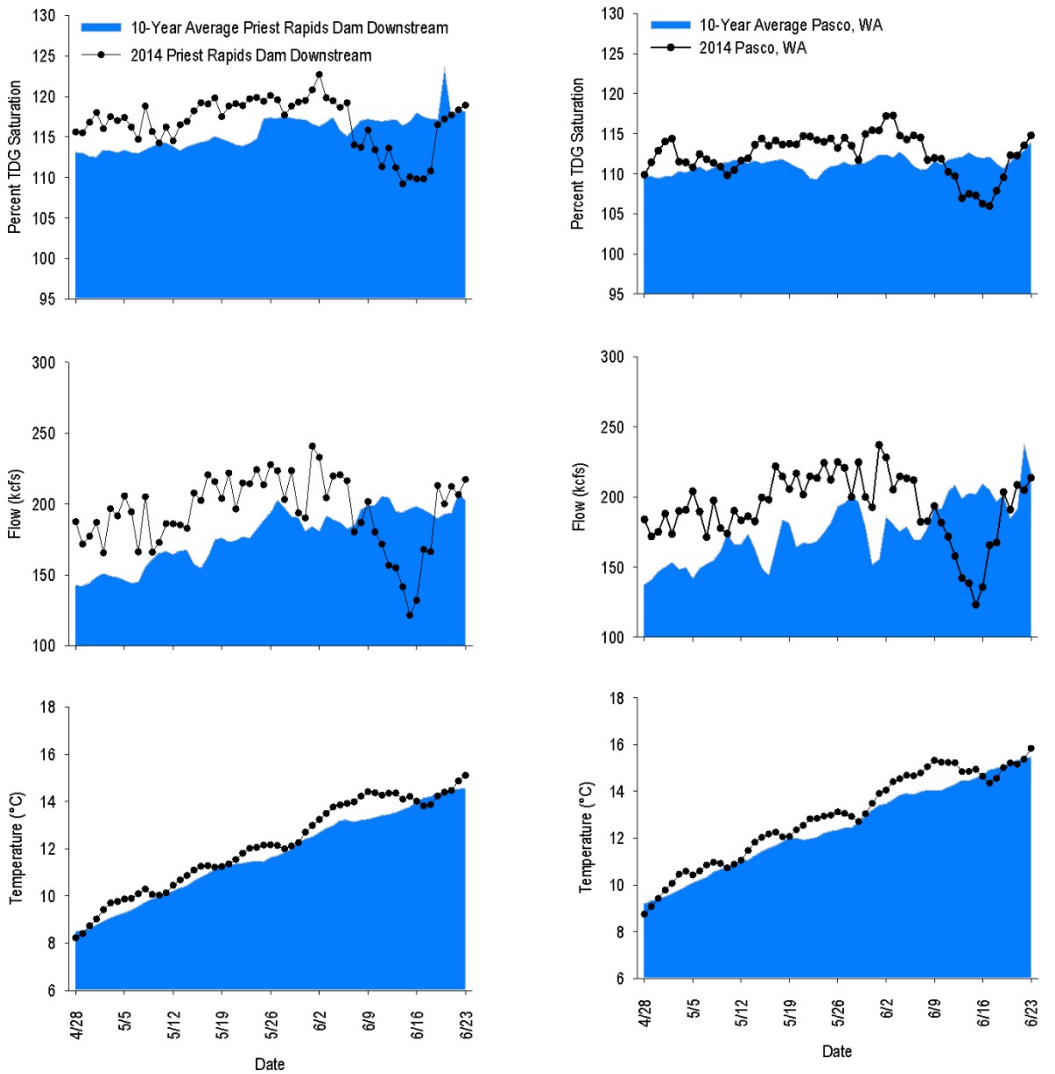

Figure 6. Daily median water quality values downstream of Priest Rapids Dam and at Pasco, WA (RM 330) are shown from 28 April – 23 June, 2014 along with the 10-year average which is depicted in blue. Flow data for Pasco, WA 10 year average is limited to data from 2006, 2010 and 2013 (*data source: www.cbr.washington.edu/dart/dart.html and Grant PUD dam operations*).

Fish Characteristics

A total of 1,720 juvenile steelhead and 1,716 yearling Chinook run-of-river smolts were tagged with JSATS transmitters and evaluated in the 2014 survival and behavioral studies. During the study, 14 tags were found to be inactive at the time of release and were excluded from survival data analysis (eight transmitters implanted in steelhead and six transmitters implanted in yearling Chinook salmon). Seven other fish excluded from the data included two holding mortalities (yearling Chinook salmon) released with active tags, three release process mortalities (one steelhead and two yearling Chinook salmon, one of which was released with an active tag), as well as two recapture mortalities (one steelhead and one yearling Chinook salmon).

Adipose clipped juvenile steelhead comprised 67% of the total steelhead tagged and released between 7-28 May 2014. The quantity of steelhead released varied by site with 399 released below Rock Island dam, 771 below Wanapum dam and 550 below Priest Rapids dam (Figure 1). Between 30 April and 24 May 2014, the vast majority of acoustic-tagged yearling Chinook salmon had been clipped at the adipose fin (94%). Yearling Chinook salmon release quantities also varied by site with 398 released below Rock Island dam, 769 below Wanapum dam, and 549 below Priest Rapids dam. Based on the 2014 Rock Island Dam run-timing smolt index (Columbia River DART website), all tagged steelhead were released between the 8th and 92nd percentile of the steelhead run-timing while Chinook salmon were released between the 12th and 89th percentile of the yearling Chinook salmon run-timing.

As analyzed by Skalski et al. 2014, the length, weight and condition factor distributions of fish released in the tailraces of Rock Island, Wanapum, and Priest Rapids dams were very comparable, suggesting no opportunity for any size bias to affect the survival estimates. Steelhead fork lengths ranged from 128-217 mm (mean length at 182.9 mm) and weight ranged from 21.5-88.0 g (mean weight at 57.0 g) (Appendix B, Figure B.1 and B.2). Yearling Chinook salmon fork lengths ranged from 108-200 mm (mean length at 143.7 mm) and weight ranged from 16.5-82.5 g (mean weight at 33.1 g) (Appendix B, Figure B.1 and B.2).

The average tag-burden for steelhead was 0.6% (range 0.4-1.5%) while the average yearling Chinook salmon tag burden was 1.1% (range 0.4-1.9%). The JSATS tags used in 2014 weighed an average of 0.32 g in air and were significantly lighter in weight than acoustic transmitters used in previous survival studies conducted in 2008-2010 where acoustic transmitters ranged from 0.75-1.50 g in air.

Acoustic Battery Life Testing

To determine tag life, 50 tags were randomly selected from three tag lots, activated, and monitored for battery failure. Tag life tags were deployed into a flow through tank supplied with ambient river water over the study period. Water conditions such as temperature and dissolved oxygen were monitored daily. The number of tags per release group followed a bell curve distribution and the average tag life was 23.7 days for lots 1 and 2 and 22.7 days for lot 3 (range 10.1-31.2 days).

Data Collection

All acoustic receivers were deployed and operational by 24 April 2014. Data collection commenced on 30 April 2014, after the first yearling Chinook salmon group was released below Rock Island Dam. The last tag detection, a steelhead, was recorded on 14 June 2014 at the Hanford arrays (RM 337). Over the study period, a total of 6,952,797 individual detections of acoustic tags were recorded on all detection arrays. The tag detection probabilities remained high at all detection arrays, ranging from 0.9873-1.000 for steelhead and 0.9769-1.000 for yearling Chinook salmon. A summary of tag detection probabilities by release group are shown in Table 1.

The majority of the deployed receivers successfully collected acoustic data for the duration of the study although there were exceptions. Fifteen of the 84 deployed receivers had mid-season disturbances in data- collection: six receivers became detached from river-bottom anchors; five receivers reached data storage capacity on internal SD cards and ceased writing new data, and three receivers malfunctioned. Of these fifteen, four where replaced immediately with supplemental receivers. The remaining eleven weren't replaced due to sufficient overlap in detection coverage or late recognition of the issue (Appendix A, Table A.5).

A small portion of the 2014 PIT tagged steelhead and yearling Chinook salmon were also detected outside the Project study area by PIT tag readers at McNary (RM 292, 5.1% steelhead and 11.3% Chinook salmon), John Day (RM 216, 7.8% steelhead and 8.2% Chinook salmon), and Bonneville (RM 146, 6.4% steelhead and 7.4% Chinook salmon) dams as well as the Columbia River estuary experimental towing site (RM 19, 1.6% steelhead and 0.8% Chinook salmon) (Appendix A, Table A.7). Of the PIT-tagged steelhead and yearling Chinook salmon that were detected at downstream PIT arrays, 99.8% were detected passing through one or more of the Grant PUD acoustic detection arrays (0.2% of tagged steelhead and 0.1% of tagged Chinook salmon were not detected at any of the 2014 JSATS detection arrays).

Table 1. Array detection probabilities by species and release site at each of the acoustic tag detection arrays between Rock Island Dam (RM 453) and the Hanford Reach (RM 337).

	Array Detection Probability Estimates (Standard Error)							
Release Locations	Crescent Bar	Sunland Estates	Wanapum	Mattawa	Priest Rapids	Vernita Bridge	White Bluffs	Hanford
Steelhead								
Rock Island Tailrace	0.9873 (0.0056)	1.000 (0.0000)	1.000 (0.0000)	1.000 (0.0000)	1.000 (0.0000)	0.9939 (0.0043)	1.000 (0.0000)	1.000 (0.0000)
Wanapum Tailrace				1.000 (0.0000)	1.000 (0.0000)	0.9971 (0.0020)	1.000 (0.0000)	1.000 (0.0000)
Priest Rapids Tailrace						0.9881 (0.0048)	0.9959 (0.0029)	0.9978 (0.0022)
Yearling Chinook								
Rock Island Tailrace	0.9769 (0.0076)	1.000 (0.0000)	1.000 (0.0000)	0.9973 (0.0027)	0.9972 (0.0028)	0.9915 (0.0049)	1.000 (0.0000)	0.9940 (0.0042)
Wanapum Tailrace				1.000 (0.0000)	1.000 (0.0000)	0.9972 (0.0020)	1.000 (0.0000)	0.9971 (00.0021)
Priest Rapids Tailrace						0.9944 (0.0032)	1.000 (0.0000)	1.000 (0.0000)

Migration Rate

In 2014, steelhead migration rates upstream of Wanapum Dam were markedly faster relative to historical rates, while downstream migrations more closely followed historical trends (Figure 7 and Figure 8). The cumulative median migration rate from the tailrace of Rock Island Dam to Wanapum Dam was 20.7 hr, a 55.5% decrease over the average median in 2006-2010/11[2]. Migration rates between Mattawa and Priest Rapids Dam also decreased within the Priest Rapids Reservoir, albeit less drastically (Δ-18.0% at 13.2 hr). Migration to in-river sites immediately below the dams varied; migration to Vernita Bridge decreased (Δ-14.3%, 1.8 hr), while Mattawa more closely followed historical trends (Δ-1.8% at 2.6 hr). In the lower reaches, median migration rates of 5.4 hr (Vernita Bridge to White Bluffs) and 8.5 hr (White Bluffs to the Hanford arrays) were recorded though no previous data exists for this area (Appendix C, Table. C.2).

In general, the migration rate of yearling Chinook salmon in 2014 was similar to the recorded median averages in 2006-2010 (Figure 7 and Figure 8). Migration from Wanapum Dam to Mattawa slightly increased by 4.8% at 3.3 hr, while migration from Priest Rapids Dam to Vernita Bridge did not appear to deviate (Δ0.0% at 2.0 hr). The only notable variation was between Priest Rapids Dam and Vernita Bridge where a 13.0% increase at 23.4 hr was documented. Median migration rates in the lowest reaches of the study were documented at 7.1 hr (Vernita Bridge to White Bluffs) and 19.2 hr (White Bluffs to the Hanford arrays). The timing of steelhead and yearling Chinook salmon arrival and passage appeared to be confounded with release timing; no additional trends in diel passage were exhibited in the data at Wanapum and Priest Rapids dams.

Forebay Residence Times

In 2014, forebay residence times were estimated using two methods; the first estimate was derived from applying the first and last detections from the BRZ and forebay[3] receivers *combined*, while the second was calculated using detections at the forebay receivers *alone*. The second method, in theory, is most similar to historical analyses although not equivalent due to differing acoustic technology and a notably less expansive array in 2014. Therefore for comparative purposes it can only be concluded that the BRZ method is likely to overestimate residence time while the forebay method is likely to underestimate.

Nonetheless, median forebay residence times in 2014 for both species at both dams were under 1 hour, regardless of the method of measuremet (Table 2). At Wanapum Dam, steelhead median forebay residence time was 28.5 min from the BRZ to forebay and 8.1 min in the immediate forebay area. Yearling Chinook salmon had a slightly shorter median residence time at Wanapum Dam; 20.3 min BRZ-forebay and 3.6 min in the immediate forebay. Median residence time at Priest Rapids Dam was longer than that at Wanapum Dam for both species; steelhead resided a median of 43.2 min within the BRZ to forebay area, and only 8.1 min in the immediate forebay. Furthermore, yearling Chinook salmon median residence time was a similar 42.8 min in the BRZ to forebay area and 3.6 min in the immediate forebay. Detailed median residence times by species, dam, and passage route are compiled in Appendix C; Table C.6 and C.7.

[2] 2011 migration rate data was limited to steelhead between Wanapum and Priest Rapids dams, thus not all median averages were calculated with this data included.

[3]Forebay receivers were deployed either directly on the upstream face of the dam or within the immediate vicinity of the upstream face of the dam (see Appendix A for further details).

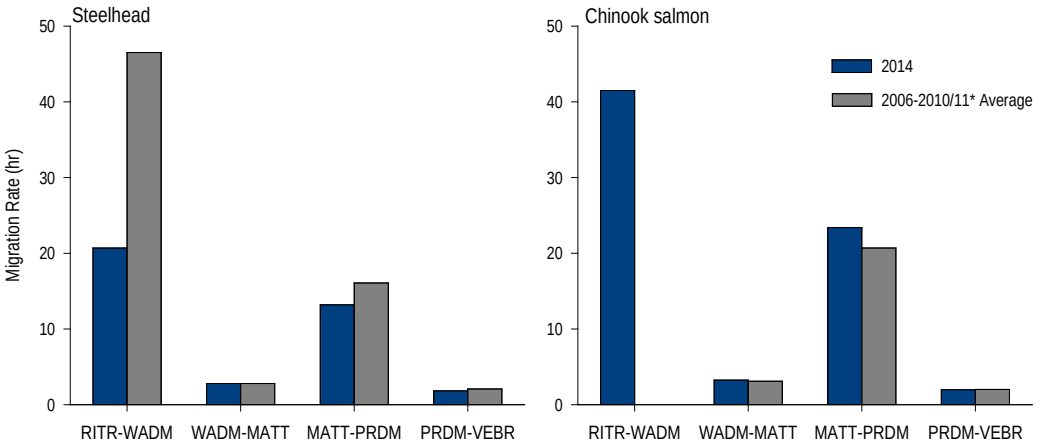

Figure 7. Steelhead and yearling Chinook salmon median migration rates compared to average median migration rates from 2006-2010/11 acoustic data. The asterisk indicates that the 2011 acoustic study solely recorded steelhead migration data between Wanapum and Priest Rapids dams, thus all other categories are void of this year's information. Further migration rate data are presented in Appendix C Table C.1, C.2.

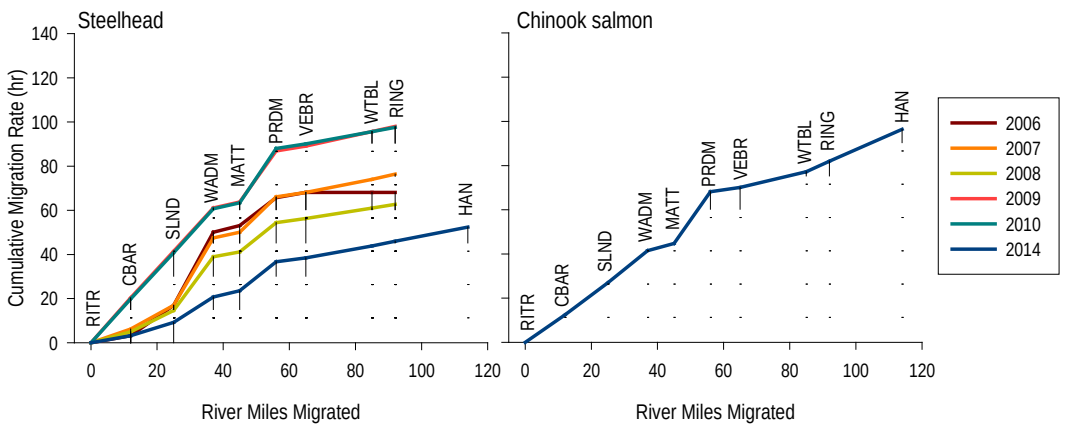

Figure 8. Cumulative median migration rates between each detection array by river mile for (left) steelhead and (right) yearling Chinook salmon. Steelhead data include relatable information from 2006-2010 and 2014 results; yearling Chinook salmon data include only 2014.

Table 2. Annual comparison of median forebay residences time at Wanapum and Priest Rapids dams (min) by species, steelhead and yearling Chinook salmon. Fish that were entrained in the gatewells, had an unknown passage location, or were last recorded with net upstream movement were excluded from this dataset.

Wanapum Dam		
Steelhead	2014[BRZ]	28.5
	2014[Forebay]	8.1
	2010	144.6
	2009	79.2
	2008	29.4
	2007	42.6
	2006	34.2
Yearling Chinook salmon	2014[BRZ]	20.3
	2014[Forebay]	3.6
	2008	14.4
Priest Rapids Dam		
Steelhead	2014[BRZ]	43.2
	2014[Forebay]	8.1
	2010	90.0
	2009	57.6
	2008	14.4
	2007	20.4
	2006	20.4
Yearling Chinook salmon	2014[BRZ]	42.8
	2014[Forebay]	6.7
	2008	13.8
	2007	16.8
	2006	18.0

Survival Analysis

The survival estimates for steelhead and yearling Chinook salmon in 2014 were analyzed in Skalski et al (2014). The survival estimate of steelhead through the Wanapum Development was 0.9294 (0.0140) and through the Priest Rapids Development was 0.9613 (0.0098). The joint Wanapum-Priest Rapids Project survival of steelhead was 0.8934 (0.0162). Yearling Chinook salmon survival through the Wanapum Development was estimated at 0.9448 (0.0128) and through the Priest Rapids Development at 0.9612 (0.087), with a joint Wanapum-Priest Rapids Project survival of 0.9082 (0.0145). The survival estimates of steelhead in 2008, 2009, 2010 and 2014 are shown with standard errors in Figure 9.

All survival estimates for both species yielded acceptable and smaller than required standard errors (NMFS 2004; NMFS 2008; Grant PUD 2006). The detailed paired-release survival analysis of steelhead and Chinook salmon smolts through Wanapum and Priest Rapids dams is presented in a separate report (Skalski et al. 2014).

Reach Survival

Reach survival represents survival estimates per individual river segments between detection arrays; complete analysis is in Skalski et al (2014). Steelhead reach survival ranged from 0.9575 to 0.9986 and yearling Chinook salmon survival ranged from 0.9599 to 0.9951 (Table 3). Low standard errors were measured for both species; ranging from 0.0036 to 0.0103. Reach survival estimates were weighted by relative reach lengths to equate what proportion of fish failed to survive per river mile (RM). Steelhead mortality per RM peaked in the reaches proceeding Wanapum (0.326% per RM, WADM-MATT) and Priest Rapids dams (0.402% per RM, PRDM-VEBR). Steelhead also incurred higher mortality per RM in the reach directly above Wanapum dam (0.354% per RM, SLND-WADM). Similar to steelhead, yearling Chinook salmon exhibited the lowest survival by RM directly downstream of Wanapum (0.288% per RM, WADM-MATT) and Priest Rapids dams (0.446% per RM, PRDM-VEBR).

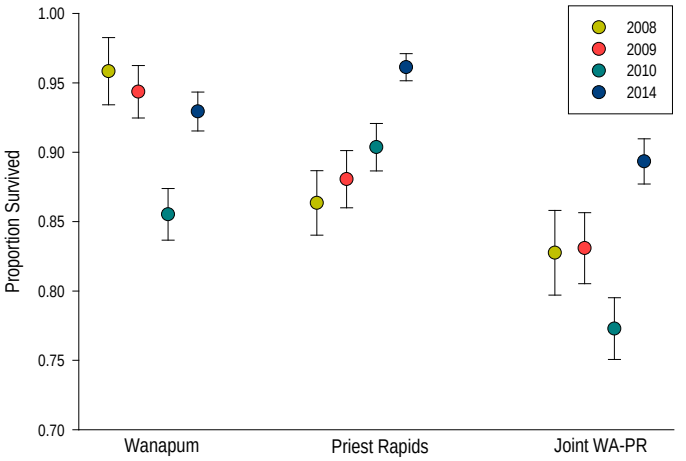

Figure 9. Comparative paired-release survival estimates of steelhead at the Wanapum Development (reservoir and dam), the Priest Rapids Development (reservoir and dam), and the Joint Wanapum-Priest Rapids Project (both developments combined).

Table 3. Survival estimates, adjusted by tagger effect and tag life (Skalski et al. 2014), are presented by reach and complemented with standard errors. Furthermore, reach survivals are weighted by total reach length (RM) for comparisons of relative percent losses per RM.

	Steelhead			Yearling Chinook Salmon		
Reach	*Survival*	*SE*	*% Loss by RM*	*Survival*	*SE*	*% Loss by RM*
RITR-CBAR	0.9986	0.0049	0.012	0.9875	0.0060	0.104
CBAR-SLND	0.9957	0.0036	0.033	0.9933	0.0045	0.052
SLND-WADM	0.9575	0.0102	0.354	0.9877	0.0063	0.103
WADM-MATT	0.9739	0.0083	0.326	0.9770	0.0077	0.288
MATT-PRDM	0.9742	0.0086	0.235	0.9979	0.0039	0.019
PRDM-VEBR	0.9638	0.0101	0.402	0.9599	0.0103	0.446
VEBR-WTBL	0.9794	0.0078	0.103	0.9951	0.0041	0.024
WTBL-HAN	0.9765	0.0085	0.076	0.9887	0.0064	0.036

Avian Predation

Similar to previous survival studies, an annual investigation of avian predation with PIT tags recovered and/or detected at piscivorous bird colonies on the Mid-Columbia River was conducted by NOAA Fisheries, USGS-Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, and Real Time Research. Preliminary detection records from this research group tallied a total of 109 PIT tags, released during the spring 2014 Grant PUD survival study, were detected among a variety of avian colonies on the Columbia Plateau and main stem, Mid-Columbia River. A total of 101 steelhead and eight yearling Chinook salmon were detected at either Banks Lake, Potholes Reservoir, Island 20 (RM 332), Crescent Island (RM 317), Central Blalock Island (RM 274), or Little Miller Island (RM 205). Of the total PIT tags recovered, they comprised 5.9% of the total steelhead and 0.5% of the total yearling Chinook salmon that were released in the Project area.

In 2014, 12 PIT tags from steelhead that were released during the 2014 survival study were detected at the Caspian tern colony at Potholes Reservoir. Based on paired acoustic tag detection histories, all steelhead whose PIT tags were

detected at the Caspian tern colony at Potholes Reservoir were consumed between release and the White Bluff detection array. This number appears to be a decrease in recovered steelhead PIT tags when compared to the 98 tags released and re-detected during the 2010 survival study (Timko et al 2011); representing a respective loss of 0.7% in 2014 and 5.0% in 2010. However, tag detection and deposition probabilities have not been applied to the raw data and are required to provide an appropriate estimate of predation (and consumption) of juvenile steelhead by Caspian terns that nested at Potholes Reservoir in 2014. A detailed analysis of predation by avian predators will be released in a separate report by Real Time Research (Evans et al. *in progress*).

Dam Survival

Based on acoustic tag detection histories, the Ricker survival estimates for steelhead and yearling Chinook salmon at Wanapum and Priest Rapids dams (commonly referred to as *concrete survival*) were calculated for treatment fish released above each dam paired with control fish released 0.5 km downstream of each dam. Table 4 lists steelhead and yearling Chinook salmon concrete survival estimates by year, with estimates remaining above 97% for both species at both dams.

Steelhead concrete survival at Priest Rapids Dam followed trends set by historical data with 2014 survival point estimates ranging between 97.8% and 98.5% (Table 4). On the other hand, at Wanapum Dam, variation in concrete survival is slightly more evident as estimates have marginally reduced from nearly 100% in 2008-2010 to 97.8% in 2014. Chinook salmon concrete survival estimates have not been calculated in recent years although 2014 estimates of 98.8% at Wanapum Dam and 97.1% for Priest Rapids Dam are similar to those calculated for steelhead in previous years at both dams.

Passage Route Efficiency

In 2014, the proportion of steelhead and yearling Chinook salmon that selected non-turbine passage routes through Wanapum Dam was lower than previous studies (55.2% and 35.0%, respectively) (Figure 10; Appendix D. Table D.1). In other words, the proportion of fish that selected the bypass or spillway at Wanapum Dam has decreased since 2008-2010 for steelhead and 2008 for Chinook salmon resulting in a lower non-turbine passage route efficiency (PRE) (Figure 12). At Wanapum Dam in 2014, the proportion of steelhead that passed through the WFB was 9.9%, a decrease of 67.4% compared to 2010 (PRE at the WFB in 2010 was 77.3%). Chinook salmon PRE at the WFB was 7.5%, representing a decrease from 29.5% passage estimates in 2008, the last year Chinook salmon PRE was estimated for Wanapum Dam.

At Priest Rapids Dam in 2014 higher PRE was documented through the powerhouse than the spillway for both study species; 30.9% of steelhead and 34.9% of Chinook salmon passed via the powerhouse. However, the majority of both species utilized the PRFB with 47.2% of steelhead and 38.1% of Chinook salmon selecting this route. Within the group that selected the PRFB, the majority passed through the spill-bay closest to the powerhouse (spill-bay 22) (Figure 11). In contrast, Chinook salmon PRE at the PRFB in 2014 was higher than previously recorded for the top-spill bypass in 2006 - 2008 when PRE ranged from 12.4% to 24.4%. A detailed list of passage percentages and annual comparisons from 2006-2014 can be referenced in Appendix D.

Table 4. Summary of dam (concrete) Ricker survival estimates by species at Wanapum and Priest Rapids dams. Asterisk indicates where treatment fish (i.e. fish detected in the forebay of Wanapum Dam passing downstream) survived at higher rates than control fish released 0.5km downstream of the dam.

	Ricker Survival Estimates	
Year	Wanapum	Priest Rapids
Steelhead		
2014	0.978	0.985
2010	*1.013	0.997
2009	*1.025	0.983
2008	0.995	0.952
Yearling Chinook salmon		
2014	0.988	0.971

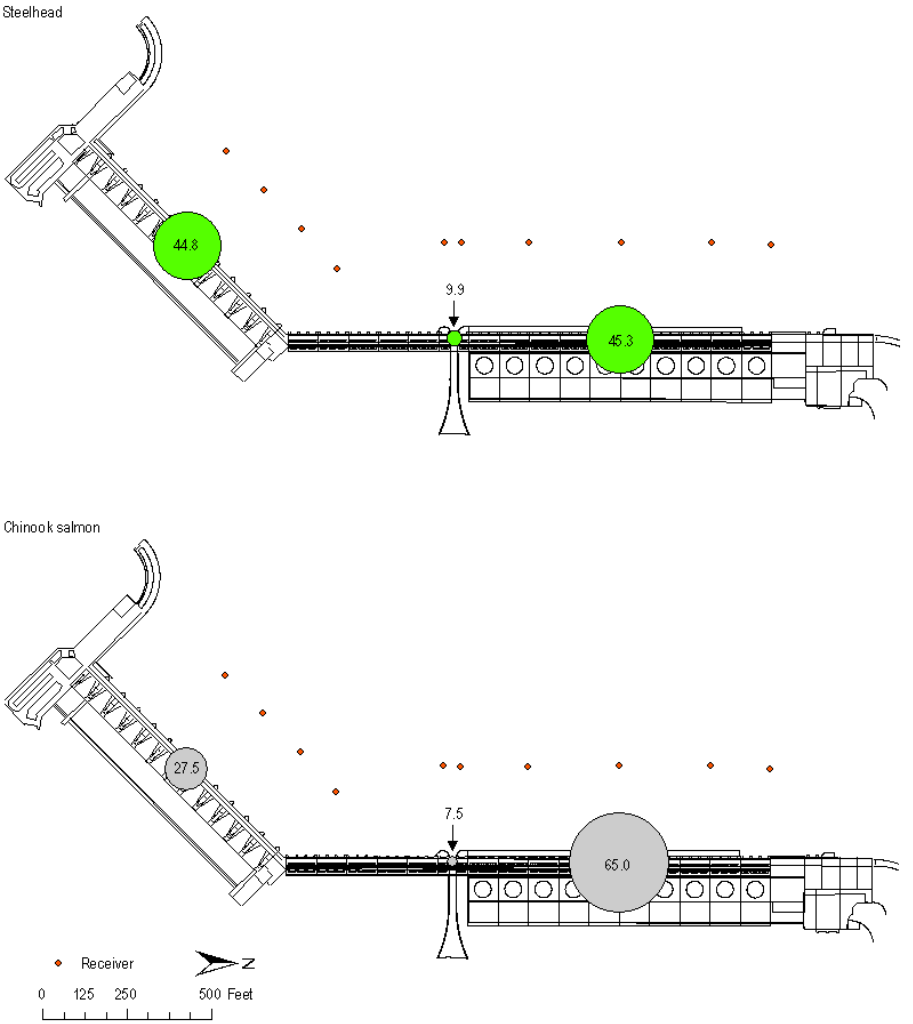

Figure 10. Passage percentages at Wanapum Dam in the spring of 2014; the top figure presents steelhead (green) and the bottom figure presents yearling Chinook salmon (gray). Detailed passage percentages shown by circles are proportional to percentages. Passage events that could not be identified are not depicted.

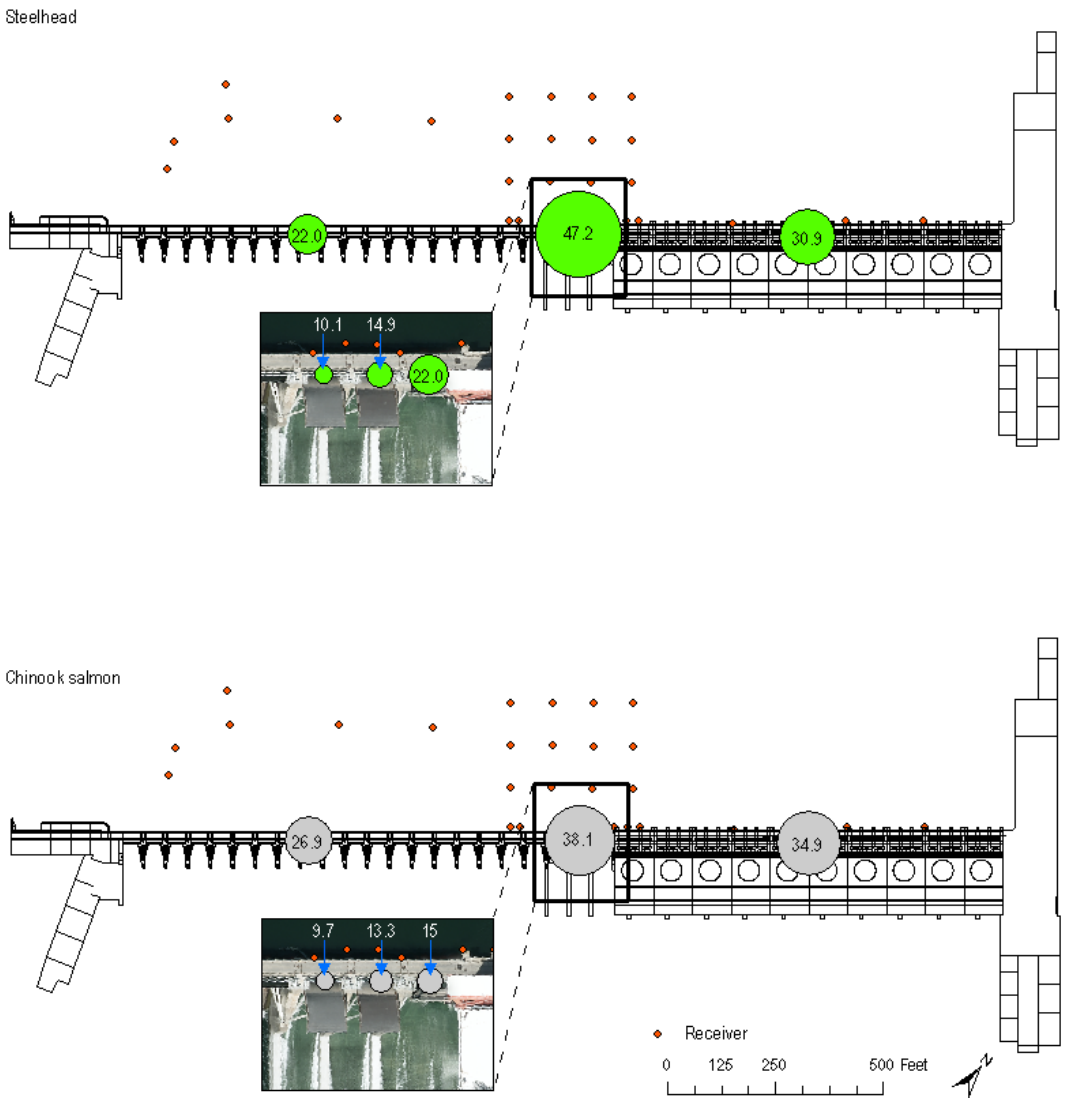

Figure 11. Passage percent at Priest Rapids Dam in 2014 for steelhead (top panel, green) and yearling Chinook salmon (bottom panel, gray) has been rounded to the nearest tenth. Detailed passage percentages are depicted as circles of diameter proportional to percentage. Passage events that could not be identified are not shown. Two fish of each species passed via the PRFB at unidentified bays and were excluded from the bay-specific analysis, 0.2% and 0.1% of steelhead and yearling Chinook salmon, respectively.

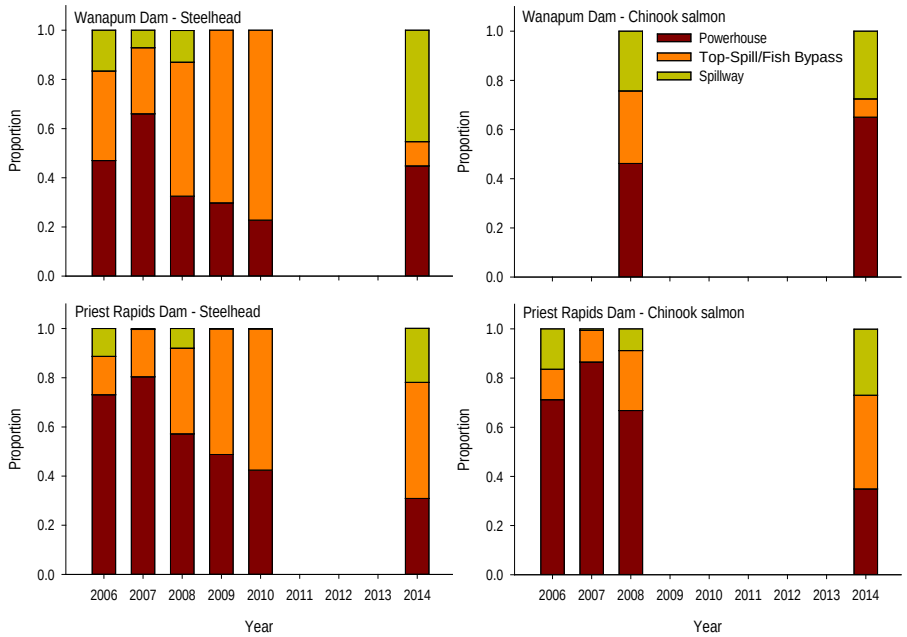

Figure 12. Historical passage proportion at Wanapum (top) and Priest Rapids dams (bottom) for steelhead (left) and Chinook salmon (right) by passage route: Powerhouse passage (maroon), top-spill/Fish Bypass passage (orange), and spillway (green). Data are representative of years when the given species were released.

Relative Route-Specific Survival

Similarly to the methods employed in previous passage studies, paired releases through a specified route were not conducted but acoustic-tagged steelhead and yearling Chinook salmon known to have successfully arrived and passed downstream of Wanapum and Priest Rapids dams were used to estimate route-specific relative survivals through each dam (Timko et al. 2010, 2011). At both dams survival was quantified as relative to fish that passed through the spillway, deemed a 'benign route', for comparative purposes and where results were significantly different from 1.0, p-values were <0.05. Steelhead that passed through the WFB had similar survival estimates as spillway fish, and steelhead that passed through the powerhouse at Wanapum Dam had nearly 5% lower survival estimates (Skalski et al. 2014). At Priest Rapids Dam, relative route-specific survival rates were significantly higher for steelhead that passed through the PRFB when compared to the spillway (Δ of 2.7%) and were significantly lower for powerhouse compared to the spillway (Δ of 3.6%) (Skalski et al. 2014).

Yearling Chinook salmon that passed via the WFB or the powerhouse did not experience significantly different survival rates than those that passed through the spillway. However, at Priest Rapids Dam yearling Chinook salmon that passed through the PRFB had significantly higher survival estimates than those that passed through the spillway (Δ of 1.8%) (Skalski et al. 2014). Conversely, yearling Chinook salmon that passed through the powerhouse decreased in survival by nearly 5% when compared to those that passed through the spillway.

Additional details on juvenile steelhead and yearling Chinook salmon relative-route specific survival can be referenced in a separate report by Skalski et al. (2014).

Based on acoustic tag detection histories, 100% of steelhead that migrated past Wanapum Dam

through the WFB were detected downstream, compared to the 94.1% of steelhead that selected the powerhouse and 99.4% that selected the spillway (Table 5). Yearling Chinook salmon that passed via the WFB measured 96.3% detected, compared to 98.2% that selected the powerhouse and 97.0% that selected the spillway. However, it is noteworthy that due to low sample size at the WFB direct comparisons of these detection histories become less powerful. Downstream of Priest Rapids Dam, 99.8% of bypass route steelhead were detected, while 93.8% of powerhouse fish were detected and 97.0% of spillway fish were detected. Similarly, 99.8% of yearling Chinook salmon passing via the PRFB were detected, compared to 92.6% detected from the powerhouse and 98.0% detected from the spillway.

Passage Proportions Relative to Migration Rates

Downstream median migration rates of steelhead and yearling Chinook salmon were divided by passage route and then statistically analyzed with the Kruskal-Wallis ranked test of variance followed by a *post-hoc* Dunn's test ($P<0.05$). In general, in 2014, median migration rates for both species, through both dams, yielded a similar pattern. Powerhouse fish migrated downstream at the slowest rate, while fish that passed through the spillway and bypass routes migrated at comparable rates (Appendix C, Table C.3 and C.4).

Fish that passed through the powerhouse at Wanapum Dam (WADM-PRDM) migrated at a rate that was statistically slower than fish that passed through the spillway and WFB; fish that passed through the spillway and WFB had comparable migration rates that were not statistically different (Figure 13). Below Priest Rapids Dam (PRDM-HAN), steelhead that passed through the PRFB migrated downstream at a rate that was statistically faster than all other fish that passed through the dam at the powerhouse and spillway. Yearling Chinook salmon that passed through the powerhouse moved downstream at a rate that was statistically slower than fish that passed through the spillway.

Passage Proportions Relative to Forebay Residence Times

The median forebay residence times of steelhead and yearling Chinook salmon at Wanapum and Priest Rapids dams in 2014, defined as the first and last detections at the BRZ and forebay arrays, were grouped by route selection and analyzed statistically with a Kruskal-Wallis ranked test of variance followed by a Dunn's *post-hoc* analysis ($P<0.05$) (Figure 14).

In the Wanapum Dam forebay, steelhead and yearling Chinook salmon that selected the powerhouse for passage had statistically shorter residence times than fish that selected the spillway or WFB. Steelhead that passed through the WFB yielded comparable residence times to fish that passed at the spillway and were not statistically different. However, yearling

Table 5. Number of tags that passed at each dam by route with the corresponding percentage of tags which were detected downstream in 2014. The percentage of tags listed for all routes reflects concrete passage survival for all passage routes, including unknown passage locations and gatewell dipped fish; however, fish with upstream movement during last detection were excluded.

	Wanapum Dam				Priest Rapids Dam			
	Steelhead		Yearling Chinook		Steelhead		Yearling Chinook	
Passage Route	n	%	n	%	n	%	n	%
All Routes	377	97.1	382	97.9	1100	97.1	1120	96.9
Bypass	36	100.0	27	96.3	507	99.6	415	99.8
Spillway	164	99.4	99	97.0	236	97.0	293	98.0
Powerhouse	152	94.1	225	98.2	276	93.8	352	92.6

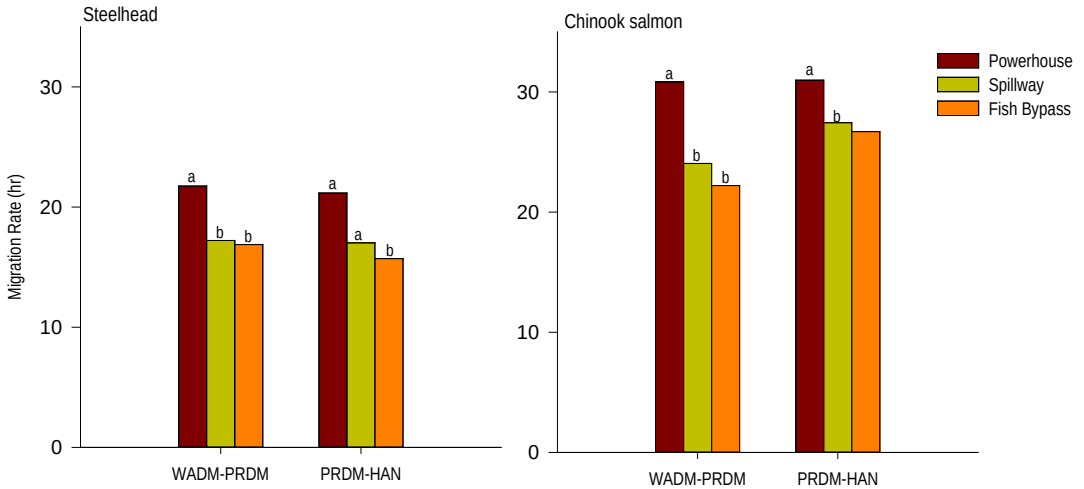

Figure 13. Median migration rates for steelhead (left) and yearling Chinook salmon (right) from Wanapum Dam to Priest Rapids Dam (WADM-PRDM) and Priest Rapids Dam to Hanford arrays (PRDM-HAN) separated by passage route (powerhouse, spillway or bypass). Letter labels above columns refer to which routes were statistical significant by reach, e.g. route "a" was statistically different than route "b" or "c" (significantly different from 1.0 where p-values were <0.05).

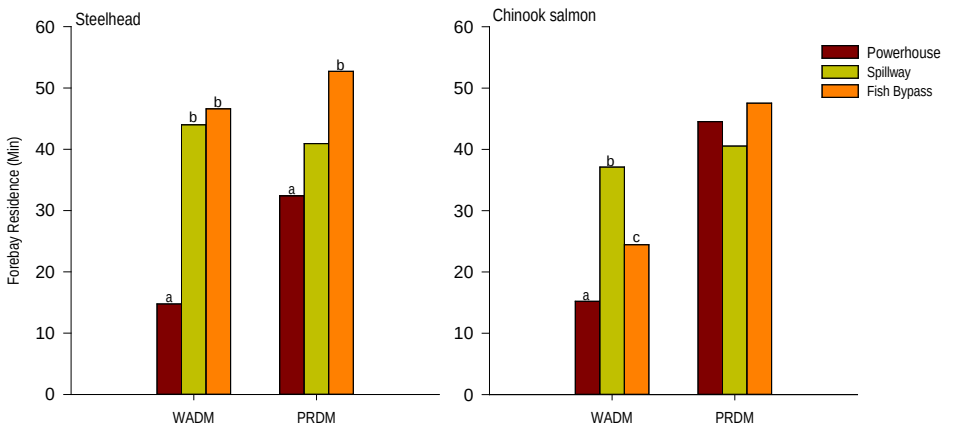

Figure 14. Median forebay residence times in minutes for steelhead and Chinook salmon at Wanapum and Priest Rapids dams separated by passage route (powerhouse, spillway or bypass). Letter labels above columns refer to which routes were statistical significant by reach, e.g. route "a" was statistically different than route "b" or "c" (significantly different from 1.0 where p-values were <0.05).

Chinook salmon that passed at the WFB had statistically shorter forebay residence times compared to those that passed through the spillway. At Priest Rapids Dam, the forebay residence times of steelhead were statistically shortest for fish that selected the powerhouse and longest for the fish that selected the PRFB for downstream passage. Yearling Chinook salmon had similar forebay residence times for all eventual routes; none of which were statistically significant.

At both dams, the hazard barrier is closer to the powerhouse than the spillway and is likely confounding these results. Yet, if milling is occurring directly upstream of the powerhouse at

either dam, it is minimal as the total duration of time spent in the vicinity of the powerhouse is significantly shorter than observed in previous acoustic tag studies. For example, the average forebay residence times of steelhead that passed at the Wanapum Dam powerhouse in 2010 was more than 4 hr while in 2014 it was less than 15 min (Appendix C; Table C.6 and C.7).

Passage Proportions Relative to Approach Position

The approach position of each tagged fish was estimated at the hazard barrier, based on the acoustic receiver the tagged fish was nearest to as it entered the immediate forebay of each dam (first detection at Wanapum Dam on Figure 15 and Priest Rapids Dam on Figure 16). Tracking of fish movement in the forebay was not conducted at Wanapum Dam in 2014. The data in Figure 15 does not reflect movement pathways or assume that fish move in a linear pathway between the hazard barrier to the point of passage, in fact in previous studies we've seen schooling or milling behavior that is more prevelant by steelhead with prolonged residence times. Nonetheless, as fish approached Wanapum Dam, the highest proportion of steelhead and yearling Chinook salmon passed through the hazard barrier near the center of the reservoir, at the north eastern side of the dam which is near the end of the powerhouse (Figure 15). Fish that entered the forebay closest to the powerhouse were more likely to pass at the powerhouse. Conversely, fish that passed through the hazard barrier on the opposite side of the forebay appeared to be more likely to pass at the spillway. This trend was more pronounced for yearling Chinook salmon when compared to juvenile steelhead. However, fish that ultimately passed through the spillway and WFB were from detections of fish, especially steelhead, which entered the immediate forebay region of the dam in all approach positions (Figure 15).

At Priest Rapids Dam, similar trends were presented as those described at Wanapum Dam but were more pronounced. One interpretation of the data illustrated in Figure 16 is that fish were being collected at the PRFB that had entered the forebay from all locations, including the north, closest to the powerhouse (Figure 16). Yearling Chinook salmon seemed less likely to be captured at the PRFB than juvenile steelhead that entered the forebay from the north, also just upstream of the powerhouse.

Priest Rapids Fish Bypass Passage Densities

At Priest Rapids Dam, steelhead and yearling Chinook salmon were tracked in the immediate forebay area between turbine unit 2 and Spill Bay 16. Relative percent passage densities by species that selected the PRFB, i.e. per spatial bin, the proportion of fish that passed through the PRFB versus those that passed through the spillway or powerhouse, are shown in Figure 17. Normalized bin density plots per species depicting where PRFB route fish were more densely detected are also illustrated in Figure 18. For both species, fish that passed downstream through the PRFB were at the highest RPP directly upstream of the PRRB. Steelhead had higher relative percent passage (RPP) extending in front of the powerhouse than yearling Chinook salmon and both species had higher RPP that angled towards the spillway side (Figure 17). Steelhead also appeared to be more likely to be collected from directly upstream of the powerhouse than yearling Chinook salmon (Figure 18).

In previous tracking studies, fish that passed downstream of Priest Rapids Dam through the prototype bypass at Spill Bay 19 and 20 were at the highest RPP on the spillway side of the prototype bypass, within the 300 foot radius from the center of the prototype bypass entrance, and in front of the spillway bays between Spill Bay 6 and Spill Bay 18 (Timko et al. 2010, 2011). More specifically, in 2010, RPP for steelhead that passed through the prototype bypass were high (70-100%) in front of the powerhouse units. This trend is also exhibited in the 2014 RPP for steelhead.

The 2014 tracking results, illustrated in Figure 17 and Figure 18, demonstrate that steelhead passing downstream of the dam through the PRFB were likely being collected from the areas directly upstream of turbine units 1 and 2. The collection of fish at the PRFB from fish transiting across the spillway was marginally captured in the 2014 data set, and was likely a result of two things. First, tracking coverage at the spillway was decreased, and second, high spill volumes throughout the study between spill bays 1 and 18 likely collected and passed fish (an estimated 22% steelhead and 27% of yearling Chinook salmon).

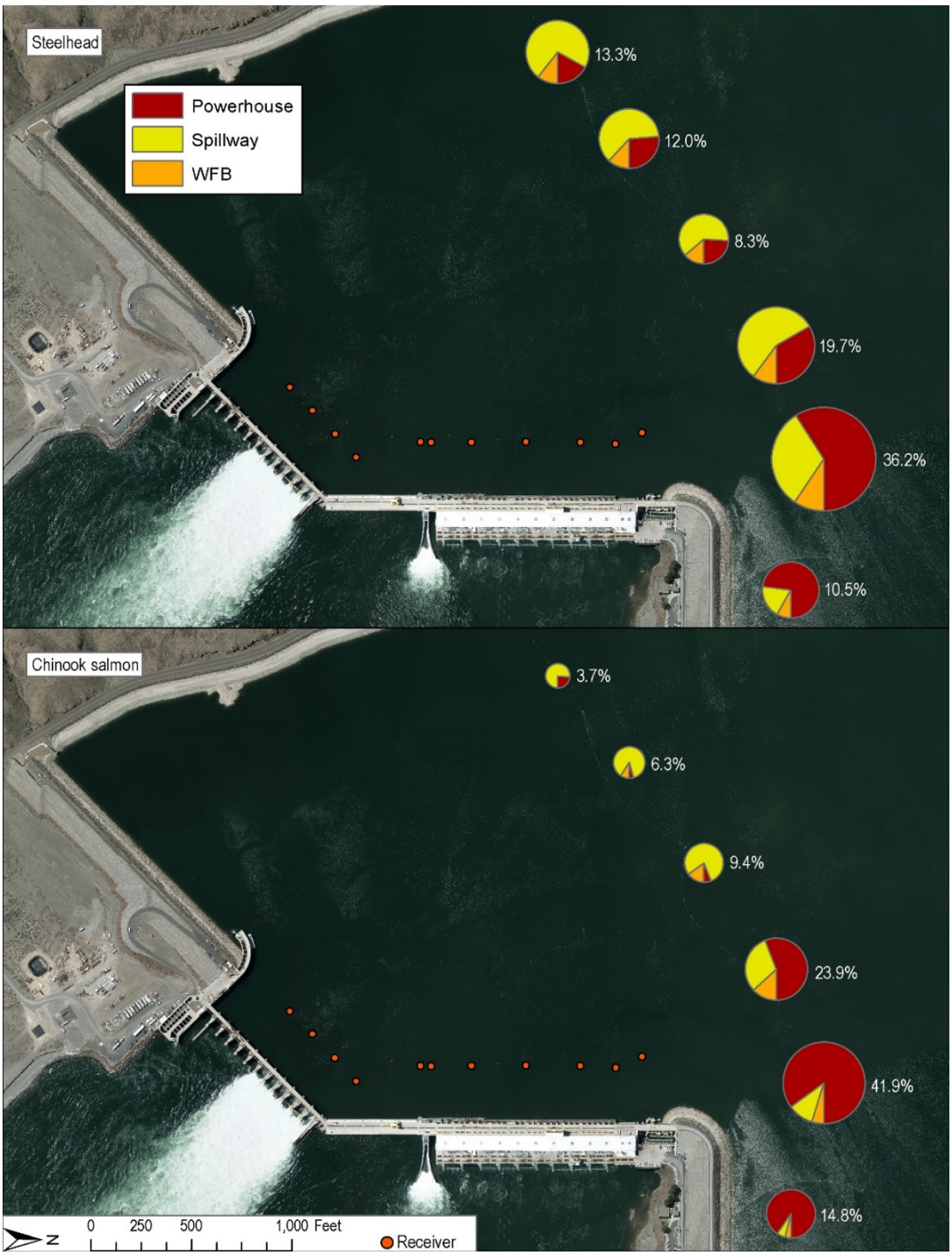

Figure 15. Proportion of juvenile steelhead (top) and yearling Chinook salmon (bottom) passing downstream at the hazard barrier of Wanapum Dam; the pie size is relative to the proportion of fish detected at each logger as fish entered the forebay (first detection). The pie composition indicates the relative passage route proportions (red = powerhouse, yellow = spillway, and orange = bypass) of fish detected in proximity to the closest receiver by species.

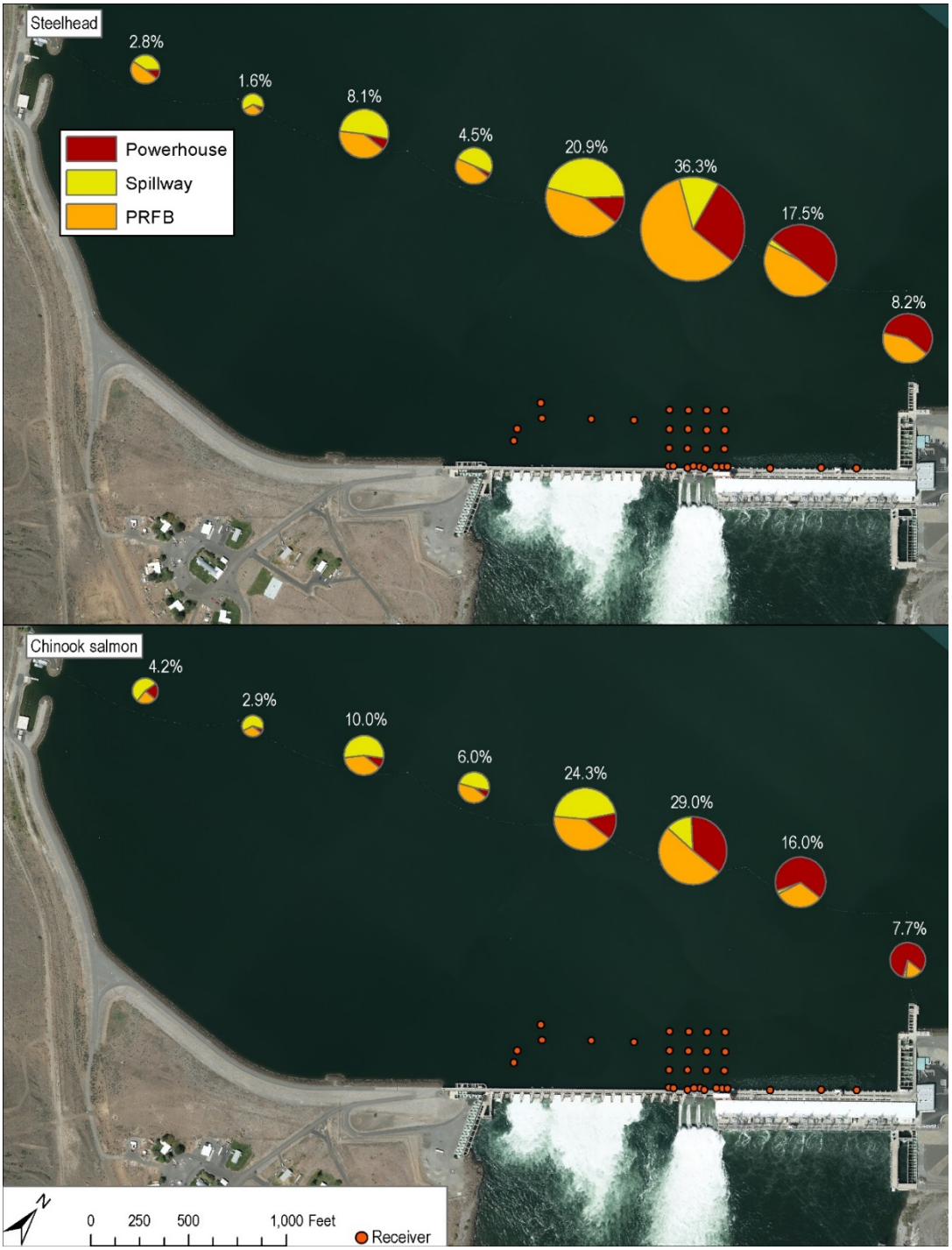

Figure 16. Proportion of juvenile steelhead (top) and yearling Chinook salmon (bottom) passing downstream at the hazard barrier of Priest Rapids Dam; the pie size is relative to the proportion of fish detected at each logger as fish entered the forebay (first detection). The pie composition indicates the relative passage route proportions (red = powerhouse, yellow = spillway, and orange = bypass) of fish detected in proximity to the closest receiver by species.

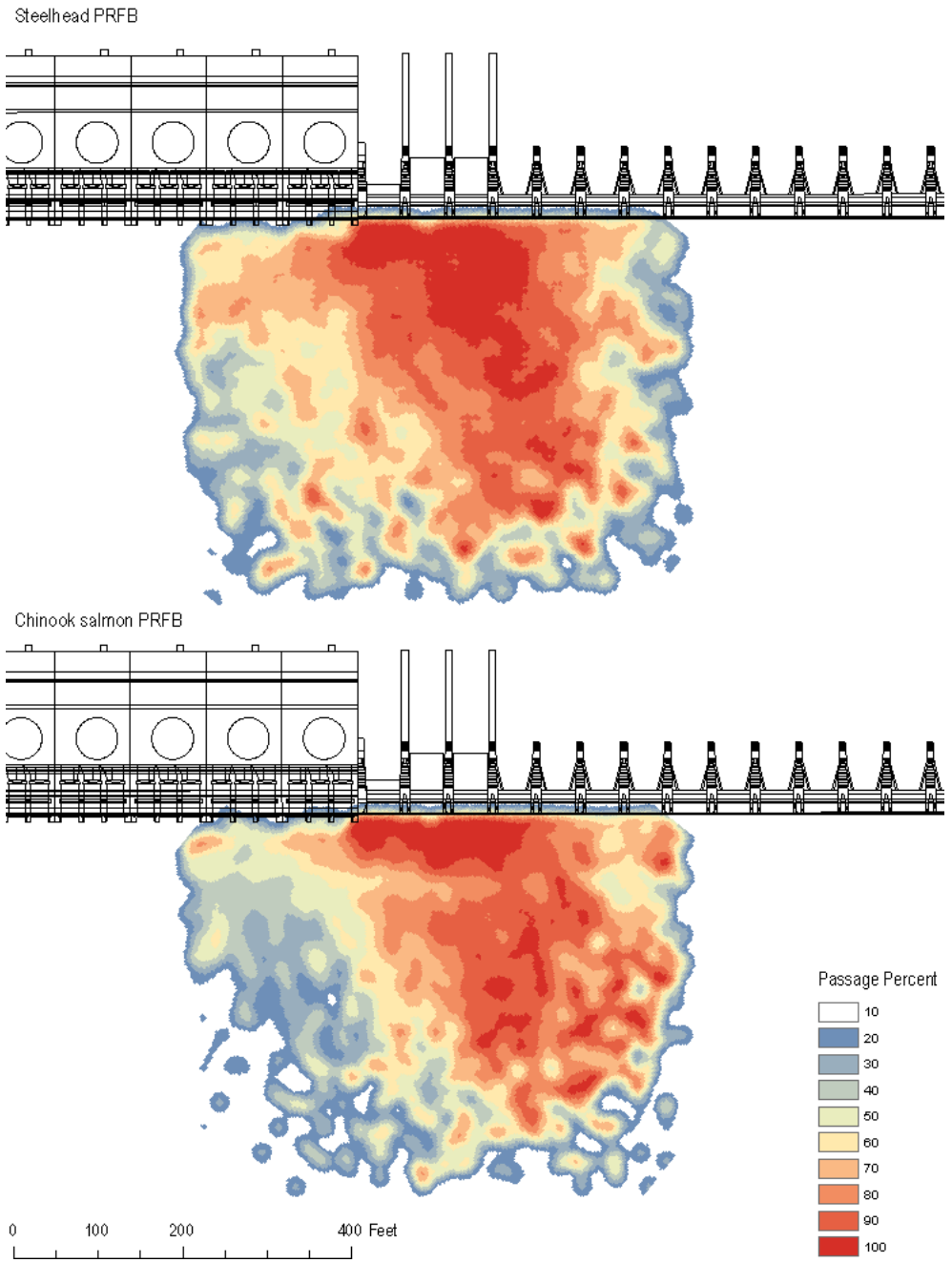

Figure 17. Relative passage percent locations of steelhead (top) and yearling Chinook salmon (bottom) that passed downstream through the Priest Rapids Fish Bypass (PRFB). RPP was calculated using the eventual passage route of each fish, which was based on total fish by species that entered each 10 ft x 10 ft bin and passed through the PRFB.

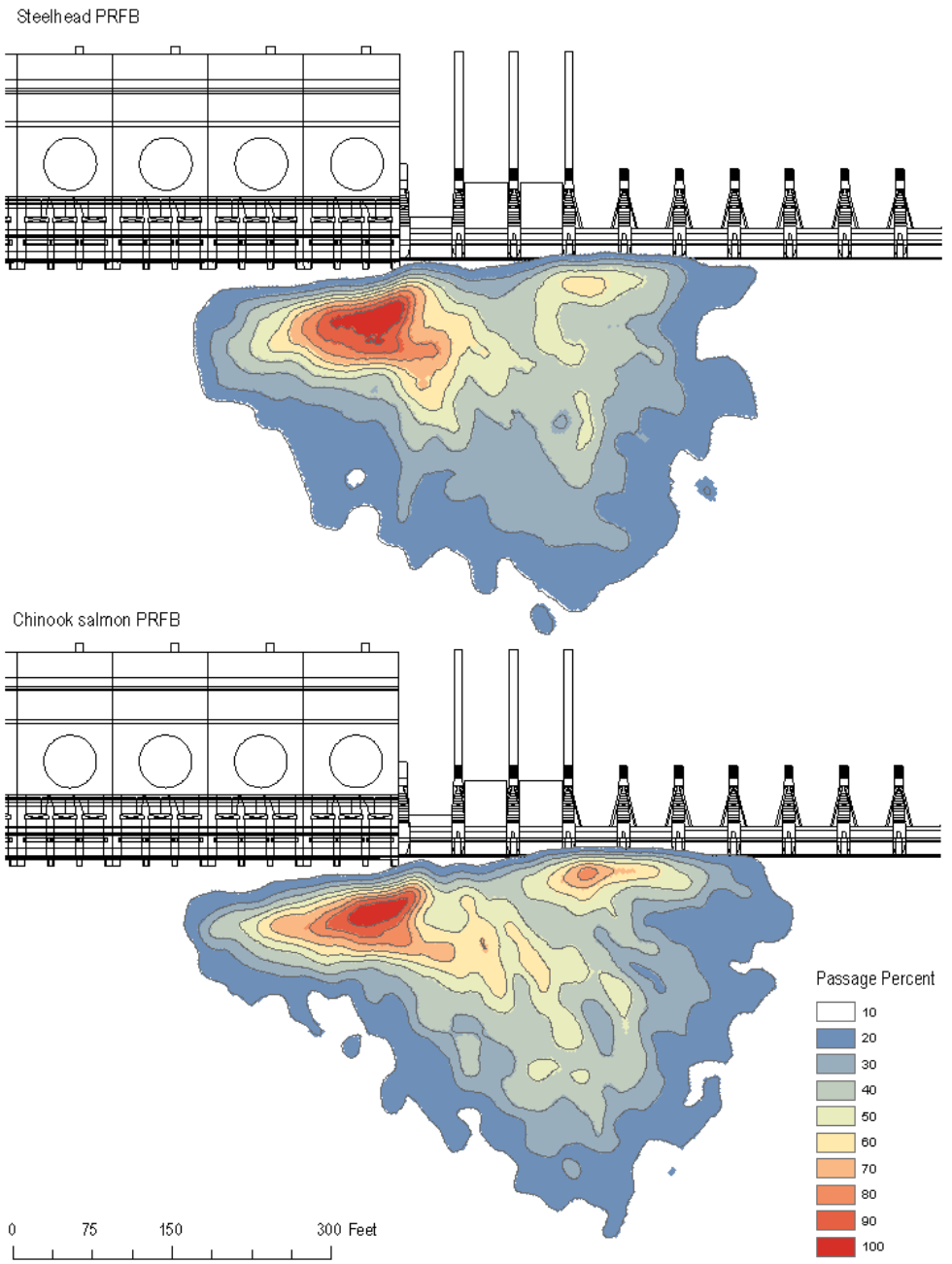

Figure 18. Normalized densities of steelhead (top) and yearling Chinook salmon (bottom) that passed downstream through the Priest Rapids Fish Bypass (PRFB) were created using a grid of 10 ft x 10 ft two-dimensional cells or bins in the forebay. Percentages were determined by the number of individual fish that entered each bin to illustrate where fish were in the forebay before passage selection occurred.

Bypass Non-Selection

Steelhead and yearling Chinook salmon that approached within 300 ft of the PRFB, but did not pass it, were termed "non-selection" fish. At the PRFB, non-selection steelhead and yearling Chinook salmon two-dimensional positions, shown in Figure 19, were evaluated for trends in forebay positions. For the most part, both species that did not select the PRFB but passed through the powerhouse were most heavily concentrated near the powerhouse, directly upstream of turbine Unit 1 and the upstream transition between the powerhouse and bypass structure. Conversely, the opposite seemed true for fish that chose to pass through the spillway instead of the PRFB.

Zone Entrance Efficiency

Zone entrance efficiency (ZEE) was measured as the ratio of fish which encounter the PRFB (to within 300 ft of the entrance) to the total population of fish approaching the dam. In 2014, nearly three quarters of all steelhead and 65% of all yearling Chinook salmon entered the PRFB zone of influence (Figure 20). ZEE in 2014 was 72.5% for steelhead and 65.2% for yearling Chinook salmon (Figure 21).

Fish Collection Efficiency

Fish collection efficiency (FCE) was measured as the ratio of fish that passed via the PRFB to the quantity of fish that entered the 300 ft zone of influence (i.e., how many fish passed through the PRFB after swimming within 300 ft of its entrance). In 2014, FCE was higher for steelhead (64%) than yearling Chinook salmon (57%) (Table 6); Figure 22). In 2014, there was greater than 95% collection efficiency at 50 ft from PRFB; both species had an estimated 98% with decreasing efficiency at greater distances. (Reference Appendix D; Table D.5 for FCE at incrementally further distances from the PRFB, starting at 50 ft to 300 ft upstream of the bypass).

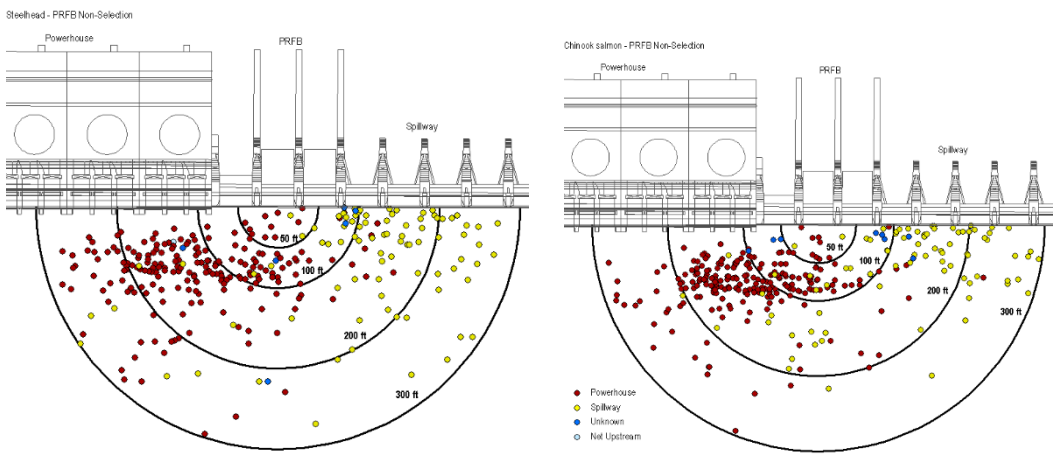

Figure 19. Juvenile steelhead (left) and yearling Chinook salmon (right) that entered the 300 ft radial zone of influence in front of the Priest Rapids Fish Bypass (PRFB) but were not captured are presented. Each point represents the closest estimated approach location to the PRFB in two-dimensions before non-selection occurred.

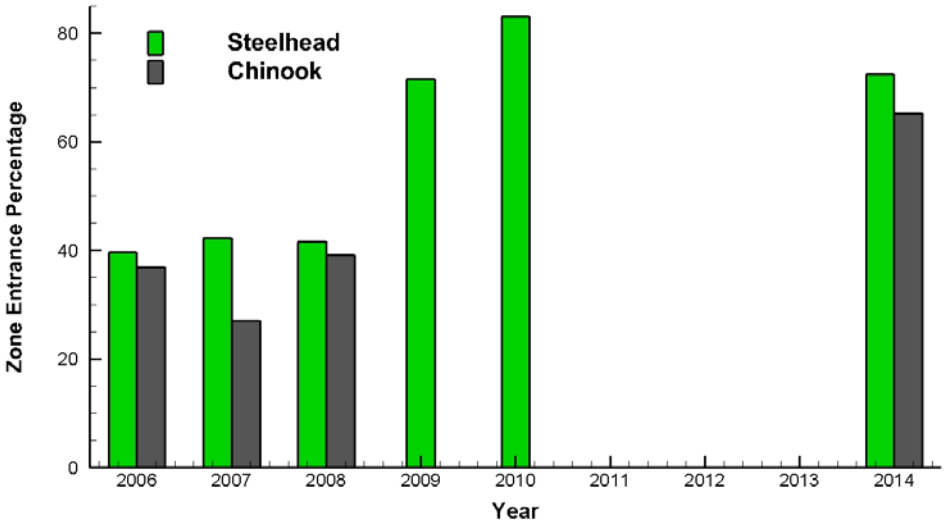

Figure 20. Percent of fish by species and year at Priest Rapids Dam that entered a 300 ft radius from the center of the bypass (PRFB) divided by the total number of fish that passed the dam (defined as zone entrance efficiency) in the 2006-2014 field studies. Behavioral studies were not conducted in 2011-2013 at Priest Rapids Dam; yearling Chinook salmon were not studied in 2009-2010.

Table 6. Priest Rapids Dam fish bypass (PRFB) passage route efficiency by year and species listed by two metrics, first as a product of zone entrance efficiency (ZEE) and fish collection efficiency (FCE), and second as a proportion of the number of fish in the forebay that passed through the PRFB by species. The difference between the passage route efficiency (PRE) product (or the predicted PRE) and the proportion (or actual PRE) is likely due to the annual environmental and hydraulic variability between the two variables, ZEE and FCE.

				PRE_{Bypass}	
Species	Year	ZEE	FCE	Product	Proportion
Steelhead	*Priest Rapids Dam Fish Bypass (PRFB)*				
	2014	0.73	0.64	0.47	0.47
	Priest Rapids Dam Prototype Bulkhead Testing				
	2010	0.78	0.69	0.54	0.57
	2009	0.72	0.66	0.47	0.51
	2008	0.42	0.59	0.25	0.33
	2007	0.42	0.34	0.14	0.19
	2006	0.40	0.39	0.16	0.15
Yearling Chinook Salmon	*Priest Rapids Dam Fish Bypass (PRFB)*				
	2014	0.65	0.57	0.37	0.38
	Priest Rapids Dam Prototype Bulkhead Testing				
	2008	0.39	0.31	0.12	0.15
	2007	0.27	0.29	0.08	0.12
	2006	0.36	0.33	0.12	0.12

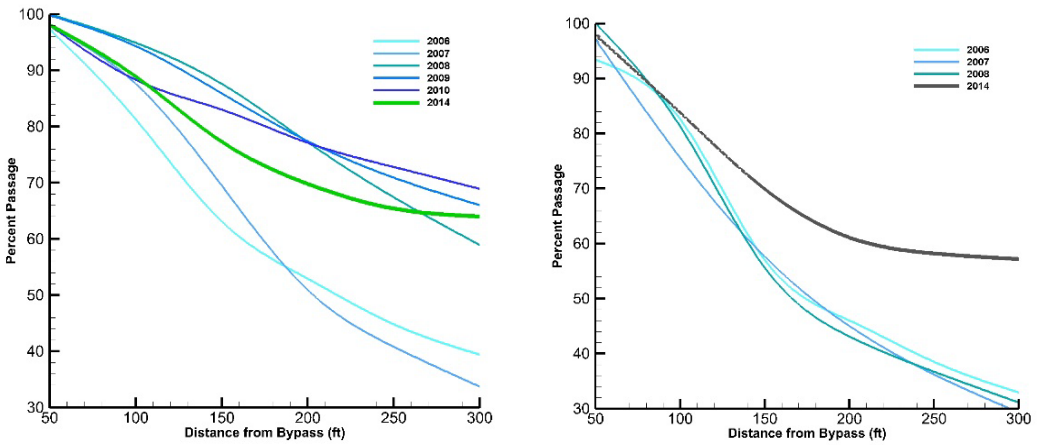

Figure 21. Percent passage of steelhead (left) and yearling Chinook salmon (right) through the Priest Rapids Dam fish bypass (PRFB) that were detected within 50, 100, 150, 200, 250, and 300 ft increments from the prototype bypass (steelhead 2006-2010, 2014; yearling Chinook salmon 2006-2008, 2014).

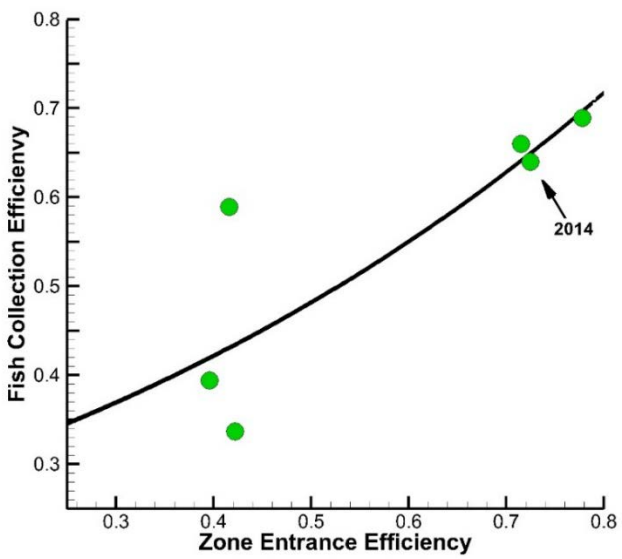

Figure 22. Steelhead fish collection efficiency (FCE) of the Priest Rapids Dam fish bypass in 2014 and at the prototype bypass in 2006-2010 are displayed by an exponential regression with zone entrance efficiency (ZEE). Each point represents steelhead (green) evaluated per year. Increased passage route efficiency at the prototype bypass occurred as an increase in proportion of study fish entered the zone of influence (300 ft radius from the center of the top-spill configuration). The highest FCE and ZEE were estimated in 2010; the second highest FCE and ZEE were estimated in 2014 and 2009. The exponential regression R^2 values of steelhead was 0.67.

Discussion

The primary goals of this study were to estimate juvenile steelhead and yearling Chinook salmon survival and to examine behavioral passage trends through the Wanapum and Priest Rapids dams. JSATS acoustic technology was used to meet these goals by surgically implanting acoustic transmitters into fish and then collecting spatial data in a continuing series of detection arrays between Rock Island Dam (RM 453) and the Hanford Reach (RM 337). Distinct emphasis was placed on the behavior of steelhead and yearling Chinook salmon as they approached and passed downstream of Priest Rapids Dam at or near the newly constructed Priest Rapids Fish Bypass (PRFB) with additional 2/3D receivers arranged to three-dimensionally track study fish directly upstream of the PRFB.

For yearling Chinook salmon, survival standards were met after a series of PIT tag evaluation studies in 2003, 2004, and 2005; however, Grant PUD was required in 2014 to assess whether survival standards were being maintained. Yearling Chinook salmon that passed through the Project comfortably met the survival standards in 2014 (Skalski et al. 2014). Yearling Chinook salmon survival through the Project increased by 4.2% (90.8%) compared to the three-year Project survival average in 2003-2005 of 86.6%.

In 2014, juvenile steelhead BiOp and SSSA performance standards were met in two of the Project areas; survival standards were met through the Priest Rapids Development and the entire Project area but were not met in the Wanapum Development (Figure 23). The survival standard for steelhead of 93% through the Wanapum Development was narrowly missed by a margin of 0.06% (Skalski et al. 2014). Although, survival through the Wanapum Development increased slightly by 1.0% (from the three-year $\hat{S}$ average of 91.9% in 2008-2010 to $\hat{S}$ of 92.9% in 2014), the Priest Rapids Development and overall Project survival increased moderately at 7.9% and 8.3%, respectively (Figure 23). The estimated Priest Rapids Development survival in 2014 was similar to the survival estimates in 2011 when general survival and predation by fish and birds was investigated (2011 $\hat{S}$ of 97%; 2014 $\hat{S}$ of 96%).

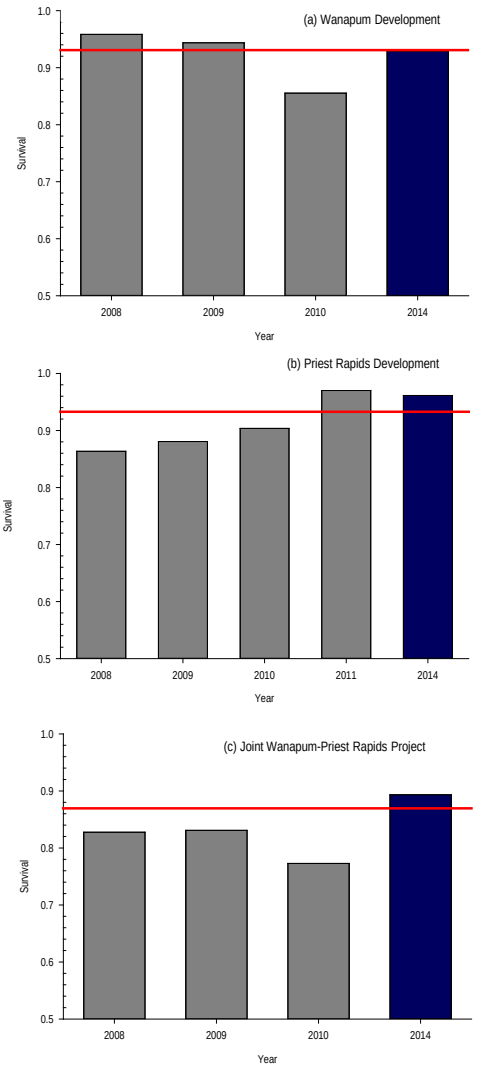

Figure 23. Survival of juvenile steelhead through the (a) Wanapum Development, (b) Priest Rapids Development, and (c) Joint Wanapum-Priest Rapids Project, 2006-2010 and 2014. The target performance standard for steelhead is 93% in each development and 86.5% in the Joint Wanapum-Priest Rapids Project (shown by red line). Steelhead survival was estimated in the Priest Rapids Development in 2011 and was similar to 2014 results.

The distinct increase in steelhead survival, predominantly through the Priest Rapids Development, was difficult to correlate to one, single variable. One possible variable was the increased regional effort to reduce avian predator populations. In comparison to previous years, the

detections of Grant PUD study fish from 2014 at Potholes Reservoir has decreased. Although study fish were detected at the Potholes Reservoir nesting colony, the decrease in overall PIT tags detected could be a function of the decreased number of nesting breeding pairs in comparison to 2010. Evans et al. (*in progress*) are preparing a separate report of a retrospective analysis on avian predation in 2014 and we hope to gain further insights from their study contributions.

Juvenile salmon migration rates have also been well correlated with survival, as well as flow and spill, where increased survival was documented in years with faster migration (Anglea et al. 2005b; Faulkner et al. 2007; Muir et al. 2001; Thompson et al. 2012). In 2014, steelhead migration rates above Wanapum Dam were considerably faster than the 2006-2010 average (Δ+55.5%). The faster migration rates were likely related to low forebay and reservoir elevations in the Wanapum Development that were 28 ft below the typical elevation, thus creating a more channelized river system. However, 2014 steelhead survival through the Wanapum Development deviated little from the 2008-2010 average, in fact the 2014 survival estimate of 92.9% was lower than that estimated in 2008 (95.8%) and 2009 (94.4%) (Figure 23). Downstream of Wanapum Dam, migration rates of steelhead and yearling Chinook salmon were more comparable to the 2008-2010/11 average, implying that changes in the environmental conditions that affected salmonid migration in 2014, were isolated to the Wanapum Reservoir.

Migrating juvenile salmonids with extended forebay residence times, *i.e.* 'milling' behavior, likely experienced an increase in predatory exposure and concurrent decreased survival estimates. When 2014 residence times were compared to historical times it yielded few definitive conclusions and was likely a result of changes in array structure and acoustic technology used. Nonetheless, upon extending the forebay to include BRZ loggers, both species were found to have resided in the forebay for less than one hour; thus milling behavior did not appear prevalent at either dam during the 2014 study.

It has been well established that passage through the powerhouse of hydroelectric dams can be harmful to migrating juvenile salmonids (Muir et al. 2001, Mighetto and Ebel 1994, Raymond 1979). In response, Grant PUD has constructed fish bypass structures at Wanapum and Priest Rapids dams that offer an additional non-powerhouse passage route. The 2014 migratory season marked the first year in which both bypass systems were in operation. In particular, 2014 was the inaugural operating season of the PRFB. Assessing each bypass's efficiency was conducted through the examination of survival by passage route (route specific survival) weighted by the bypass's ability to collect fish. Steelhead route specific survival through Wanapum Dam matched historical trends as fish that passed through the powerhouse were statistically measured at lower survival than fish that passed through the spillway or WFB. Yearling Chinook salmon deviated from hypothesized trends and showed no route specific improvements to survival; all routes yielded high survival at Wanapum Dam. Steelhead and yearling Chinook salmon that passed downstream of Priest Rapids Dam through the PRFB yielded statistically higher survival rates through the proceeding downstream reach than fish that passed through either the spillway or powerhouse. In addition to incurring the lowest survival at both dams, both species that passed through the powerhouse also had the slowest downstream migration rates relative to alternative passage routes.

Passage proportions at Wanapum Dam in 2014 were likely affected by low reservoir elevations. Only 10% of steelhead passed downstream through the WFB in 2014 compared to nearly 77% in 2010. Additionally in 2014, powerhouse route selection increased by 22% with the remaining 44% passing through the spillway; no steelhead passed through the spillway in 2010. It is reasonable to speculate that the changes in passage route proportions at Wanapum Dam may have negatively affected the estimated steelhead 2014 concrete survival. The 2014 steelhead concrete survival estimate was 97.8%, where 2009 and 2010 yielded virtually 100% survival with more steelhead passed through the WFB in previous years. Yearling Chinook salmon WFB collection decreased by 22% and powerhouse collection increased by 18% in 2014 relative to 2008, while spillway proportions remained similar (Δ+3%). The ubiquitous decrease in 2014 WFB selection is a direct result of the Wanapum Reservoir drawdown that decreased the flow at the bypass to 80% below normal, which resulted in less attraction flow

and ultimately decreased selection of that passage route.

Passage proportions of steelhead at Priest Rapids Dam match previous results more closely, though notable differences remain. The proportion of steelhead that passed through the powerhouse in 2014 decreased by 12% when compared to 2010. For comparison, yearling Chinook salmon passage at the powerhouse in 2014 also decreased noticeably compared to 2008 (Δ-33%). Yet in 2014 the PRFB collected 11% fewer steelhead relative to 2010 and 13% fewer yearling Chinook salmon relative to 2008. The confounding factor likely driving these changes in PRFB passage was the additional inadvertent spill in 2014. Less than 1% of 2010 steelhead passed through the spillway as it was sparsely operated, but in 2014, 22% of the steelhead passed through the spillway as it was operated during the majority of the study. The dam operations at each facility are dynamic from year to year, however the additional route for passage altered the anticipated Priest Rapids Dam passage dynamic, expressed predominantly by diminished PRFB selection than observed in previous years with a prototype bulkhead top-spill.

Further approach analysis corroborates with this hypothesis. Relative percent passage figures confirm that fish encountering the PRFB entrance from the spillway end are sufficiently attracted to pass at the PRFB. However, results from the normalized bin density figures confound this effect because a lower density of fish encountered the PRFB from the spillway, relative to the opposite side of the PRFB at the junction of the powerhouse. The normalized bin densities at Priest Rapids Dam also demonstrated that there was some attraction for fish to pass at the PRFB when they were in the forebay, directly upstream of turbine units 1 and 2. Based on the approach analysis from the BRZ, fish that entered the forebay near the spillway (south end of the BRZ) were more likely to have passed through the spillway and never encountered the PRFB entrance. Therefore, we suspect that if the spillway was closed in 2014, the PRFB would have likely collected a significant portion, if not all, of the steelhead that had entered the Priest Rapids Dam forebay at or near the spillway.

In summary, over the past several years, steelhead survival estimates in the Wanapum and Priest Rapids developments have failed to consistently meet BiOp and SSSA performance standards. In 2014, steelhead survival met nearly all performance standards; narrowly missing the mark at the Wanapum Development. Providing a quantitativly robust identification of a single factor that accounts for the increase in survival is convoluted, considering the ecological complexity of the Mid-Columbia River system, but several modifications to the river ecosystem suggest possible affects.

Grant PUD has put considerable effort into the management of piscivorous fish and birds, likely leading to decreased mortality from predation throughout the entire Project area. Additionally, the change in forebay elevation at Wanapum Dam has resulted in competing factors; faster migration rates that likely assisted in increasing survival, and lower WFB selection which may have led to an overall decreased Project survival. Another considerable change in Project operations in 2014 was the addition of the PRFB, allowing 2014 steelhead a safer alternative to powerhouse or spillway passage. The addition of this non-turbine route, however, did not considerably increase dam survival in 2014 relative to 2008-2010 results. Yet, it is feasible that less spill may increase PRFB selection in future years, and based on 2014 relative route-specific survival, increased passage at the PRFB would increase overall dam survival estimates similar to the WFB's effect on survival at Wanapum Dam in 2009-2010.

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greatly appreciated. Teknologic Engineering supported the behavioral components of this study at Priest Rapids Dam, namely the design of 2/3D data collection and analysis of positioning, post-data collection. Special thanks to Brent Smith (Teknologic Engineering) for the manufacture, education, and assistance with the many receivers used in this study as well as Liana Wunderlich (Teknologic Engineering) and Michael Meagher (Blue Leaf) for 2/3D analysis. We would also like to thank Columbia Helicopters and Central Valley Helicopters for their skillful transport and release of fish throughout this study.

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Appendix A

Acoustic Array Positioning and System Detection Efficiency

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Table A.1. The 2014 receiver deployment configurations for Wanapum Dam. Table includes the array deployed at the Boat Restricted Zone (BRZ) and the array installed in the forebay. Unique system ID, unique receiver identification numbers, elevation, and position (NAD 83 HARN Washington State Plane South Feet) are provided. The forebay array also includes location relative to the dam (PH = powerhouse, WFB = Wanapum Fish Bypass, SP = spillway). Receivers that detached, leaked, or had SD card malfunctions are indicated by an asterisk.

System ID	Number	Receiver Location	Northing	Easting	Elevation (ft)
Wanapum Dam BRZ					
W416_3A	331	BRZ	562996.0	1770418.0	533.0
W416_3B	332	BRZ	563352.0	1770847.6	533.0
W416_3C	333	BRZ	563724.4	1771346.9	533.0
W416_3D	334	BRZ	564084.6	1771874.8	533.0
W416_3E	335	BRZ	564322.0	1772439.5	533.0
W416_3F	336	BRZ	564158.2	1773090.2	533.0
Wanapum Dam Forebay					
W416_1A	301	SP	561666.2	1772087.0	515.0
W416_1B	302	SP	561778.2	1772200.7	515.0
W416_1C	303	SP	561890.1	1772316.5	515.0
W416_1D	304	SP	561996.7	1772434.3	515.0
W416_1E	305	WFB	562315.5	1772356.7	510.0
W416_1F	306	WFB	562367.4	1772357.8	510.0
W416_1G	307	PH	562568.0	1772357.0	515.0
W416_1H*	308	PH	562840.2	1772354.8	515.0
W416_1I	309	PH	563110.9	1772355.9	515.0
W416_1J*	310A	PH	563287.0	1772364.4	515.0
W416_1J	310B	PH	563417.0	1772309.6	515.0

Table A.2. The 2014 receiver deployment configurations for Priest Rapids Dam. Table includes the array deployed at the Boat Restricted Zone (BRZ) and the array installed in the forebay. Unique system ID, unique receiver identification numbers, elevation, and position (NAD 83 HARN Washington State Plane South Feet) are provided. The forebay array also includes location relative to the dam (PH = powerhouse, PRFB = Priest Rapids Fish Bypass, SP = spillway). Receivers that detached, leaked, or had SD card malfunctions are indicated by an asterisk.

System ID	Number	Receiver Location	Northing	Easting	Elevation (ft)
Priest Rapids Dam BRZ					
P397_4A	531	BRZ	478452.6	1784995.4	475.0
P397_4B	532	BRZ	478658.8	1785536.5	475.0
P397_4C	533	BRZ	478900.6	1786073.0	475.0
P397_4D	534	BRZ	479126.5	1786614.2	475.0
P397_4E	535	BRZ	479358.6	1787158.4	475.0
P397_4F	536	BRZ	479579.3	1787688.0	475.0
P397_4G	537	BRZ	479800.0	1788217.7	475.0
P397_4H	538	BRZ	479835.3	1788895.1	475.0
Priest Rapids Dam Forebay					
P397_1A*	501A	SP	478159.7	1787659.8	447.1
P397_1AS	501B	SP	478218.5	1787635.2	455.0
P397_1B*	502A	SP	478339.7	1787699.4	450.1
P397_1BS	502B	SP	478397.1	1787645.1	455.0
P397_1C	503	SP	478496.5	1787898.6	444.1
P397_1D	504	SP	478628.5	1788072.7	441.1
P397_1E*	505	SP	478572.7	1788376.5	426.0
P397_1F*	506	PRFB	478637.4	1788458.1	425.5
P397_1G	507	PRFB	478664.5	1788505.4	436.6
P397_1H	508	PRFB/PH	478708.6	1788547.0	454.5
P397_1I	509	PH	478875.9	1788767.2	450.0
P397_1J	510	PH	479042.5	1788970.0	450.0
P397_1K	511	PH	479154.3	1789111.0	450.0

Table A.3. The 2014 receiver deployment configurations for Priest Rapids Dam 3D array. Unique system ID, unique receiver identification numbers, elevation, and position (NAD 83 HARN Washington State Plane South Feet) are provided. Location relative to the dam (PH = powerhouse, PRFB = Priest Rapids Fish Bypass, SP = spillway) is included. Receivers that detached, leaked, or had SD card malfunctions are indicated by an asterisk.

System ID	Number	Receiver Location	Northing	Easting	Elevation (ft)
Priest Rapids 3D Array					
P397_1AA	551	SP	478558.4	1788358.5	423.8
P397_1AB	552	SP/PRFB	478611.1	1788438.2	455.3
P397_1AC*	553	PRFB	478656.6	1788482.7	423.2
P397_1AD	554	PRFB/PH	478708.6	1788547.0	474.2
P397_1AE*	568	PH	478728.4	1788571.8	462.1
P397_1AF	555	PH	478745.1	1788592.9	476.0
P397_2AA*	556	SP	478630.3	1788301.8	476.0
P397_2AB	557	SP/PRFB	478688.6	1788376.5	455.0
P397_2AC	558	PRFB	478747.0	1788451.4	476.0
P397_2AD	559	PH	478804.2	1788524.4	410.0
P397_2AE	560	SP	478708.3	1788240.6	455.0
P397_2AF	561	SP/PRFB	478767.4	1788315.8	476.0
P397_2AG	562	PRFB	478824.7	1788391.7	455.0
P397_2AH	563	PH	478882.2	1788464.6	476.0
P397_2AI	564	SP	478785.0	1788180.1	476.0
P397_2AJ	565	SP/PRFB	478844.2	1788256.3	455.0
P397_2AK	566	PRFB	478902.7	1788330.0	476.0
P397_2AL	567	PH	478960.9	1788401.4	455.0

Table A.4. The 2014 receiver deployment configuration at each of the in-river detection sites (Crescent Bar, Sunland Estates, Mattawa, Vernita Bridge, White Bluffs, Hanford 1 and Hanford 2). Unique system ID, unique receiver identification numbers, and receiver position (NAD 83 Washington State Plane South Feet) are provided. All in-river receivers were attached to an acoustic release and deployed on the river bottom. Receivers that failed, intermittently or permanently, to collect data are indicated by an asterisk. Receiver 703R was installed as a replacement after the original receiver (703) broke free from its mount.

System ID	Receiver	Northing	Easting
Crescent Bar			
W441_5A	101	689415.4	1761800.6
W441_5B	102	689703.5	1761903.8
W441_5C	103	689991.7	1762003.8
Sunland Estates			
W428_2A	201	625132.5	1758901.5
W428_2B	202	625296.5	1759237.7
W428_2C*	203	625459.3	1759571.5
W428_2D	204	625620.9	1759902.9
Mattawa			
P408_4A	401	521626.1	1774599.8
P408_4B	402	521312.0	1774882.0
P408_4C	403	521001.9	1775122.8
P408_4D	404	520787.4	1775365.9
Vernita Bridge			
M388_6A	601	476247.4	1830873.7
M388_6B*	602	476498.6	1830768.2
M388_6C	603	476754.8	1830662.8
M388_6D	604	477032.7	1830545.5
White Bluffs			
M368_5A	701	489104.8	1902501.1
M368_5B	702	489243.8	1902684.2
M368_5C*	703	489382.7	1902867.4
M368_5C	703R	489382.7	1902867.4
M368_5D*	704	489521.6	1903063.1
Hanford 1			
M339_0A	801	352472.1	1952070.4
M339_0B	802	352323.5	1952550.7
M339_0C	803	352106.3	1953177.0
M339_0D	804	351933.0	1953736.3
Hanford 2			
M337_0A*	901	343642.8	1953544.4
M337_0B*	902	343912.3	1953776.5
M337_0C	903	344119.5	1953965.6
M337_0D	904	344377.4	1954187.5

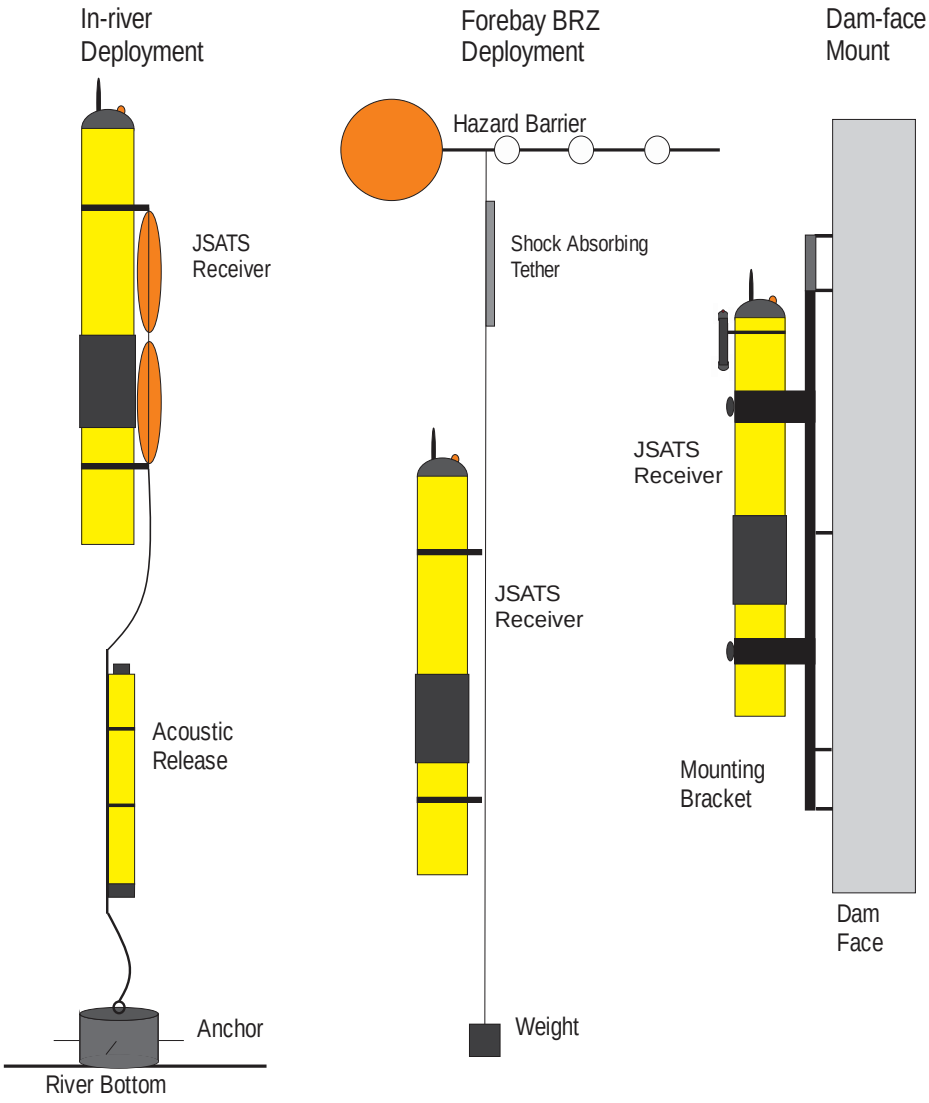

Figure A.1. Deployment schematic of in-river JSATS receivers fixed to the river bottom (left) with a concrete weight (approximately 75 lb.). Receivers were tethered to the release anchor assembly with 15' of 3/8" aircraft cable. Receivers attached to the hazard barrier of the BRZ at Wanapum and Priest Rapids dams (center) were suspended between large pelican clips attached to the pad-eye of hazard barrier crown buoys and 20 lb. lead weights. Shock absorbing tethers were affixed to 15' of 3/8" aircraft cable to reduce shock load to receivers during periods of heavy weather. Receivers attached to the face of Priest Rapids Dam (right) were attached via a metal bracket secured with rock bolts.

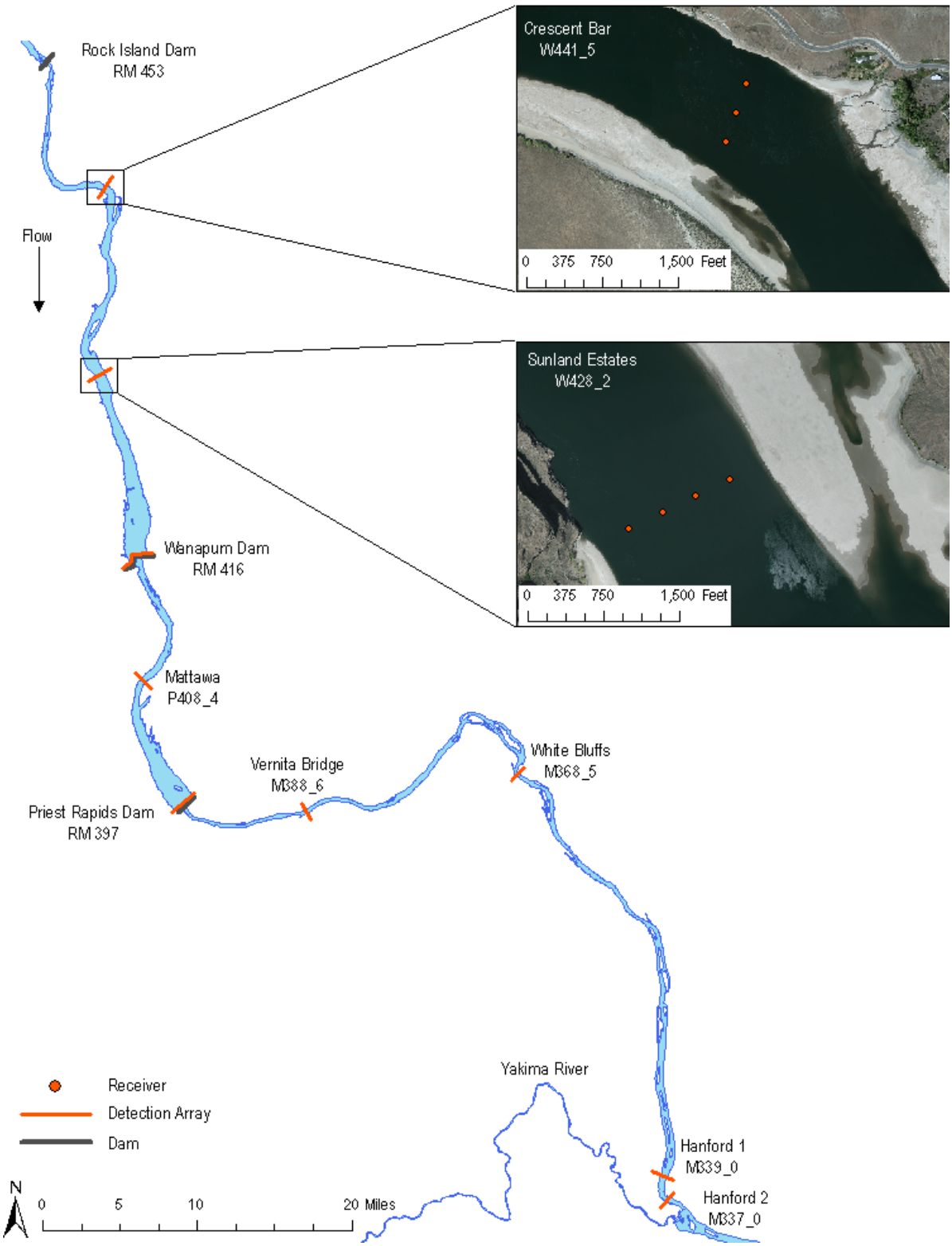

Figure A.2. Position of arrays deployed for the survival study including a detailed view of the cross-river detection arrays at Crescent Bar and Sunland Estates. Digital imagery courtesy of Grant PUD taken in March 2014.

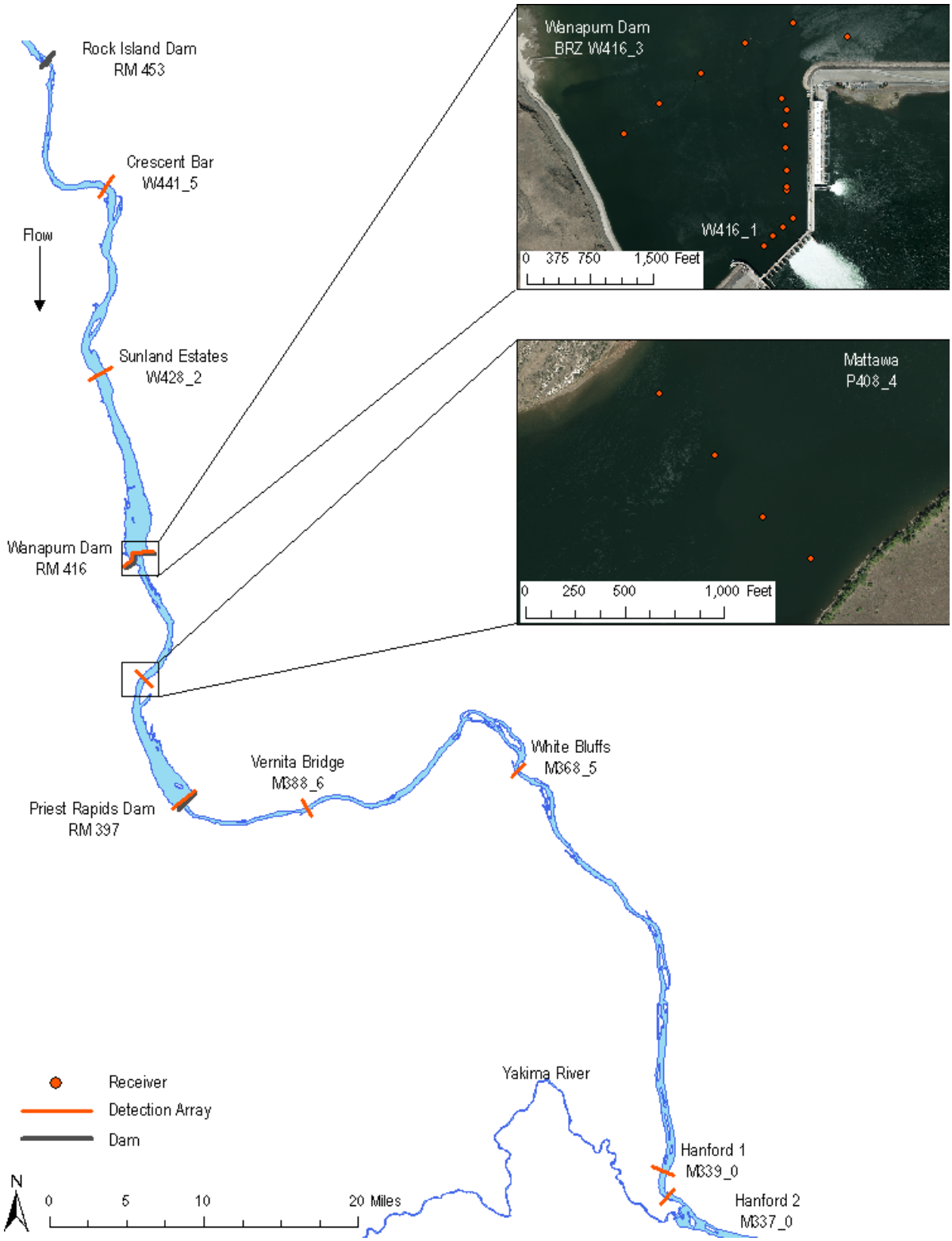

Figure A.3. Position of arrays deployed for the survival study including a detailed view of the detection array at Wanapum Dam and cross-river detection array at Mattawa. Digital imagery courtesy of Grant PUD taken in March 2014.

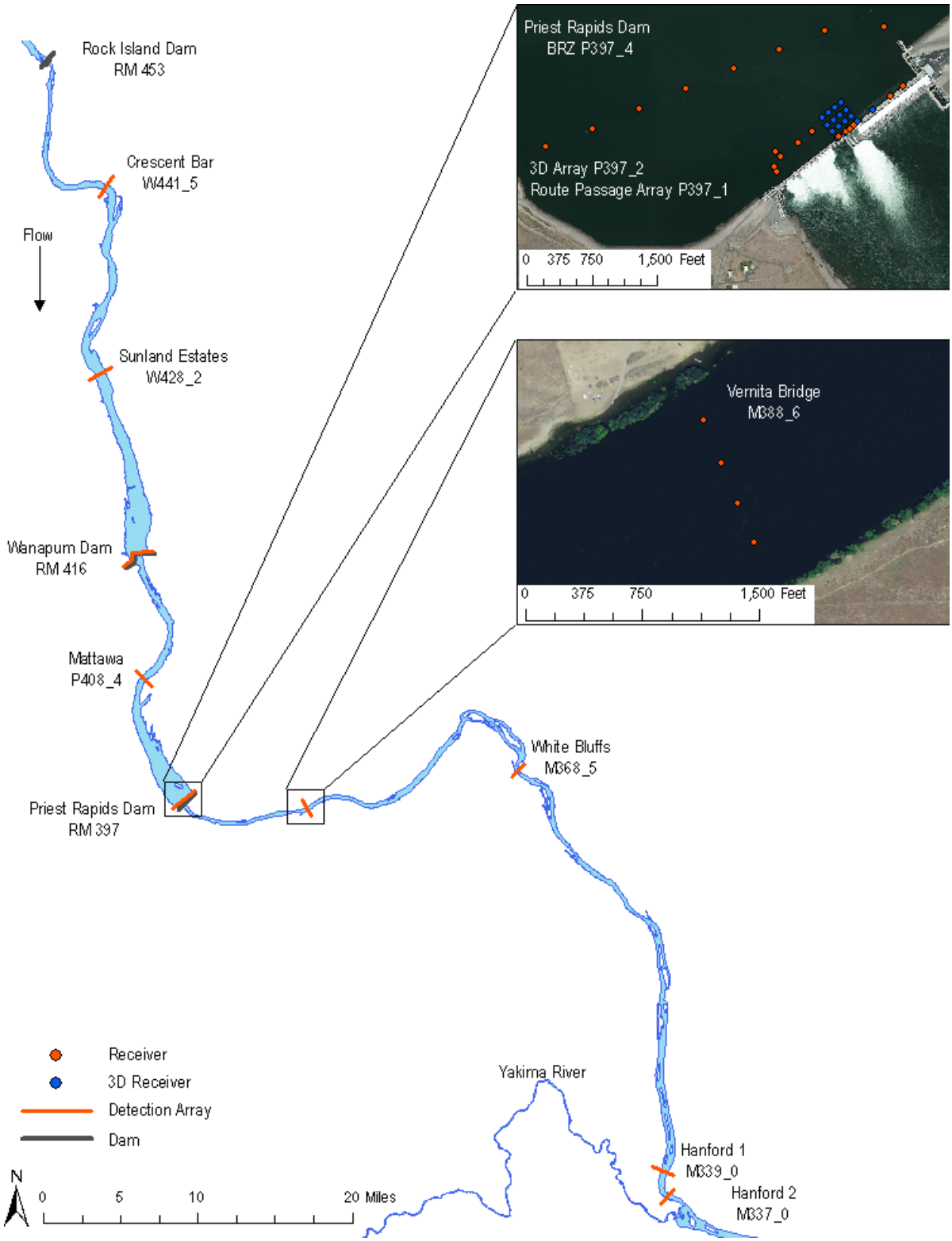

Figure A.4. Position of arrays deployed for the survival study including a detailed view of the detection array at Priest Rapids Dam and cross-river detection array at Vernita Bridge. Digital imagery of Priest Rapids Dam courtesy of Grant PUD taken in March 2014. Digital imagery of Vernita Bridge is the 2013 National Agriculture Imagery Program Mosaic for Benton County (http://datagateway.nrcs.usda.gov/gdgorder.aspx).

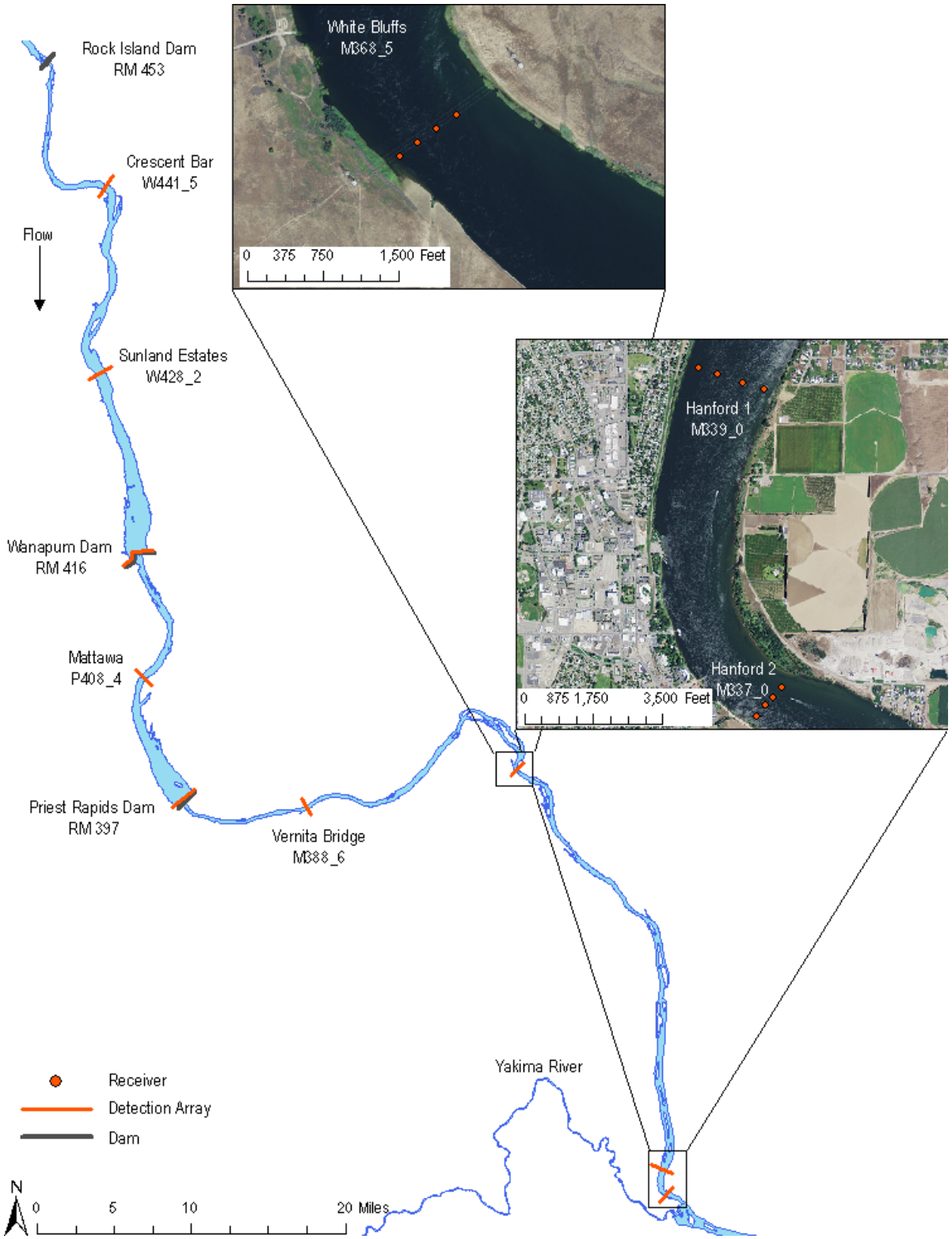

Figure A.5. Position of arrays deployed for the survival study including a detailed view of the cross-river detection array at White Bluffs, Hanford 1 and Hanford 2. Digital imagery is the 2013 National Agriculture Imagery Program Mosaic for Franklin County (http://datagateway.nrcs.usda.gov/gdgorder.aspx).

Table A.5. Summary of data collection failure events by detection array is listed with last valid detection date and time, and a brief explanation of lost data collection.

Full SD Cards and Flooded Receivers					
Array	System ID	Number	Receiver Location	Last Detection	Comments
Priest Rapids FB	P397_1A	501A	SP	5/12/2014 3:20:38 AM	SD card full
Priest Rapids FB	P397_1B	502A	SP	5/29/2014 10:41:46 PM	SD card full
Priest Rapids FB	P397_1F	506	PRFB		Flooded receiver
Priest Rapids 3D	P397_1AC	553	PRFB	5/24/2014 2:41:48 AM	Flooded receiver
Priest Rapids 3D	P397_2AA	556	SP		SD card full
Failed Receivers or SD Cards					
Array	System ID	Number	Receiver Location	Last Detection	Comments
Priest Rapids FB	P397_1D	504	SP		Receiver malfunction
Priest Rapids FB	P397_1E	505	SP	5/11/2014 5:32:59 AM	Receiver malfunction
Priest Rapids 3D	P397_1AE[1]	568	PH		Power lost
Vernita Bridge	M388_6B	602	Vernita Bridge	Unknown	SD card unreadable
Hanford 2	M337_0B	902	Hanford 2	Unknown	SD card unreadable
Damaged/Detached Receiver					
Array	System ID	Number	Receiver Location	Last Detection	Comments
Sunland Estates	W428_2C	203	Sunland Estates	5/27/2014 7:22:10 AM	Detached, not replaced
Wanapum FB	W416_1H	308	PH	5/28/2014 7:09:34 AM	Detached, not replaced
Wanapum FB	W416_1J	310A	PH	5/13/2014 9:28:57 PM	Detached, replaced
Wanapum FB	W416_1J	310B	PH	5/28/2014 7:02:01 AM	Detached, not replaced
Vernita Bridge	M388_6B	602	Vernita Bridge	Unknown	Detached, not replaced
White Bluffs	M368_5C	703	White Bluffs	6/3/2014 8:39:41 PM	Detached, replaced
White Bluffs	M368_5D	704	White Bluffs	5/31/2014 11:44:44 AM	Detached, not replaced
Hanford 2	M337_0A	901	Hanford 2	5/17/14 5:52:07 PM	Physical damage

[1] Receiver was cabled to the surface and wrote data files to an external hard drive.

Table A.6. Total number of valid acoustic tag detections at each detection array deployed in the study area in 2014. First and last valid acoustic detection date and time are also listed.

Detection Array	First Detection	Last Detection	Number of Detections
Crescent Bar	4/30/14 1:16:21 PM	5/27/14 5:27:00 PM	35,003
Sunland Estates	4/30/14 8:41:18 PM	5/27/14 10:41:55 PM	163,396
Wanapum BRZ	5/1/14 8:45:16 PM	5/28/14 7:04:11 AM	174,183
Wanapum Forebay	5/1/14 9:05:07 PM	5/28/14 7:12:49 AM	215,728
Mattawa	5/1/14 11:55:02 PM	6/4/14 9:18:24 PM	236,059
Priest Rapids BRZ	5/2/14 10:47:00 PM	6/1/14 11:14:15 PM	1,112,135
Priest Rapids 3D	5/2/14 10:55:30 PM	6/1/14 11:23:27 PM	1,472,805
Priest Rapids Forebay	5/2/14 10:56:38 PM	6/1/14 11:23:24 PM	2,439,699
Vernita Bridge	5/3/14 4:04:31 AM	6/3/14 4:09:09 PM	214,399
White Bluffs	5/3/14 11:29:21 AM	6/3/14 8:40:21 PM	468,503
Hanford 1	5/3/14 11:19:50 PM	6/14/14 3:18:47 PM	247,184
Hanford 2	5/3/14 11:49:01 PM	6/14/14 3:53:41 PM	173,703
		Total Number of Detections:	6,952,797

Table A.7. The 2014 PIT tag quantities of steelhead and yearling Chinook salmon detected downstream of the study area including McNary, John Day, and Bonneville dams along with an experimental estuary detection tow. Release site is in the tailrace of each dam, approximately 0.5 km downstream of each dam. The quantity of PIT tags detected was reported by PTAGIS (http://www.ptagis.org/).

Species	Release Site	McNary	John Day	Bonneville	Estuary	Total Detected
Steelhead	Rock Island	15	34	26	7	82
	Wanapum	43	44	41	13	141
	Priest Rapids	31	57	44	8	140
Yearling Chinook salmon	Rock Island	38	31	30	6	105
	Wanapum	81	61	66	3	211
	Priest Rapids	77	50	32	4	163

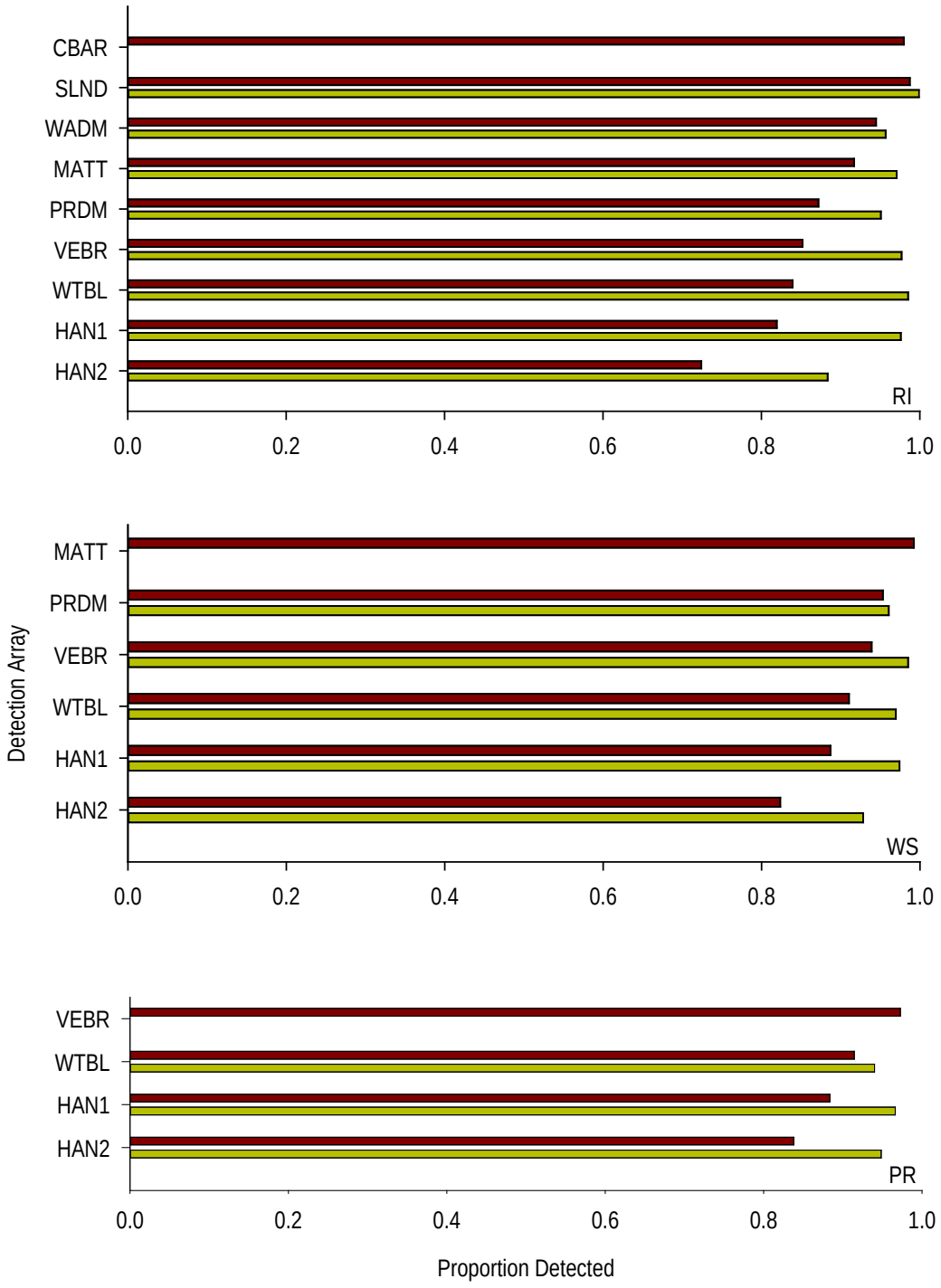

Figure A.6. The 2014 absolute detection rate of steelhead by release group (RI = Rock Island, WS = Wanapum, and PR = Priest Rapids dams). Red bars present the calculation from total released in the tailrace of each dam to each detection array, and the yellow bars present the proportion detected between arrays—the positive detection at the upstream array to the positive detection at the nearest downstream array.

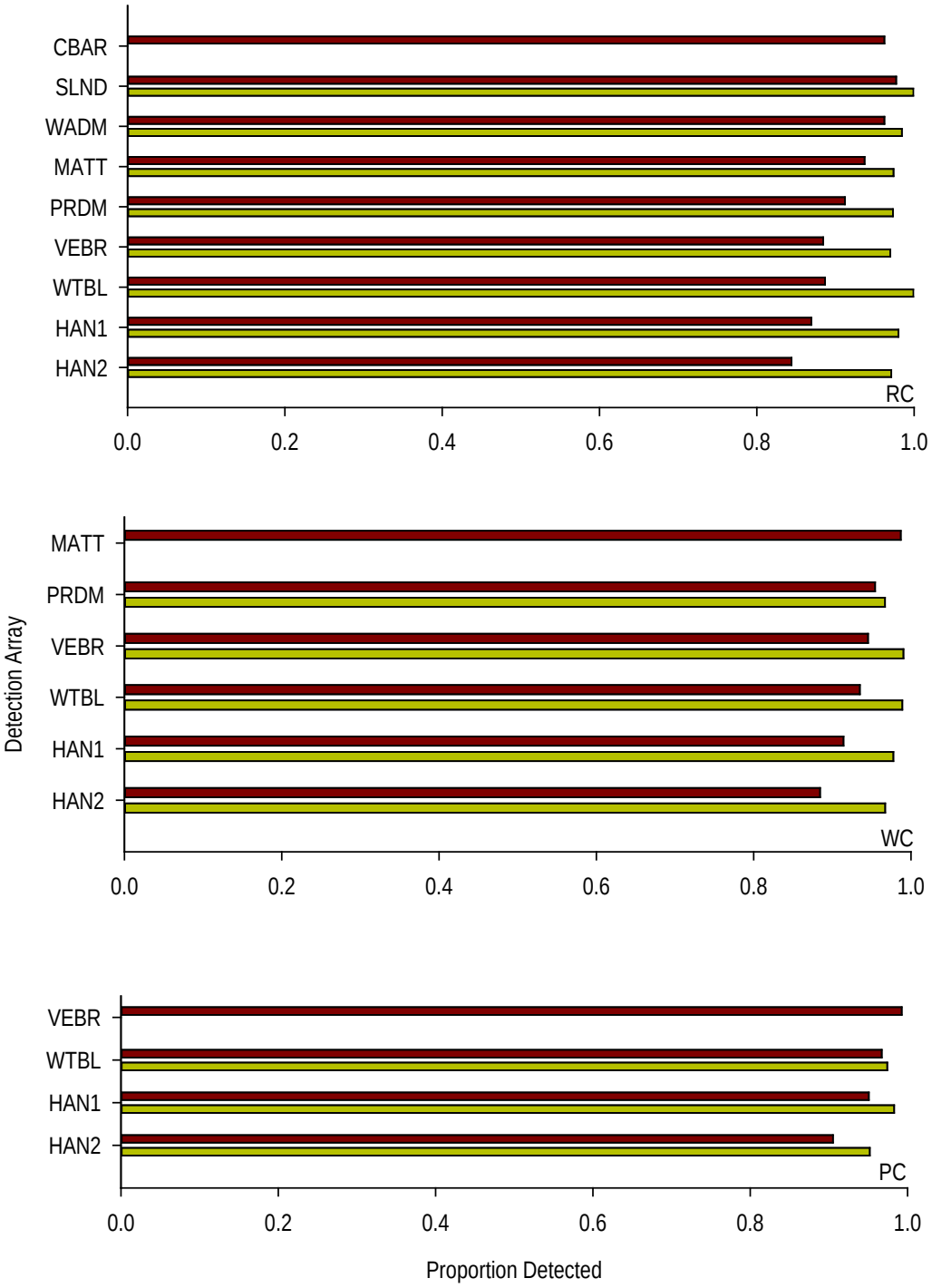

Figure A.7. The 2014 absolute detection rate of yearling Chinook salmon by release group (RC = Rock Island, WC = Wanapum, and PC = Priest Rapids dams). Red bars present the calculation from total released in the tailrace of each dam to each detection array, and the yellow bars present the proportion detected between arrays—the positive detection at the upstream array to the positive detection at the nearest downstream array.

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Appendix B

Fish Handling and Release Characteristics

List of Tables

List of Figures

Table B.1. The quantity of steelhead and yearling Chinook salmon that were collected, tagged, and released by release groups during the spring of 2014. RCO5, WC05, and PC05 were not successfully released on May 4. RI=399, WS=771, PR=550, RC=398, WC=769, and PC=549.

Release Groups and Number of Fish Released													
Steelhead						Chinook salmon						Date	
RI	n_{RI}	WS	n_{WS}	PR	n_{PR}	RC	n_{RC}	WC	n_{WC}	PC	n_{PC}	Collection	Surgery	Release
						CH RC01	18					28-Apr	29-Apr	30-Apr
						CH RC02	18					29-Apr	30-Apr	1-May
						CH RC03	18	CH WC01	27			30-Apr	1-May	2-May
						CH RC04	18	CH WC02	31	CH PC01	19	1-May	2-May	3-May
								CH WC03	32	CH PC02	20	2-May	3-May	4-May
						CH RC06	18	CH WC04	33	CH PC03	22	3-May	4-May	5-May
						CH RC07	18			CH PC04	23	4-May	5-May	6-May
ST RI01	20					CH RC08	19	CH WC06	34			5-May	6-May	7-May
ST RI02	20					CH RC09	17	CH WC07	35	CH PC06	24	6-May	7-May	8-May
ST RI03	20	ST WS01	29			CH RC10	20	CH WC08	40	CH PC07	25	7-May	8-May	9-May
ST RI04	20	ST WS02	32	ST PR01	22	CH RC11	20	CH WC09	41	CH PC08	28	8-May	9-May	10-May
ST RI05	20	ST WS03	34	ST PR02	23	CH RC12	20	CH WC10	43	CH PC09	28	9-May	10-May	11-May
ST RI06	20	ST WS04	35	ST PR03	23	CH RC13	20	CH WC11	44	CH PC10	31	10-May	11-May	12-May
ST RI07	21	ST WS05	37	ST PR04	25	CH RC14	20	CH WC12	43	CH PC11	32	11-May	12-May	13-May
ST RI08	21	ST WS06	40	ST PR05	26	CH RC15	20	CH WC13	43	CH PC12	32	12-May	13-May	14-May
ST RI09	21	ST WS07	42	ST PR06	27	CH RC16	20	CH WC14	40	CH PC13	31	13-May	14-May	15-May
ST RI10	22	ST WS08	45	ST PR07	28	CH RC17	19	CH WC15	39	CH PC14	30	14-May	15-May	16-May
												15-May	16-May	17-May
ST RI11/12	44	ST WS09/10	99	ST PR08/09	63	CH RC18/19	38	CH WC16/17	75	CH PC15/16	57	16-May	17-May	18-May
ST RI13	22	ST WS11	53	ST PR10	33	CH RC20	19	CH WC18	36	CH PC17	27	17-May	18-May	19-May
ST RI14	22	ST WS12	49	ST PR11	35	CH RC21	19	CH WC19	35	CH PC18	27	18-May	19-May	20-May
ST RI15	22	ST WS13	45	ST PR12	35	CH RC22	19	CH WC20	33	CH PC19	25	19-May	20-May	21-May
ST RI16	22	ST WS14	42	ST PR13	33			CH WC21	31	CH PC20	23	20-May	21-May	22-May
ST RI17	21	ST WS15	43	ST PR14	32			CH WC22	34	CH PC21	24	21-May	22-May	23-May
ST RI18	20	ST WS16	42	ST PR15	32					CH PC22	21	22-May	23-May	24-May
ST RI19	21	ST WS17	38	ST PR16	31							23-May	24-May	25-May
		ST WS18	34	ST PR17	29							24-May	25-May	26-May
		ST WS19	32	ST PR18	27							25-May	26-May	27-May
				ST PR19	26							26-May	27-May	28-May

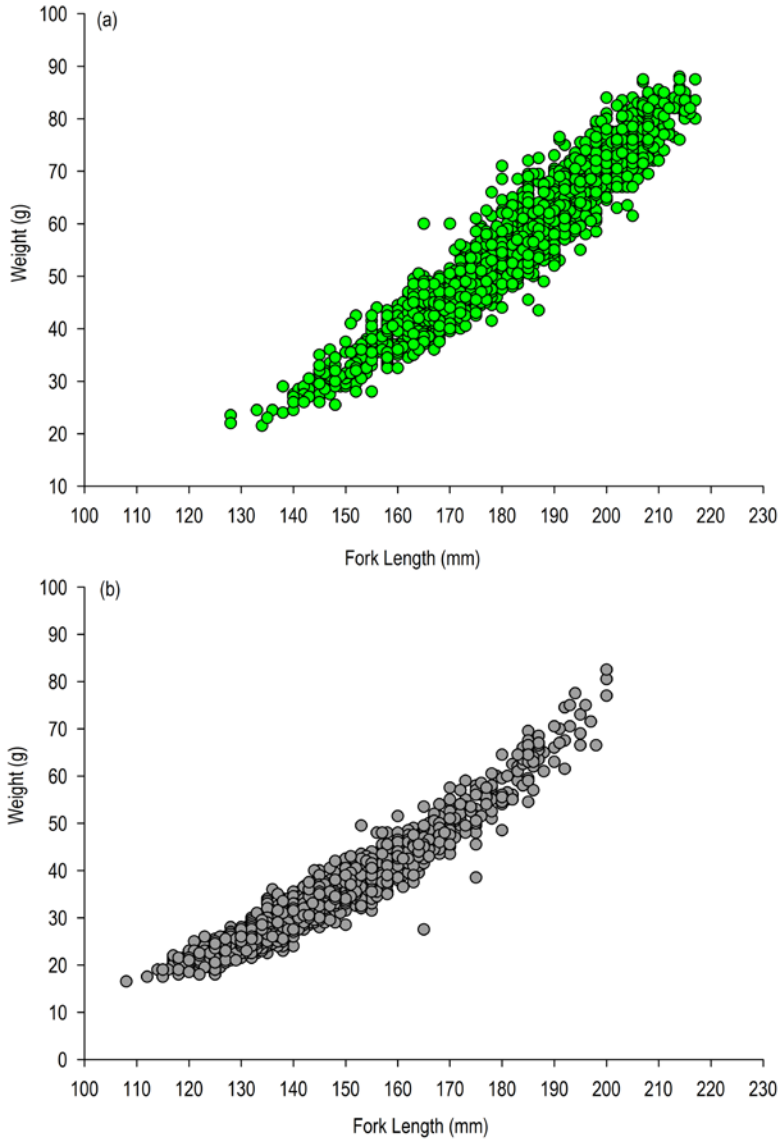

Figure B.1. Size distribution of tagged (a) steelhead (n=1,720, green) and (b) yearling Chinook salmon (n=1,716, gray) released for the 2014 Grant PUD survival and behavioral analyses.

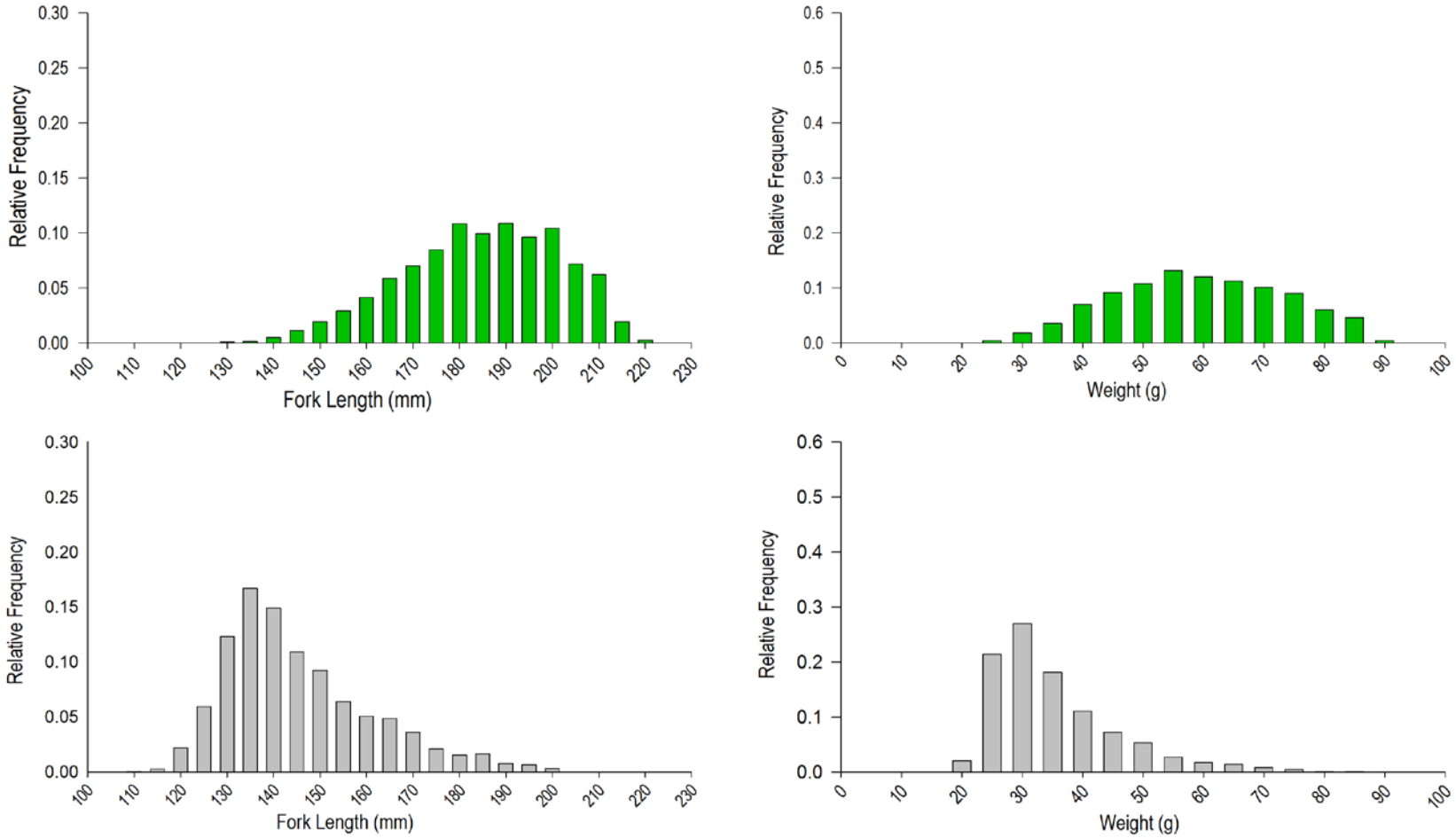

Figure B.2. Relative frequency of length and weight of tagged steelhead (shown in green, n=1,720) and yearling Chinook salmon (shown in grey, n=1,716) released in the 2014 Grant PUD survival and behavioral analyses. The fork length in millimeters of (a) steelhead and (c) yearling Chinook salmon as well as the weight in grams of (b) steelhead and (d) yearling Chinook salmon are shown above. The average steelhead fork length was 182.9 mm (range 128.0-217.0 mm) and weight was 57.0 g (range 21.5-88.0 g). The average yearling Chinook salmon fork length was 143.7 mm (range 108.0-200.0 mm) and weight was 33.1 g (range 16.5-82.5 g).

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Appendix C

Migration Rates and Forebay Residence Times

List of Tables

Table C.1. Summary of 2014 median migration rates (measured in hours) for all release groups listed by species (steelhead and yearling Chinook salmon) and independent reach. Median travel times were measured from either the time of release (in the tailrace of each dam) or last detection at the previous array, to the first detection at the next downstream array. Cumulative travel times, measured from the time of release to first detection at a given array, are indicated in parenthesis. Fish entrained in the gatewells were not included in this measurement.

		Detection Arrays							
Species	Release Site	CBAR	SNLD	WADM	MATT	PRDM	VEBR	WTBL	HAN
Steelhead	Rock Island Dam	3.2	6.0 (9.2)	11.5 (20.7)	2.5 (23.2)	13.7 (36.9)	1.8 (38.7)	4.4 (43.1)	8.0 (51.1)
	Wanapum Dam				3.0	12.7 (15.7)	1.8 (17.5)	4.4 (21.9)	8.7 (30.6)
	Priest Rapids Dam						1.9	7.4 (9.3)	8.7 (18.0)
Yearling Chinook salmon	Rock Island Dam	5.0	12.0 (17.0)	24.5 (41.5)	2.9 (44.4)	20.4 (64.8)	1.9 (66.7)	5.2 (71.9)	17.2 (89.1)
	Wanapum Dam				3.6	26.4 (30.0)	1.9 (31.9)	5.9 (37.8)	19.7 (57.5)
	Priest Rapids Dam						2.1	10.2 (12.3)	20.7 (33.0)

Table C.2. Annual median migration rates (measured in hours) for all release groups listed by species, reach and study year. Median travel times were measured from either the time of release or last detection at the previous array to the first detection at the next downstream detection array. Yearling Chinook salmon travel data from 2009-2010 were sourced from Chelan County PUD memorandum 2012 (O'Connor 2012 Memo), while all steelhead and remaining yearling Chinook salmon data were taken from 2006-2011 GCPUD acoustic survival reports (Timko; Sullivan; Thompson et al. 2006-2012). Fish entrained in the gatewells were not included in this analysis.

Species	Year	WADM	MATT	PRDM	VEBR	WTBL	HAN
Steelhead	2014	20.7	2.8	13.2	1.8	5.4	8.5
	2011		3.6	9.8			
	2010	60.7	2.7	24.6	2.1		
	2009	61.1	2.7	23.1	2.2		
	2008	39	2.2	13.2	1.9		
	2007	47.5	2.6	16	2		
	2006	50.1	3	12.6	2.4		
Yearling Chinook salmon	2014	41.5	3.3	23.4	2.0	7.1	19.2
	2010		2.9	21.1	2.2		
	2009		3.1	24.2	2.2		
	2008		2.1	17.1	1.9		
	2007		4	24	1.9		
	2006		3.2	14.4	1.9		

Table C.3. Annual median migration rates (measured in hours) of steelhead and yearling Chinook salmon from Wanapum Dam to each detection array by passage route. Yearling Chinook salmon were not monitored at Wanapum Dam during 2006-2011 acoustic studies. Furthermore, there were no steelhead detected passing through the Wanapum Dam spillway in 2009 or 2010.

		Powerhouse		WFB		Spillway	
Species	Year	MATT	PRDM	MATT	PRDM	MATT	PRDM
Steelhead	2014	2.8	16.1	2.4	11.6	2.2	14.7
	2010	3	24.5	2.4	25		
	2009	3.2	23	2.5	22.1		
	2008	2.5	15.6	2.1	13.9	2.1	9.1
	2007	2.8	16.2			2.3	16.9
Yearling Chinook salmon	2014	3.1	23.4	3.1	15.0	2.5	19.6
	2008	2.3	18.5	2.2	18.2	1.8	12.7

Table C.4. Annual median migration rates (measured in hours) of steelhead and yearling Chinook salmon (referenced below as Chinook) from Priest Rapids Dam to each detection array are presented by passage route. There was only one steelhead detected passing through the Priest Rapids Dam spillway in 2009 and 2010 and there is no yearling Chinook salmon passage data available for 2009 or 2010.

		Powerhouse				PRFB				Spillway			
Species	Year	VEBR	RING	WTBL	HAN	VEBR	RING	WTBL	HAN	VEBR	RING	WTBL	HAN
Steelhead	2014	1.9		4.5	8.6	1.7		4.4	8.3	1.9		4.4	8.9
	2010	2.1	7.1			2.1	6.9			2.3	6.2		
	2009	2.2	7.3			2.2	7.5			2.0	6.5		
	2008	1.9	6.5			1.8	6.5			1.8	6.4		
	2007	2.0	6.4			2.0	6.4			5.6	8.0		
Chinook	2014	2.0		5.4	20.4	1.9		5.7	18.7	2.0		5.3	17.9
	2008	1.9	6.8			1.9	6.8			1.8	6.3		

Table C.5. Annual comparison of median residence times (in minutes) for steelhead and yearling Chinook salmon at Crescent Bar, Sunland, Mattawa, Vernita Bridge, White Bluffs, and Hanford detection arrays. Data in these locations was not collected for yearling Chinook salmon in previous years, while steelhead data was collected in only a subset of these locations in 2008-2010.

Species	Year	CBAR	SLND	MATT	VEBR	WTBL	HAN
Steelhead	2014	84	372	180	102	156	174
	2010			180	216		
	2009			288	288		
	2008			324	180		
Yearling Chinook salmon	2014	90	468	216	120	174	192

Table C.6. Annual median forebay residence times at Wanapum Dam (in minutes) for steelhead and yearling Chinook salmon. The 2014 residence times were quantified in two ways: 1) BRZ Residence Time (BRZ), the time elapsed between the first detection at the BRZ and the last detection in the Wanapum forebay, and 2) Forebay Residence Time (Forebay), the time elapsed between the first and last detection on only those receivers in the immediate Wanapum forebay. The second approach is the most similar to historical measurements although not equivalent due to differing technology and array placement. Fish entrained in the gatewells, last detected with net upstream movement, or with unknown passage route were excluded from forebay residence time analyses.

Species	Year	All Routes	Powerhouse	Bypass	Spillway
Steelhead	2014BRZ	28.5	14.8	46.6	44.0
	2014Forebay	8.1	3.0	15.6	20.4
	2010	144.6	289.2	121.8	
	2009	80.4	43.8	87.0	
	2008	30.0	10.2	58.2	18.0
	2007	29.4	27.0		61.2
	2006	26.4	22.8		49.8
Yearling Chinook salmon	2014BRZ	20.3	15.2	24.4	37.1
	2014Forebay	3.6	1.8	9.0	12.0
	2008	0.2	14.4	14.4	14.4

Table C.7. Annual median forebay residence times at Priest Rapids Dam (in minutes) for steelhead and yearling Chinook salmon. The 2014 residence times were quantified in two ways: 1) BRZ Residence Time (BRZ), the time elapsed between the first detection at the BRZ and the last detection in the Wanapum forebay, and 2) Forebay Residence Time (Forebay), the time elapsed between the first and last detection on only those receivers in the immediate Priest Rapids forebay. The second approach is the most similar to historical measurements although not equivalent due to differing technology and array placement. Fish entrained in the gatewells, last detected with net upstream movement, or with unknown passage route were excluded from forebay residence time analyses.

Species	Year	All Routes	Powerhouse	Bypass/Top-Spill	Spillway
Steelhead	2014BRZ	43.2	32.4	52.7	40.9
	2014Forebay	8.1	7.8	12.6	6.0
	2010	91.8	52.8	147.0	21,322.8[2]
	2009	57.6	45.6	42.6	44.4
	2008	14.4	13.2	13.2	10.2
	2007	20.4	19.8	22.2	9.6
	2006	19.8	19.8	40.8	7.8
Yearling Chinook salmon	2014BRZ	42.8	44.5	47.5	40.6
	2014Forebay	6.7	8.4	7.8	4.2
	2008	13.8	12.6	15.6	13.8
	2007	16.8	16.2	21.0	9.0
	2006	18.0	19.2	30.6	9.0

[2]In 2010, one acoustic-tagged steelhead was last detected at the spillway after spending 14.8 days in the forebay (tag code 4566.21, release group WS14), first detected on 5/25/2010 7:56:35 – 6/9/2010 3:19:28. The tag was detected downstream at Vernita Bridge (6/9/2010 5:36:46 am) and Ringold (6/9/2010 11:52:02). Migration rates between sites fit typical egress for juvenile steelhead and did not exhibit typical predation suspected detection histories; the tagged fish is an outlier but could not excluded from the data set.

Appendix D

Passage Route Efficiency, Zone Entrance Efficiency, and Fish Collection Efficiency

The passage route efficiency (PRE) at Wanapum and Priest Rapids dams are listed in Tables F.1 and F.2, respectively, (2006-2010 and 2014). Zone entrance efficiency (ZEE) at the Wanapum Dam Fish Bypass (WFB) and Priest Rapids Dam Fish Bypass (PRFB) are shown in Table F.3. Fish collection efficiency (FCE) at Wanapum Dam and Priest Rapids Dam are listed in Tables F.4 and F.5, respectively (2006-2010 and 2014). All tables have data segregated by species.

List of Tables

Table D.1. The passage route efficiencies (PRE) of downstream migrant steelhead through Wanapum Dam in 2014 are shown below with 2006-2010 results for comparison (*from* Timko et al. 2011) [3]. At each dam, powerhouse passage includes fish that were entrained in the gatewells. Passage events that could not be identified or fish last detected with upstream movement were not included in PRE estimates. In 2006-2007, a prototype fish bypass was used for surface passage of smolts at the sluiceway along with a top-spill bulkhead at Spill Bay 12.

Year	Passage Route	n_i	n_{total}	PRE_i
Wanapum Dam				
2014	Powerhouse	162	362	44.8%
	Fish Bypass	36	362	9.9%
	Spillway	164	362	45.3%
	Non-Turbine Passage	*200*		*55.2%*
2010	Powerhouse	128	563	22.7%
	Fish Bypass	435	563	77.3%
	Spillway	0	563	0.0%
2009	Powerhouse	218	731	29.8%
	Fish Bypass	513	731	70.2%
	Spillway	0	731	0.0%
2008	Powerhouse	179	550	32.5%
	Fish Bypass	300	550	54.5%
	Spillway	71	550	12.9%
2007	Powerhouse	749	1135	66.0%
	Top-Spill (SB12)/Sluiceway	305	1135	26.9%
	Spillway	81	1135	7.1%
2006	Powerhouse	150	319	47.0%
	Top-Spill (SB12)/Sluiceway	116	319	36.4%
	Spillway	53	319	16.6%

[3] Analysis has been refined thus numbers reported in this table differ slightly than reported in prior years (Timko et al. 2011).

Table D.2. The passage route efficiencies (PRE) of downstream migrant steelhead through Priest Rapids Dam in 2014 are shown below with 2006-2010 results for comparison (*from* Timko et al. 2011)[4]. At each dam, powerhouse passage includes fish that were entrained in the gatewells. Passage events that could not be identified or fish last detected with upstream movement were not included in PRE estimates.

Year	Passage Route	n_i	n_{total}	PRE_i
Priest Rapids Dam				
2014	Powerhouse	332	1075	30.9%
	Fish Bypass	507	1075	47.2%
	Spillway	236	1075	22.0%
	Non-Turbine Passage	*743*		*69.1%*
2010	Powerhouse	469	1105	42.4%
	Top-Spill Prototype Bypass	635	1105	57.5%
	Spillway	1	1105	0.1%
2009	Powerhouse	612	1254	48.8%
	Top-Spill Prototype Bypass	641	1254	51.1%
	Spillway	1	1254	0.1%
2008	Powerhouse	607	1062	57.2%
	Top-Spill Prototype Bypass	370	1062	34.8%
	Spillway	85	1062	8.0%
2007	Powerhouse	785	976	80.4%
	Top-Spill Prototype Bypass	187	976	19.2%
	Spillway	4	976	0.4%
2006	Powerhouse	446	610	73.1%
	Top-Spill Prototype Bypass	95	610	15.6%
	Spillway	69	610	11.3%

[4] Analysis has been refined thus numbers reported in this table differ slightly than reported in prior years (Timko et al. 2011).

Table D.3. The passage route efficiencies (PRE) of downstream migrant yearling Chinook salmon through Wanapum and Priest Rapids dams in 2014 are shown below with 2006-2010 results for comparison (*from* Sullivan et al. 2009)[5]. At each dam, powerhouse passage includes fish that were entrained in the gatewells. Passage events that could not be identified or fish last detected with upstream movement were not included in PRE estimates.

Year	Passage Route	n_i	n_{total}	PRE_i
Wanapum Dam				
2014	Powerhouse	234	361	65.0%
	Fish Bypass	27	361	7.5%
	Spillway	99	361	27.5%
	Non-Turbine Passage	*126*		*35.0%*
2008	Powerhouse	455	984	46.2%
	Fish Bypass	290	984	29.5%
	Spillway	239	984	24.3%
Priest Rapids Dam				
2014	Powerhouse	380	1088	34.9%
	Fish Bypass	415	1088	38.1%
	Spillway	293	1088	26.9%
	Non-Turbine Passage	*708*		*65.1%*
2008	Powerhouse	600	898	66.8%
	Top-Spill Prototype Bypass	219	898	24.4%
	Spillway	79	898	8.8%
2007	Powerhouse	738	853	86.5%
	Top-Spill Prototype Bypass	110	853	12.9%
	Spillway	5	853	0.6%
2006	Powerhouse	326	458	71.2%
	Top-Spill Prototype Bypass	57	458	12.4%
	Spillway	75	458	16.4%

[5] Analysis has been refined thus numbers reported in this table differ slightly than reported in prior years (Sullivan et al.2009; Timko et al. 2010, 2011).

Table D.4. The percent zone of entrance efficiency (ZEE) of the Priest Rapids Dam Fish Bypass (2014) and top-spill configuration (2006-2010) for steelhead and yearling Chinook salmon.

Year	Steelhead	Yearling Chinook salmon
2014	72.50%	65.20%
2010	77.80%	
2009	71.50%	
2008	41.60%	39.10%
2007	42.20%	27.10%
2006	39.60%	36.90%

Table D.5. Fish collection efficiency (FCE) of steelhead and yearling Chinook salmon smolts at the Priest Rapids Dam Fish bypass (2014) and top-spill configuration (2006-2010). The collection zone in 2008-2010 was defined as the radius extending 300 ft from the center of the top-spill configuration (at the junction of Spill Bay gates 20 and 21). The top-spill configuration included the prototype top-spill bulkhead at Spill bays 19 and 20 along with Tainter gates 21 and 22, sluiceway (top-spill in 2008-2009, bottom-spill in 2010). In 2006-2007, the collection zone was defined as the radius extending 300 ft from the center of the prototype top-spill bulkhead (at the junction of Spill Bay gates 19 and 20).

Collection Zone (ft)	2014	2010	2009	2008	2007	2006
Steelhead						
50	98.1%	98.0%	99.8%	100.0%	97.9%	97.3%
100	88.9%	88.3%	94.3%	94.9%	87.6%	81.3%
150	77.3%	83.0%	85.9%	87.6%	69.5%	63.1%
200	69.8%	77.1%	77.4%	77.2%	50.9%	52.9%
250	65.4%	72.8%	70.9%	67.4%	40.8%	44.8%
300	64.0%	68.9%	66.0%	58.9%	33.7%	39.4%
Yearling Chinook salmon						
50				100.0%	97.1%	93.4%
100				81.3%	75.6%	82.6%
150				55.6%	57.6%	57.0%
200				43.1%	45.0%	46.0%
250				36.7%	36.2%	38.5%
300				31.1%	29.3%	32.9%

Grant County PUD 2014 Steelhead and Yearling Chinook Acoustic Tag Study

PRELIMINARY RESULTS

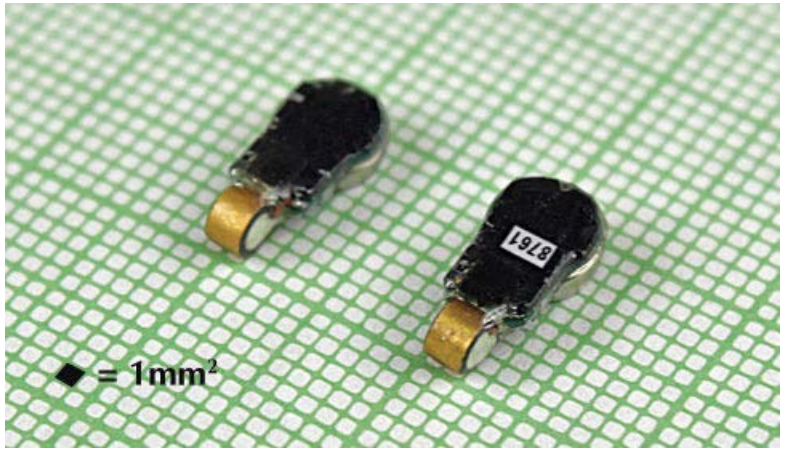
Blue Leaf Environmental

Presenter: Kyle Hatch

JSATS Acoustic Technology

LOTEK *Model L-AMT-1.421*

acoustic transmitters



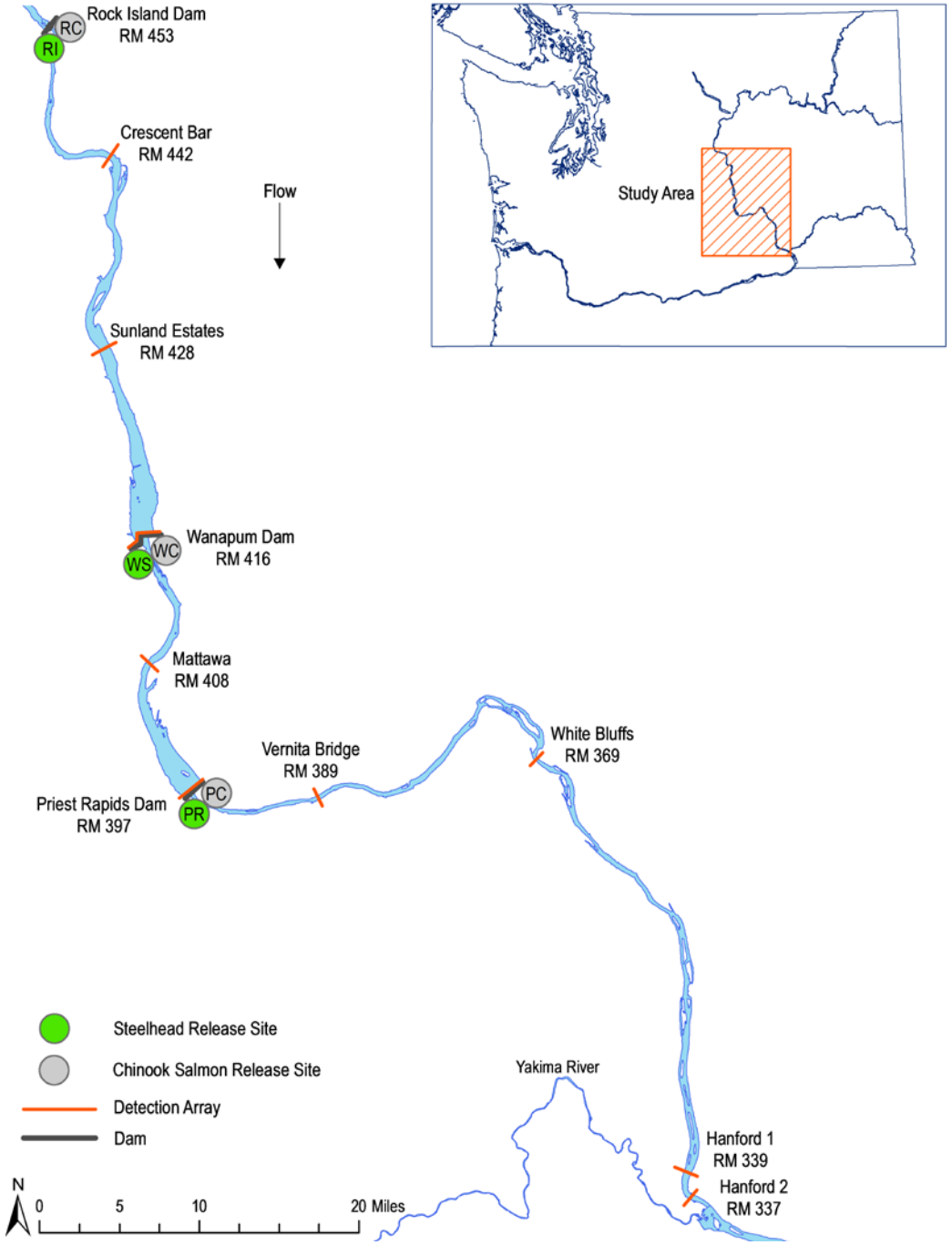
Biomark HDX12

12 mm PIT tags

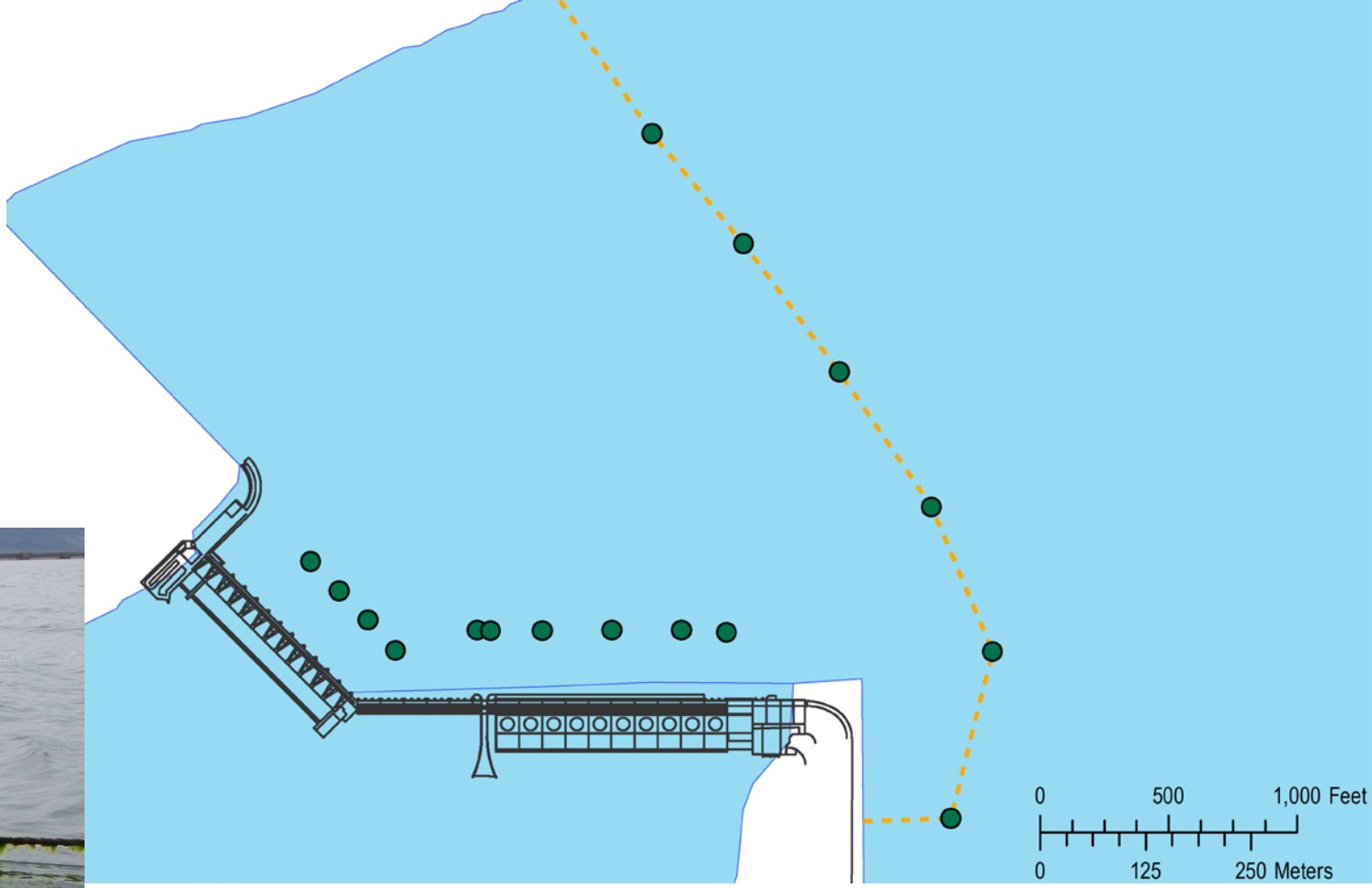
Teknologic
Autonomous
Receivers

Project Overview

- Release Dates and Quantities
  - Steelhead (May 7-28)
    - Rock Island: 399
    - Wanapum: 771
    - Priest Rapids: 550
  - Yearling Chinook (Apr 30 – May 24)
    - Rock Island: 398
    - Wanapum: 769
    - Priest Rapids: 549



Wanapum Dam



- Receivers for 0/1 and passage route determination
  - ✓ 6 BRZ (Boat Restricted Zone)
  - ✓ 10 dam

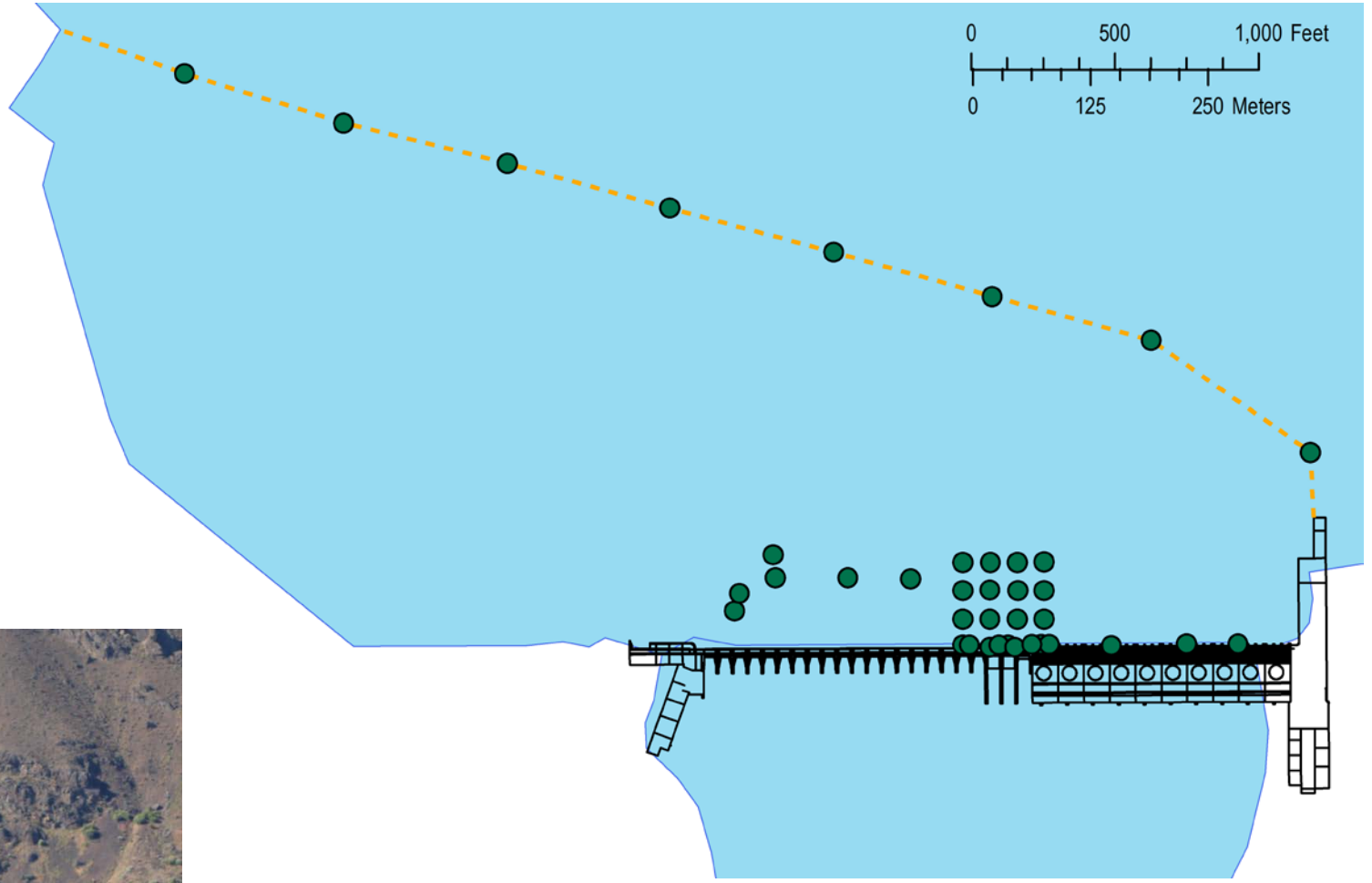
Passage Route Selection

Wanapum Dam

- Steelhead: Non-Turbine FPE 55%
  - 9.9% bypass, 44.8% spillway
  - 45.3% powerhouse
- Yearling Chinook: Non-Turbine FPE 35%
  - 7.5% bypass, 27.5% spillway
  - 65.0% powerhouse

FPE = Fish Passage Efficiency

Priest Rapids Dam



- Receivers for 0/1, passage route determination, and 3D tracking at top-spill
  - ✓ 8 BRZ (Boat Restricted Zone)
  - ✓ 28 dam

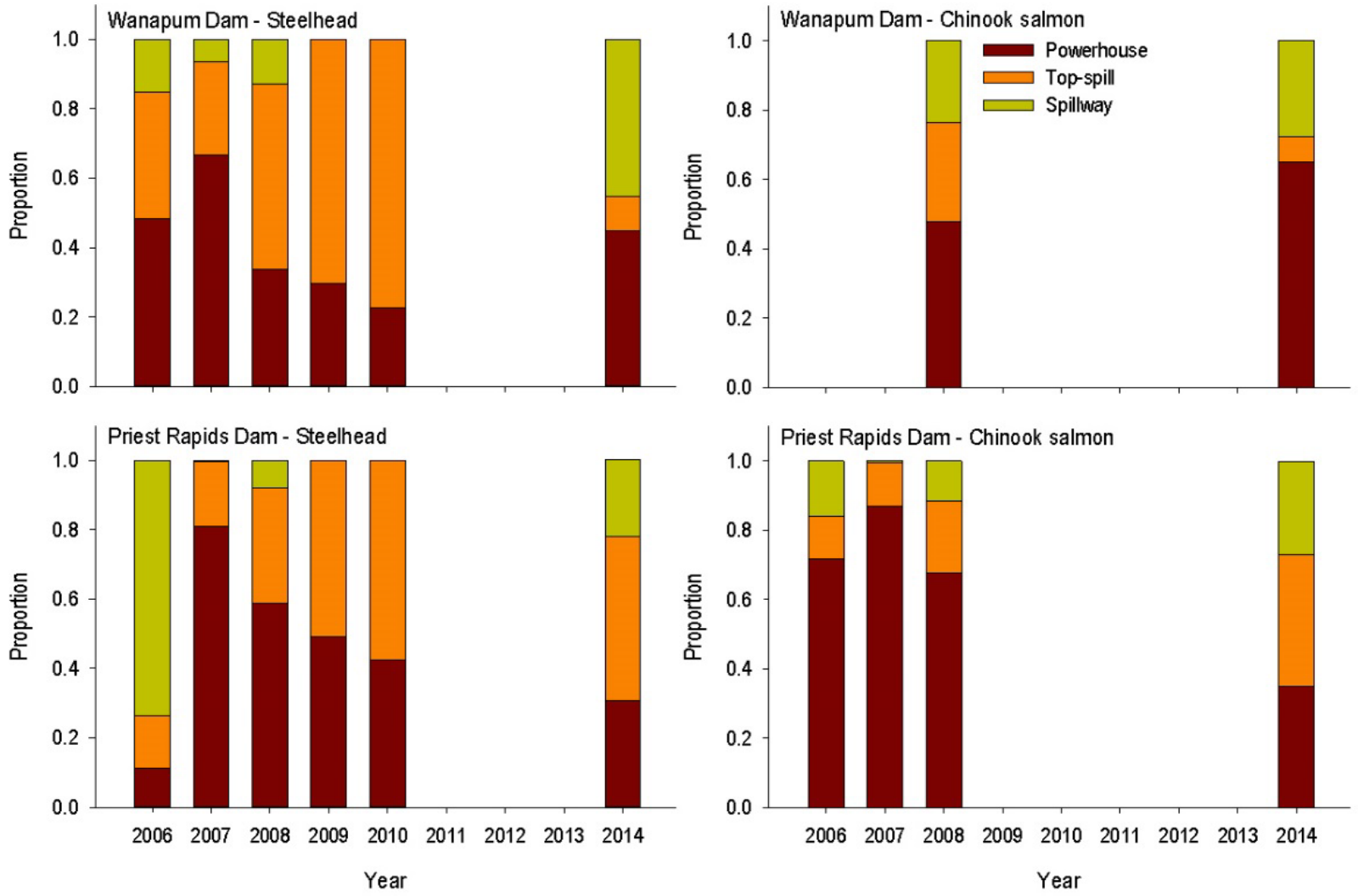
Passage Route Selection

Priest Rapids Dam

- Steelhead: Non-Turbine FPE 69%
  - 47.2% top-spill, 22.0% spillway
  - 30.9% powerhouse
- Yearling Chinook: Non-Turbine FPE 65%
  - 38.1% top-spill, 26.9% spillway
  - 34.9% powerhouse

FPE = Fish Passage Efficiency

Passage Route Selection



Passage Survival by Dam

Species	Year	Wanapum	Priest Rapids
Steelhead			
	2014	0.978	0.985
	2010	*1.013	0.997
	2009	*1.025	0.983
	2008	0.995	0.952
Yearling Chinook			
	2014	0.988	0.971

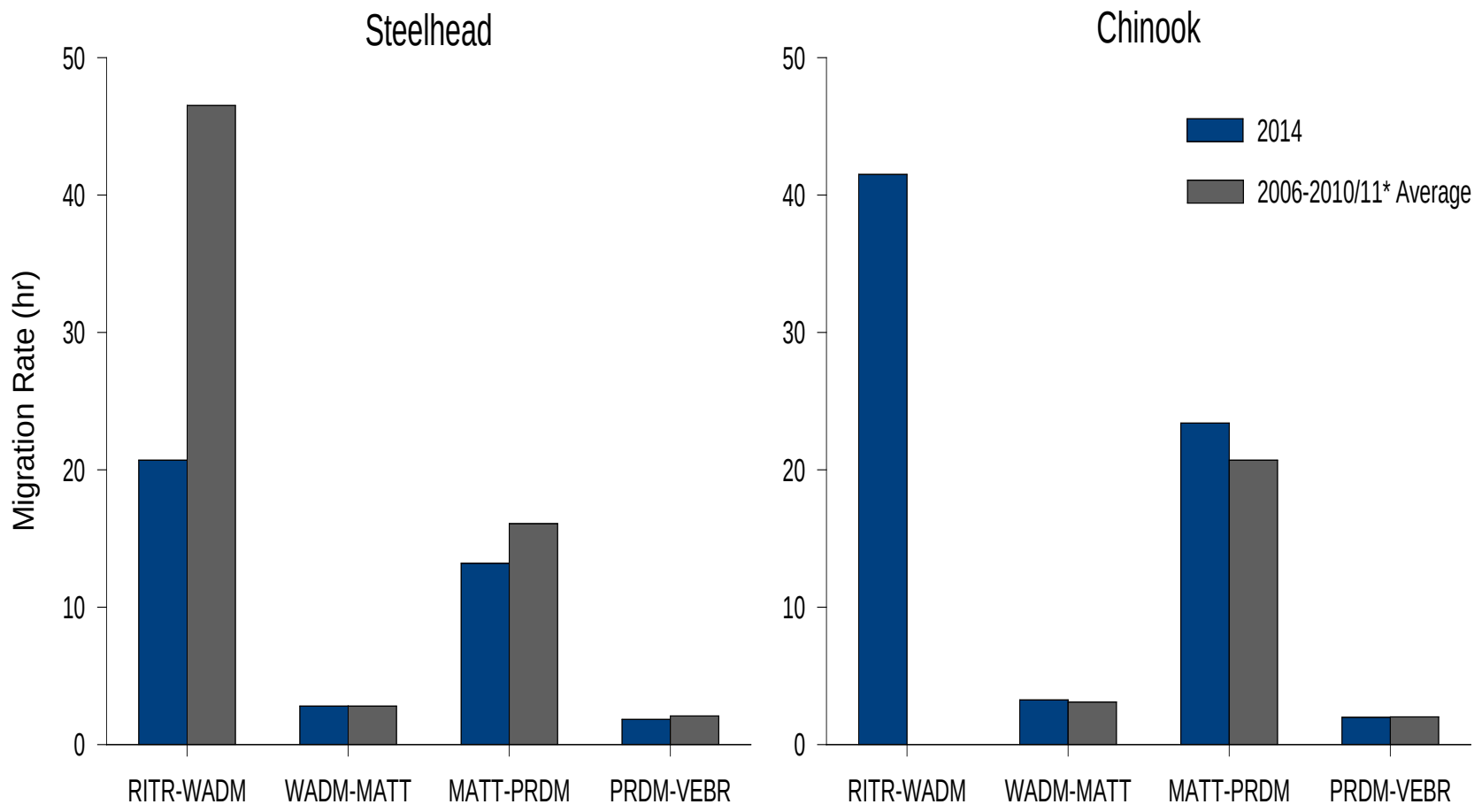
Point estimates are based on proportions of fish detected downstream at one or more locations that passed at each dam.

Survival by Passage Route

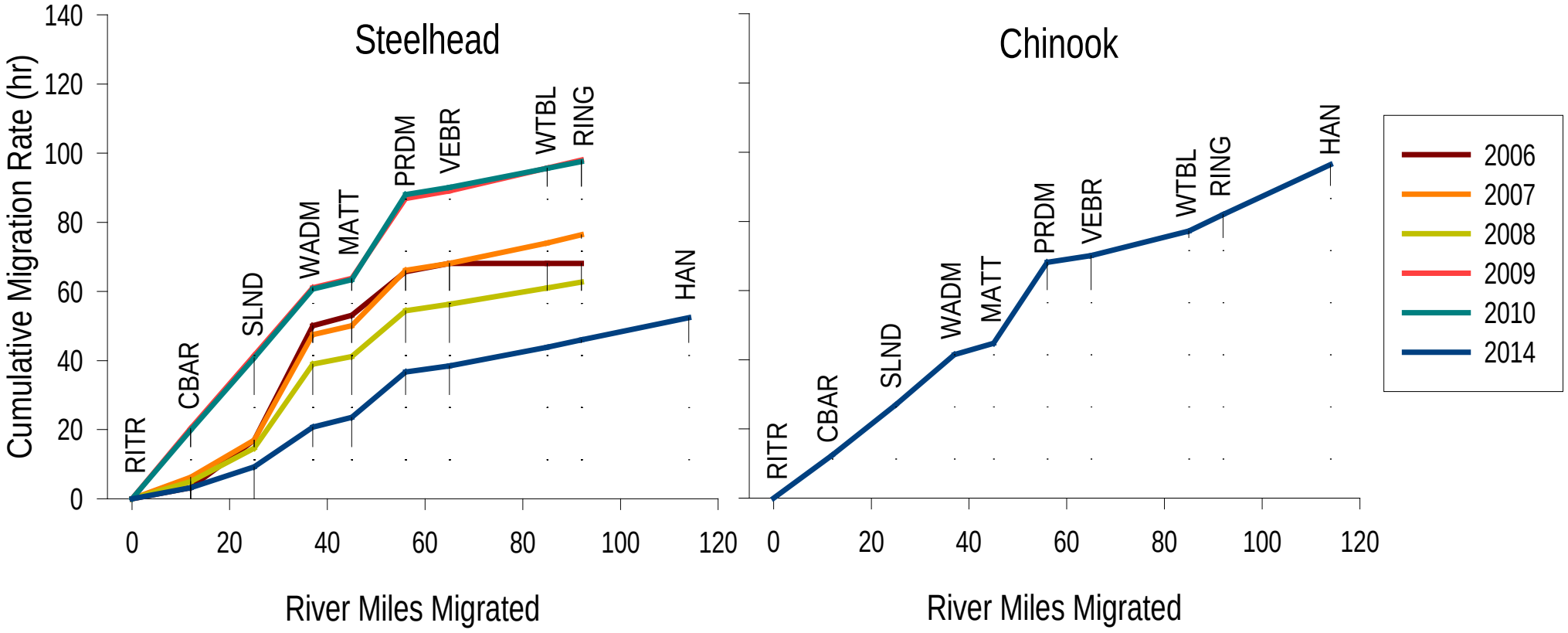
	Wanapum		Priest Rapids	
Passage Route	Qty Passed	Detected Downstream	Qty Passed	Detected Downstream
Steelhead				
WFB/PRFB	36	1.000	507	0.996
Spillway	164	0.994	236	0.970
Powerhouse	152	0.941	276	0.938
Yearling Chinook				
WFB/PRFB	27	0.963	415	0.998
Spillway	99	0.970	293	0.980
Powerhouse	225	0.982	352	0.926

Point estimates are based on proportions of fish detected downstream at one or more locations that passed at each dam.

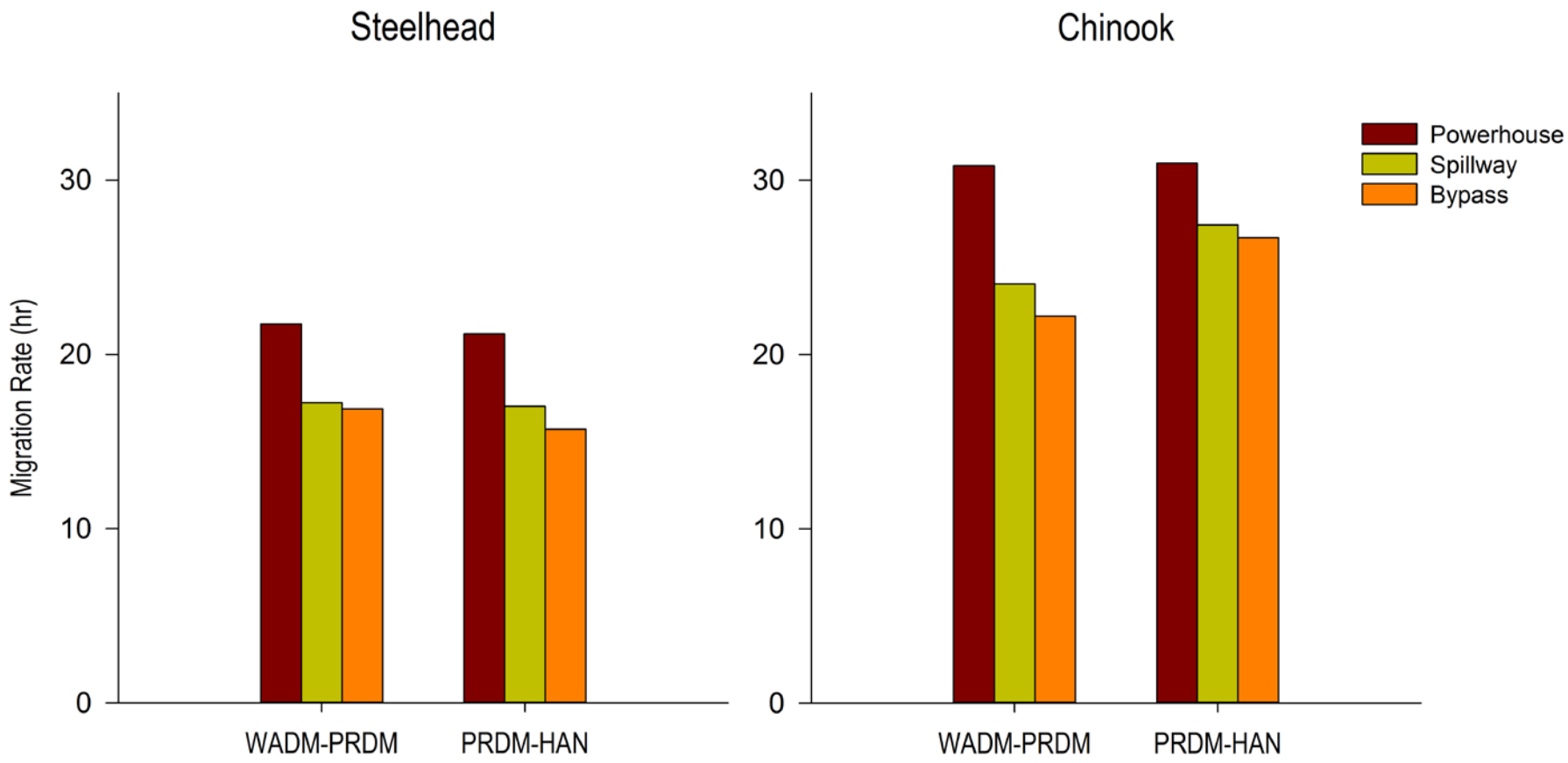
Migration Rates



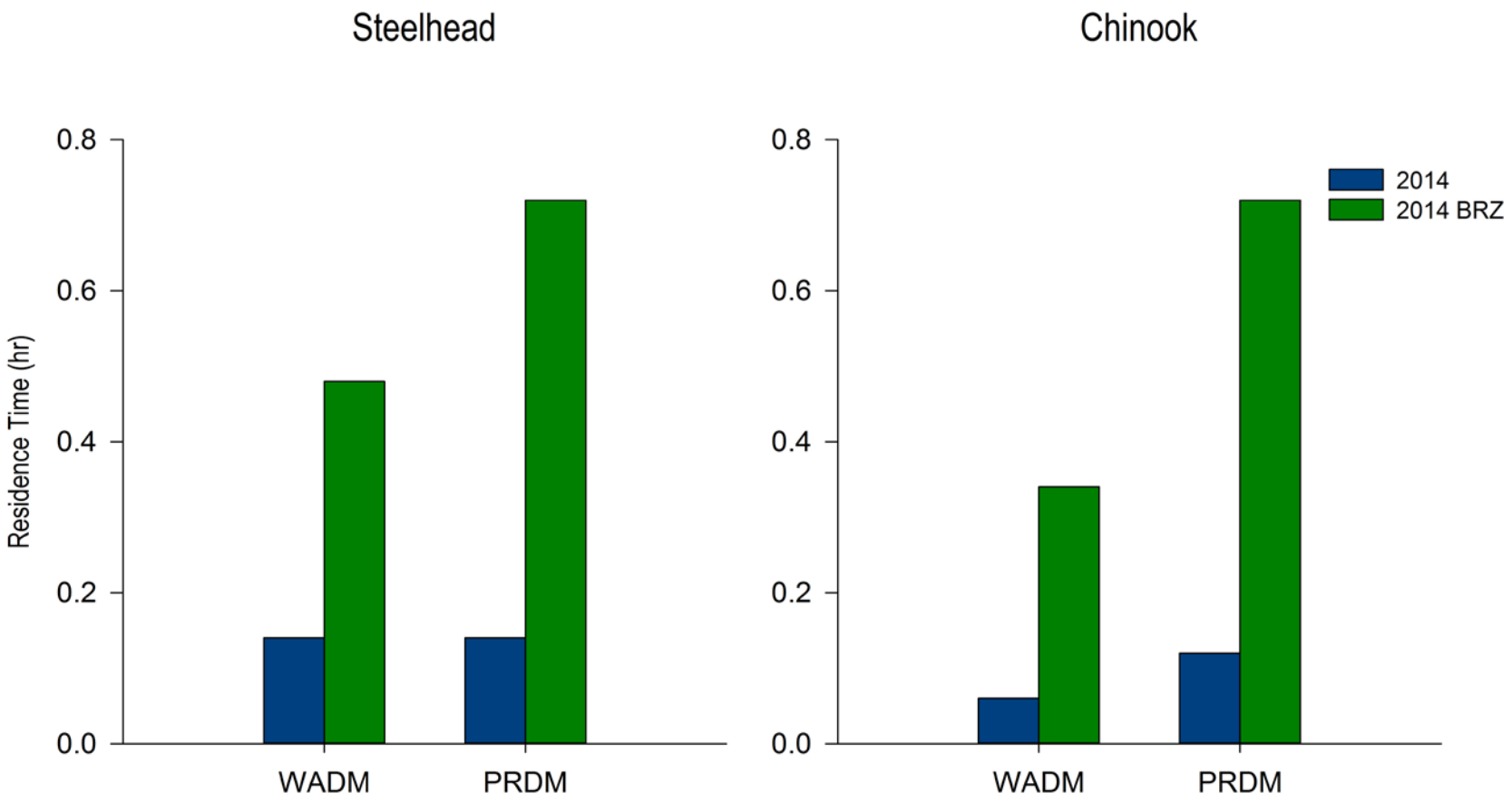
Cumulative Migration Rate



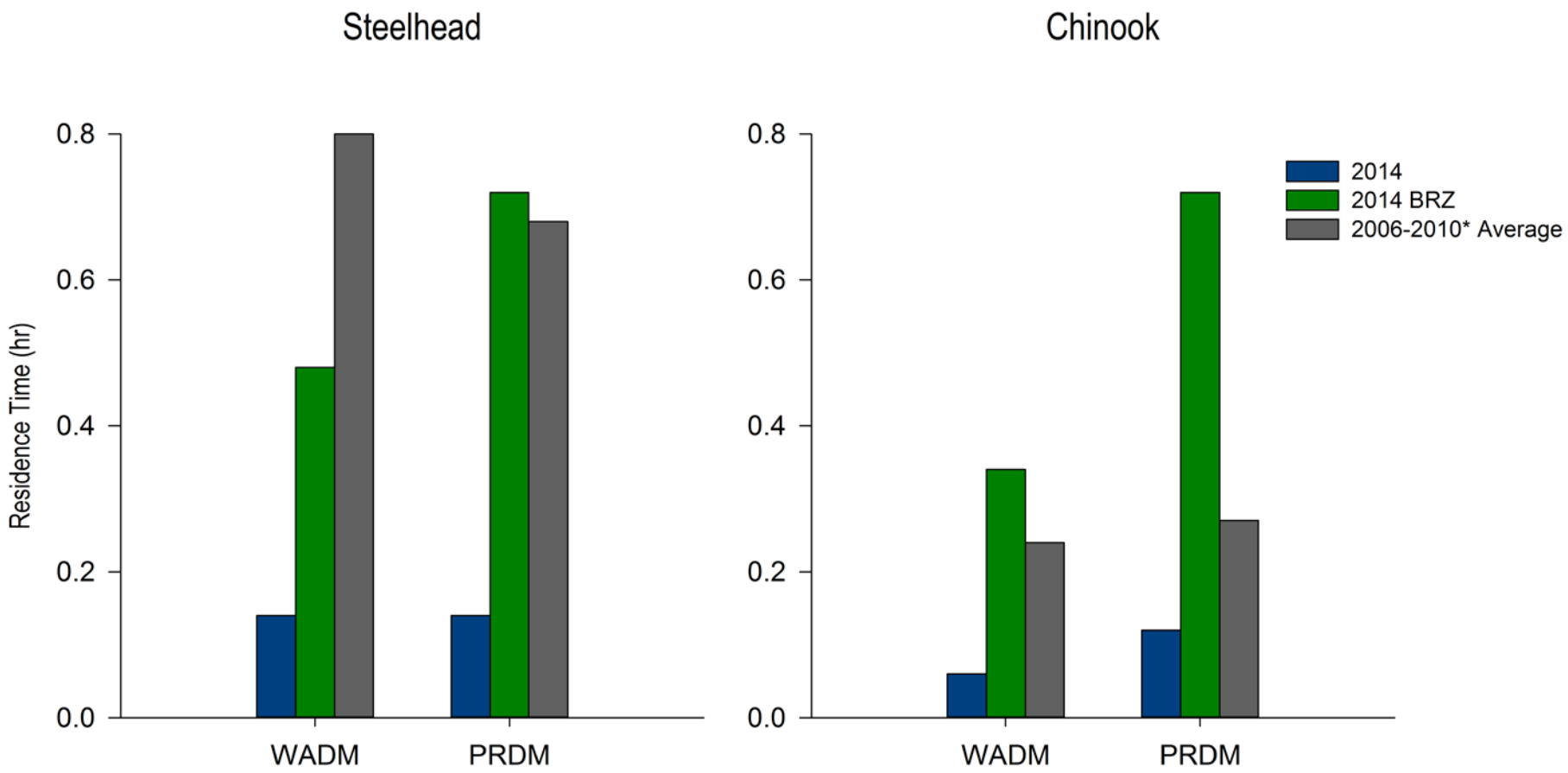
Migration Rates by Passage Route



Median Forebay Residence

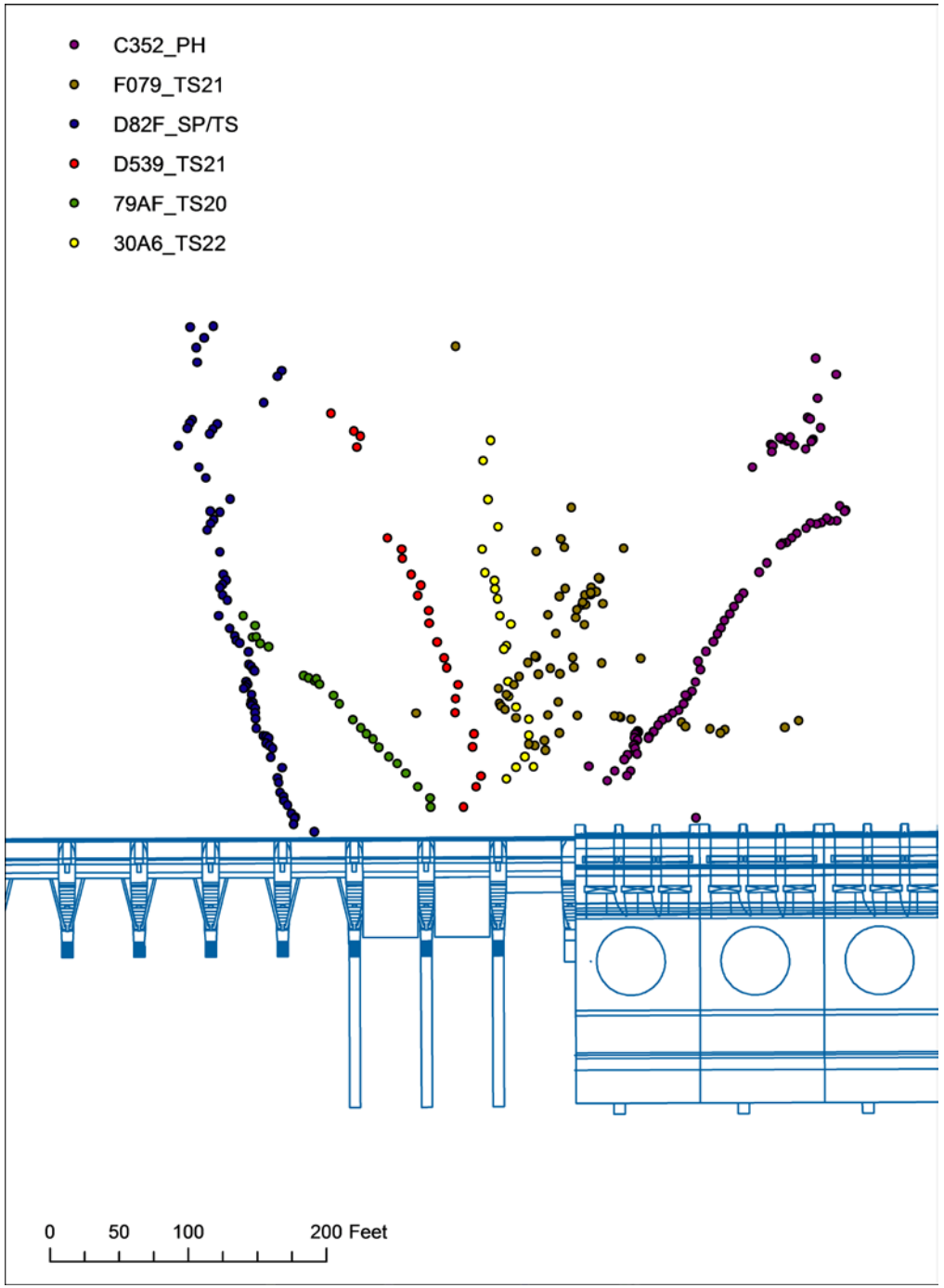


Median Forebay Residence



3D Positions

in progress



SOA 2011-01

Priest Rapids Coordinating Committee

Statement of Agreement

Modified Schedule and Funding Agreement for Juvenile Sockeye and Steelhead Survival Studies at the Priest Rapids Project

Submitted to Priest Rapids Coordinating Committee: January 26, 2011
Approved by the Priest Rapids Coordinating Committee: February 16, 2011 (Final Email Vote)

Statement:

The Priest Rapids Coordinating Committee agrees that based on high survival estimates after two years of evaluating juvenile sockeye survival, the third year of juvenile sockeye survival study can be deferred until 2016, to allow more comprehensive evaluation of sources of juvenile steelhead mortality in Public Utility District No. 2 of Grant County (Grant PUD)'s Priest Rapids and Wanapum reservoirs. In 2016, Grant PUD will conduct year three of the juvenile sockeye survival study, which will also serve as the initial five year check-in study for sockeye. For 2012 through 2016, the NNI Fund will be based on the current two year survival average for sockeye. For 2017 and beyond, the NNI Fund will be based on a new three sockeye survival average, based on 2016 study results, if validated by the PRCC. Funding for the 2011 steelhead loss evaluation will be provided using Grant PUD funds originally allocated for the originally anticipated 2011 juvenile sockeye survival study, plus NNI funds of $1,973,659. Equipment purchased for this study with NNI funds can be used in other studies upon agreement of the PRCC.

Per Section 15.3 (**NNI- Function of Fund**) of the Priest Rapids Salmon and Steelhead Settlement Agreement (Agreement), the PRCC "*recognize that the performance standards specified herein may not be achieved for certain stocks through current (2003) Project operations. The purpose of the Fund is to provide the Parties with additional financial capacity to undertake measures to improve survivals of Covered Species prior to the time when the Project attains applicable juvenile project survival standards. The NNI Fund is intended to provide near-term compensation for annual survivals that are less than the survival objectives in the performance standards for the Project for spring Chinook, steelhead, summer Chinook and sockeye. Grant PUD will reduce its annual NNI Fund contributions as progress toward meeting these performance standards is achieved. When the Parties determine that the performance standards have been achieved on a species-by-species basis, the NNI Fund annual contributions for that species will be terminated.*"

The PRCC also reiterates that Grant PUD shall, per Section 15.3 of the Agreement, "*develop annual plans for the expenditure of funds from the NNI Fund in consultation with the PRCC and with the approval of the Parties. These annual plans may be developed as a part of the annual Habitat Plans required by Appendix A or they may also include other measures or activities designed to improve survivals for Covered Species and contribute to the achievement of applicable performance standards for the Project. Grant PUD shall report annually on the activities associated with the NNI Fund in its Annual Progress and Implementation Plans required by Action 36 of Appendix A.*"

Background:

Section 15.6 (**New Survival Estimates)** of the Priest Rapids Salmon and Steelhead Settlement Agreement (Agreement) requires Grant PUD to conduct survival studies for covered species "*to evaluate steady progress toward meeting performance standards and to adjust the NNI Fund, Grant PUD shall, in consultation with the PRCC, conduct survival studies for Covered Species*". The Section 15.6 (Agreement) also states that the "*results of these studies will be used to estimate survival rates for Covered Species based on the arithmetic 3-year average of the annual estimates*". However, Section 15.6 of the Agreement also allows the PRCC to modify the schedule presented in Section 15.6 (*the schedule may be modified by consensus of the Parties and in consultation with the PRCC)*.

In 2008, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.9584 (SE=0.0242) and 0.8635(SE=0.0232), respectively, or 0.8276 (SE=0.0305) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2009a).

In 2009, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.9436 (SE=0.0189) and 0.8806(SE=0.0206), respectively, or 0.8309(SE=0.0256) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2009b).

In 2010, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.8553(SE=0.0186) and 0.9037(SE=0.017), respectively, or 0.7729(SE+0.0223) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2010).

In the three years of juvenile steelhead, the arithmetic mean juvenile steelhead survival is 81.05% for the combined project. Priest Rapids Dam passage survival was estimated to be 91.8%, 95.4% and 96.7% for 2008, 2009 and 2010 respectively, and Wanapum Dam passage survival was estimated to be 96.4%, 97.3%, and 97.2% for 2008, 2009 and 2010 respectively. Priest Rapids Reservoir passage survival was estimated to be 89.1%, 91.0%, and 91.3% for 2008, 2009 and 2010 respectively, and Wanapum Dam Reservoir passage survival was estimated to be 85.3%, 91.7%, and 86.7% for 2008, 2009 and 2010 respectively. Therefore, the PRCC has concluded that further investigation of juvenile steelhead losses in Priest Rapids and Wanapum reservoirs is warranted and necessary in order for survival performance standards to be met

In 2009 and 2010 Grant PUD released a total of 1,815 and 1,593 acoustic-tagged run-of-river sockeye smolts respectively, to estimate juvenile sockeye survival through the Priest Rapids Project,. Paired release-recapture methods were used to estimate survival through the Wanapum and Priest Rapids developments (dam and reservoirs). Using a paired release-recapture methodology, juvenile sockeye survival through the Wanapum and Priest Rapids developments (dam and reservoir) during 2009 was estimated to be 0.9726 (SE=0.0093) and 0.9460 (SE=0.0114), respectively. During 2009, the juvenile sockeye passage survival estimate through the Priest Rapids Project (both developments and reservoirs) was 0.9201 (SE=0.0142) (Skalski et al. 2009b). In 2010, juvenile sockeye survival through the Wanapum and Priest Rapids developments (dam and reservoir) was estimated at 0.9408 (SE=0.0138) and 0.9688 (SE=0.0139), respectively. The juvenile sockeye passage survival estimate through the Priest Rapids Project (both developments and reservoirs) in 2010 was 0.9114 (SE=0.0187; Skalski et al. 2010). For the combined Priest Rapids Project, the two year arithmetic mean for juvenile sockeye survival for 2009 and 2010 is 91.4%. This is 4.65% above the required performance standard identified in the Priest Rapids Salmon and Steelhead Settlement Agreement (86.49%).

Priest Rapids Coordinating Committee
Statement of Agreement on the Schedule
For Conducting Survival Evaluations

Submitted to the Priest Rapids Coordinating Committee: September 28, 2011
Approved by the Priest Rapids Coordinating Committee: December 5, 2011

Statement: Per Section 15.6 of the Priest Rapids Salmon and Steelhead Settlement Agreement (Agreement), the Priest Rapids Coordinating Committee agrees to the modified schedule for conducting survival evaluations as identified in Table 1 of this Statement of Agreement (SOA).

(1) The Priest Rapids Coordinating Committee (PRCC) agrees that the scheduled survival evaluation check-in for juvenile spring Chinook will occur during the spring outmigration of 2014. However, if it is apparent that that the Priest Rapids Top-Spill **will not** be completed and operational by February 2014 the PRCC will modify the attached schedule by September 2013. Grant PUD would then conduct the necessary survival evaluation check-in for spring Chinook during the spring outmigration in 2015.

(2) The PRCC agrees that survival evaluations for juvenile steelhead will occur over 3 consecutive years (2014, 2015 and 2016) with the first year initiated during the spring outmigration of 2014. If juvenile steelhead standards are met based on a 2 year consecutive average, the PRCC may consider deferring the third year of study. In addition, if juvenile steelhead standards are slightly less than required standards, the PRCC will evaluate future study needs. If it is apparent that that the Priest Rapids Top-Spill **will not** be completed and operational by February 2014 the PRCC will modify the attached schedule by September 2013. Grant PUD would then initiate the first year survival evaluation juvenile steelhead during the spring outmigration in 2015.

(3) The PRCC agrees that the scheduled survival evaluation check-in for sockeye will occur during the spring outmigration of 2016. This is consistent and does not change the intent or language incorporated into SOA 2011-01 approved by the PRCC on February 16, 2011 ("*Modified Schedule and Funding Agreement for Juvenile Sockeye and Steelhead Survival Studies at the Priest Rapids Project*").

(4) The PRCC agrees that survival evaluations for subyearling Chinook in the Priest Rapids Project will not be conducted until after the Priest Rapids Top-Spill is completed and operational and will occur over a three year consecutive timeframe of 2016-2018. If subyearling Chinook standards are met based on a 2 year consecutive average, the PRCC may consider deferring the third year of study, with

a 5 year check-in occurring in 2023. If juvenile subyearling Chinook standards are slightly less than required standards, the PRCC will evaluate future study needs. The PRCC will determine the feasibility (does methodology exist) for conducting subyearling Chinook by September of 2015. The PRCC also agrees that this SOA (SOA 2011-06) supersedes SOA 2009-4 (*2009 Subyearling Chinook Survival Study*), which required Grant PUD to conduct a subyearling evaluation in 2010 if a valid methodology was determined.

(5) The PRCC agrees that the scheduled check-ins for each species will occur at an interval of 5 years from the conclusion of a survival evaluation. For example, if sockeye survival evaluations are conducted in 2016, the first check-in would be 2021 and every 5 years thereafter for each species.

(6) The PRCC agrees that an additional year of testing, after the 5 year check-in may be needed based on the results from the first 5 year check-in. Per bullet item #7 below, the PRCC can modify (by consensus) the approved survival evaluation schedule.

(7) The PRCC, per Section 15.6 of the Agreement, agrees that the survival evaluation schedule can be modified (by consensus) and that all future modifications to the schedule will be documented by a Statement of Agreement.

Background: In 2006, Grant PUD entered into the Priest Rapids Salmon and Steelhead Settlement Agreement (Agreement) with state, federal, and tribal entities. The Agreement constitutes a comprehensive and long-term adaptive management program for the protection, mitigation, and enhancement of both ESA listed (UCR spring Chinook and UCR summer steelhead) and non-listed species (summer and fall Chinook, sockeye and coho), which pass or may be affected by the Priest Rapids Project.

A key element of the Agreement is to achieve steady progress toward meeting performance standards for both ESA listed and non-listed species. Accordingly, an initial survival evaluation schedule was presented in Table 2 of Section 15.6 (New Survival Estimates) of the Agreement. Due to a myriad of factors, including invalidation of study results (juvenile steelhead), lack of technology to measure survival (subyearling Chinook), modifications to the initial schedule (sockeye and yearling Chinook) and the fact that the initial schedule only covers years 2003 through 2011, the PRCC finds it necessary to modify the initial survival evaluation schedule. Language in Section 15.6 of the Agreement allows *"the schedule to be modified (by consensus) and in consultation with the PRCC as needed."*

Yearling Chinook: Grant PUD conducted PIT tag and 3-D acoustic tag survival evaluations for yearling Chinook salmon in 2003, 2004 and 2005. Survival standards were achieved for yearling Chinook based on the arithmetic 3-year average of the annual estimates (86.59%). A five-year check-in for yearling Chinook survival was scheduled to occur in 2010, however the PRCC deferred the check-in to after the Priest

Rapids Top-Spill was complete, so the committee could focus on juvenile steelhead performance.

Steelhead: In 2006, Grant PUD initiated year 1 of a three consecutive year 3-D acoustic tag juvenile steelhead survival evaluation. Results from the 2006 juvenile steelhead evaluation were invalidated by the PRCC because the evaluation did not achieve the statistical accuracy stated in the Priest Rapids Salmon and Steelhead Agreement, and was not used in NNI Fund recalculations. Results from 2006 were potentially affected by issues such as fish source and quality (Wanapum gatewells), tagger effects, and high total dissolved gas.

In 2007, Grant PUD released three separate groups of acoustic-tagged steelhead below Rock Island Dam to compare survival and migration dynamics of alternative fish sources (Rocky Reach and Wanapum Gatewell) and handling methods. This evaluation was not designed to be a true survival evaluation (only single point release), and served as a test year to correct issues that led to invalidating the 2006 study.

In 2008, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.9584 (SE=0.0242) and 0.8635(SE=0.0232), respectively, or 0.8276 (SE=0.0305) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2009a).

In 2009, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.9436 (SE=0.0189) and 0.8806(SE=0.0206), respectively, or 0.8309(SE=0.0256) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2009b).

In 2010, using a paired release-recapture methodology, juvenile steelhead survival was estimated through the Wanapum and Priest Rapids developments (dam and reservoir) to be 0.8553(SE=0.0186) and 0.9037(SE=0.017), respectively, or 0.7729(SE+0.0223) through the combined Priest Rapids Project (both developments and reservoirs; Skalski et al. 2010).

In the three years of evaluations (2008-2010), the arithmetic mean for juvenile steelhead survival was calculated at 81.05% (for the combined project). Priest Rapids Dam passage survival was estimated at 91.8% (2008), 95.4% (2009) and 96.7% (2010), while Wanapum Dam passage survival was estimated to be 96.4%, 97.3%, and 97.2% for 2008, 2009 and 2010 respectively. Priest Rapids Reservoir passage survival was estimated to range from 89.1% to 91.3% (2008-2010), while Wanapum Dam Reservoir passage survival was estimated to be 85.3%, 91.7%, and 86.7% for 2008, 2009 and 2010 respectively.

Sockeye: Using a paired release-recapture methodology, juvenile sockeye survival through the Wanapum and Priest Rapids developments (dam and reservoir) during 2009 was estimated to be 0.9726 (SE=0.0093) and 0.9460 (SE=0.0114), respectively. During 2009, the juvenile sockeye passage survival estimate through the Priest Rapids Project (both developments and reservoirs) was 0.9201 (SE=0.0142) (Skalski et al. 2009b).

In 2010, juvenile sockeye survival through the Wanapum and Priest Rapids developments (dam and reservoir) was estimated at 0.9408 (SE=0.0138) and 0.9688 (SE=0.0139), respectively. The juvenile sockeye passage survival estimate through the Priest Rapids Project (both developments and reservoirs) in 2010 was 0.9114 (SE=0.0187; Skalski et al. 2010). For the combined Priest Rapids Project, the two year arithmetic mean for juvenile sockeye survival for 2009 and 2010 is 91.4%. This is 4.65% above the required performance standard identified in the Priest Rapids Salmon and Steelhead Settlement Agreement (86.49%).

Subyearling: In 2009, Grant PUD conducted a pilot sub-yearling Chinook in the Priest Rapids development (one dam and reservoir) using the Juvenile Salmon Acoustic Telemetry System (JSATS) acoustic tag, to evaluate the JSATS tag technology and its suitability for conducting a Project-wide sub-yearling survival study. Analyses of the 2009 study indicated similar findings as were seen in the 2008 pilot sub-yearling acoustic tag evaluation. That tag battery-life issue related to the use of an active tag is a limiting factor, due to a variety of life-history strategies seen within a population of sub-yearling Chinook. On November 24, 2009 a sub-yearling Chinook workshop was held to discuss the feasibility of conducting a valid sub-yearling Chinook survival study. Grant PUD and PRCC representatives attended this workshop. Based on information presented at this workshop, the PRCC remains engaged in discussions with Grant PUD on the possibility of conducting a meaningful sub-yearling Chinook survival study in the Project once technology is confirmed. The PRCC was presented with a draft white paper regarding the possibility of conducting a Project wide sub-yearling survival study on September 29, 2010 (http://www.gcpud.org/prcc/PRCC.htm).

Table 1. Survival evaluation check-in schedule.

	2003–05	2006	2007	2008	2009	2010	2011	2012	2013	2014[A]	2015	2016	2017	2018	2019	2020	2021
Spring Chinook	86.6%[1]	.	.	.	.	N/A[2]	.	.	.	X[3]	.	.	.	.	X[4]	.	.
Steelhead	.	N/A[5]	N/A[6]	81.05%[7]			.	.	.	X[8]	X	X[9]	.	.	.	.	X[10]
Sockeye	.	.	.		91.14%[11]		.	.	.		.	X[12]	.	.	.	.	.
Summer Chinook	.	.					.	.	.		.	X[13]			.	.	.

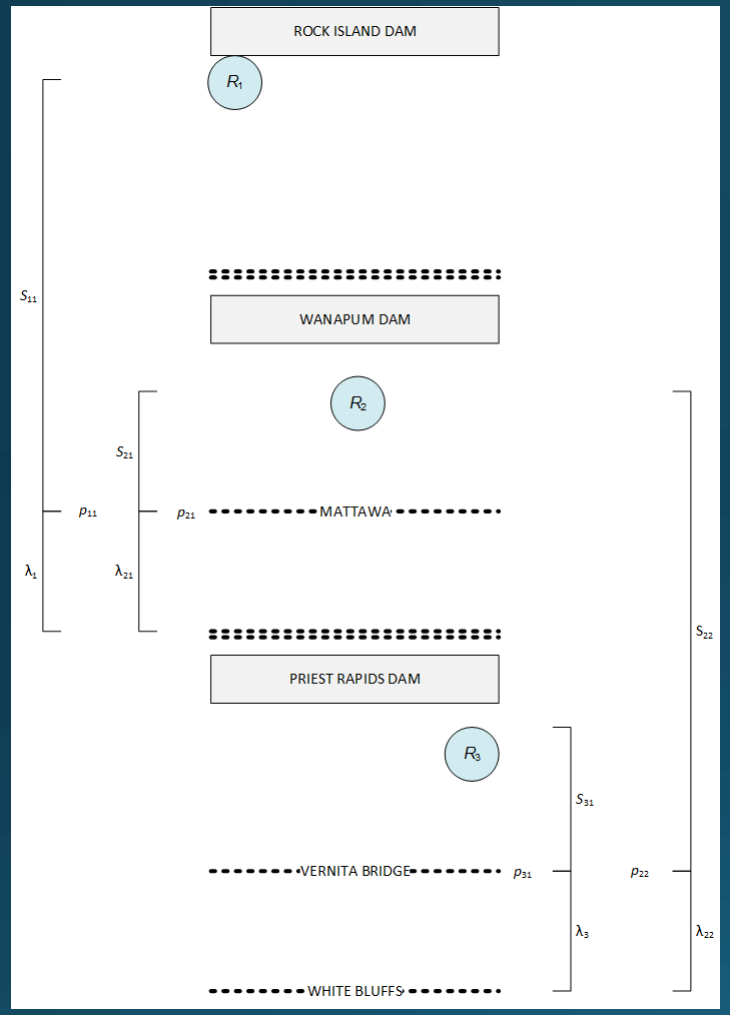
[A]PRCC may need to modify the survival evaluation check-in schedule for spring Chinook and steelhead survival evaluations, if the Priest Rapids Top-spill is **NOT** completed prior to the outmigration in spring of 2014.
[1]The arithmetic 3-year average of the annual estimates for yearling Chinook (2003-2005).
[2]The 5 year check-in for yearling Chinook was not conducted per discussions with PRCC.
[3] 2014 would serve as the 5 year check-in for yearling Chinook and would occur after completion of the Priest Rapids Top-spill.
[4]Yearling Chinook check-in.
[5]Year 1 of the juvenile steelhead was invalidated due to handling and tagging effects.
[6]The 2007 juvenile steelhead evaluation focused on improved handling and tagging methodologies.
[7]The arithmetic 3-year average of the annual estimates for juvenile steelhead (2008-2010).
[8]2014 would serve as the first year of a 3 year consecutive evaluation for summer steelhead and would occur after completion of the Priest Rapids Top-spill.
[9]PRCC may defer the third consecutive year of the juvenile steelhead evaluation if survival standards are achieved over 2 consecutive years.
[10]2021 would serve as the 5 year check-in for juvenile steelhead.
[11] The arithmetic 2-year average of the annual estimates for sockeye (2009-2010). Year 3 of sockeye survival was deferred to 2016 and would occur after completion of the Priest Rapids Top-Spill.
[12]2016 would serve as the 5 year check-in for sockeye and would occur after completion of the Priest Rapids Top-spill
[13] During 2016-2018, Grant PUD would conduct three consecutive years of survival evaluations for subyearling Chinook (if feasible).

Spring 2014 Survival Results for Yearling Chinook Salmon and Steelhead at Wanapum and Priest Rapids Dams

Grant County Public Utility District

John R. Skalski
R. L. Townsend
J. Lady

L. Sullivan
M. Timko



$$\hat{S}_{\text{Project}} = \frac{\hat{S}_{11}}{\hat{S}_{21}} \text{ or } \frac{\hat{S}_{22}}{\hat{S}_{31}}$$

Release Numbers	
CH1	ST
398	398
768 (765)	771 (766)
549	550
1,715	1,719

Figure 1. Schematic of the study design used to estimate project passage survival based on a paired release-recapture model (i.e., R_1 and R_2; R_2 and R_3).

Assessment of Assumptions

Tagger Distribution

- Three taggers for entire study
- Effort well distributed over time
- Effort well distributed over release locations

Tagger Distribution

Yearling Chinook Salmon

Release	A	B	C
Rock Island	112 (28.1)	162 (40.7)	124 (31.1)
Wanapum	226 (29.4)	295 (38.4)	247 (32.2)
Priest Rapids	152 (27.7)	219 (39.9)	178 (32.4)

Steelhead

Release	A	B	C
Rock Island	93 (23.3)	157 (39.3)	149 (37.3)
Wanapum	155 (20.1)	315 (40.9)	301 (39.0)
Priest Rapids	115 (20.9)	221 (40.2)	214 (38.9)

Tagger Rank Performance

- Pooled over replicates
- Cumulative survival of R_1, R_2, and R_3 to White Bluffs
- Survivals by release location

Tagger	R1	R2	R3
A	3	2	3
B	1	1	2
C	2	3	1

R1	R2	R3
1	2	1
2	1	2
3	3	3

$\bar{R}$
2.0
1.5
2.5

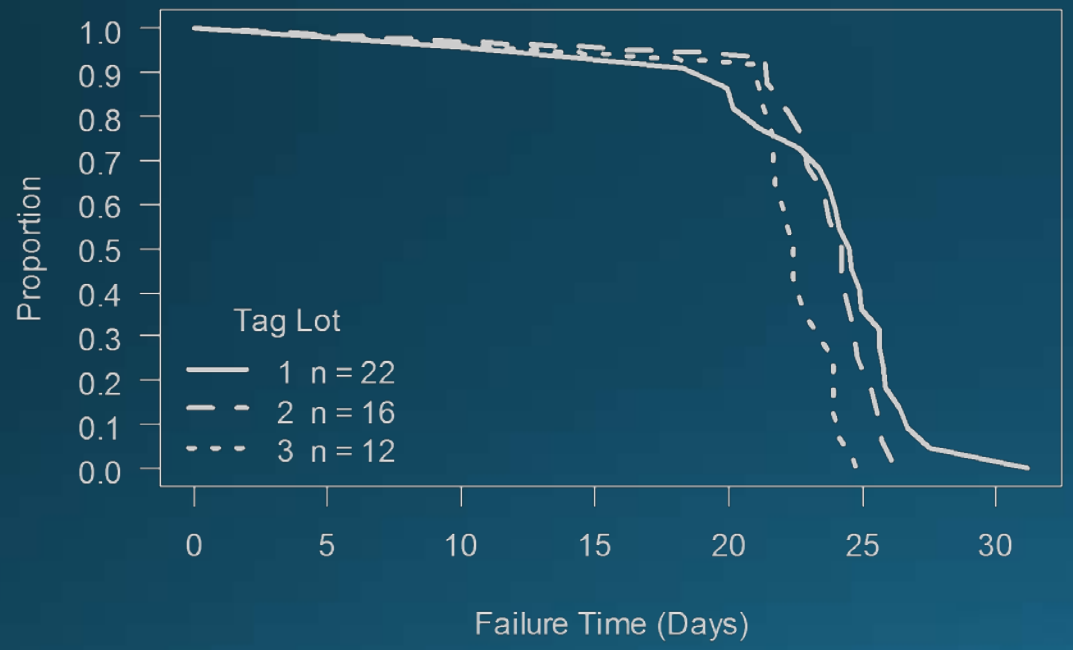
1 = lowest $\hat{S}$, ⋯, 3 = highest $\hat{S}$

$E(\bar{R}) = 2.0$

Conclusion: Use all fish from all taggers

Tag Life

Three tag lots

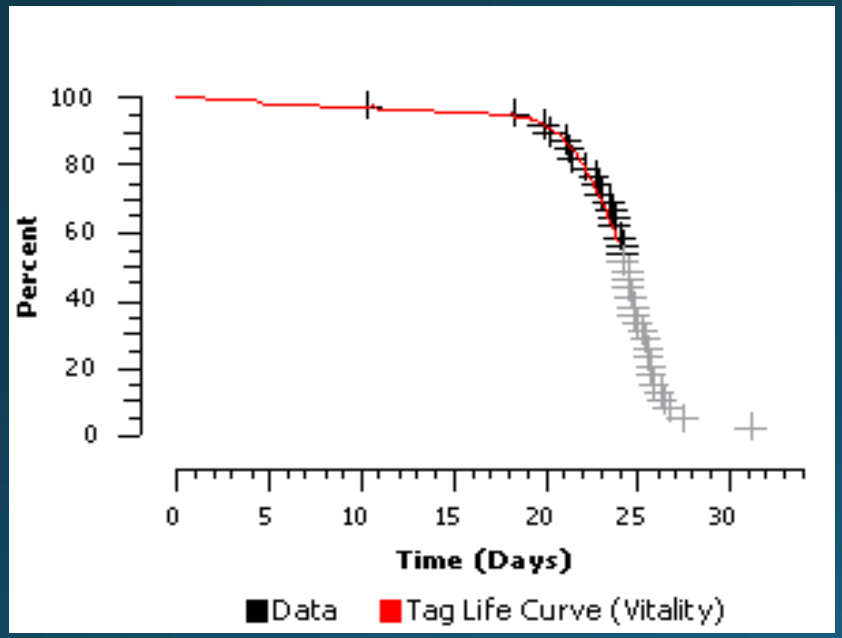


Lots Tested	*P*-value
1 vs. 2	0.5793
1 vs. 3	0.0241
2 vs. 3	0.0633

Pool tag lots 1 and 2; leave tag lot 3 separate.

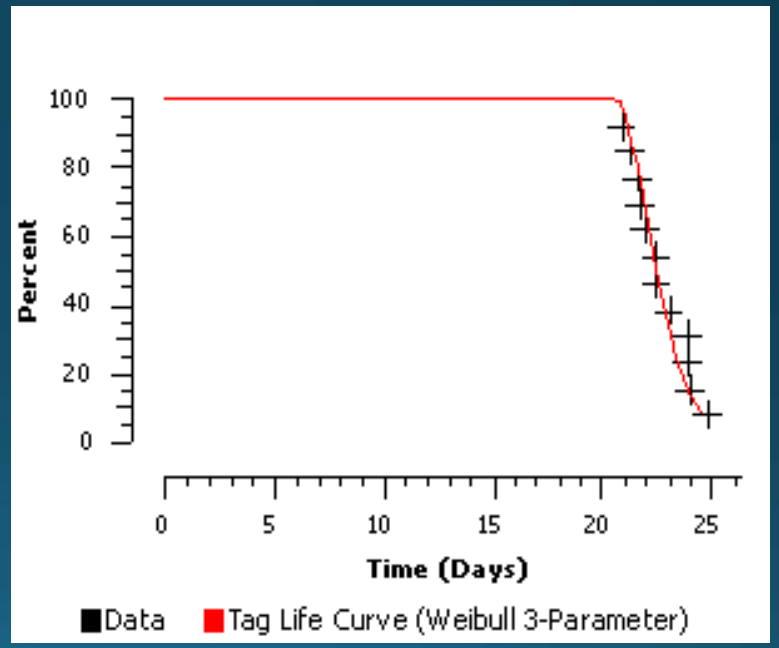
Tag-Life Curves

Tag Lots 1 & 2 Pooled



n = 38 tags
Average tag life ($\bar{t}$) = 23.7 days

Tag Lot 3



n = 12 tags
Average tag life ($\bar{t}$) = 22.7 days

Tag-Life Corrections

WANAPUM

Yearling Chinook Salmon

Site	Lot	Mattawa	Priest Rapids
Rock Island	1 & 2	0.9873 (0.0047)	0.9834 (0.0059)
	3	1.0000 (0.0000)	1.0000 (0.0000)
Wanapum	1 & 2	0.9883 (0.0044)	0.9844 (0.0058)
	3	1.0000 (nan)	1.0000 (0.0000)

Steelhead

Site	Lot	Mattawa	Priest Rapids
Rock Island	1 & 2	0.9909 (00033)	0.9893 (0.0040)
	3	1.0000 (0.0000)	1.0000 (0.0000)
Wanapum	1 & 2	0.9889 (0.0041)	0.9868 (0.0047)
	3	1.0000 (nan)	1.0000 (0.0001)

In all cases, $\hat{L} \geq 0.986$

Tag-Life Corrections

PRIEST RAPIDS

Yearling Chinook Salmon

Site	Lot	Vernita Bridge	White Bluffs
Wanapum	1 & 2	0.9837 (0.0056)	0.9822 (0.0061)
	3	1.0000 (0.0000)	1.0000 (0.0000)
P. Rapids	1 & 2	0.9862 (0.0047)	0.9838 (0.0056)
	3	1.0000 (nan)	1.0000 (0.0000)

Steelhead

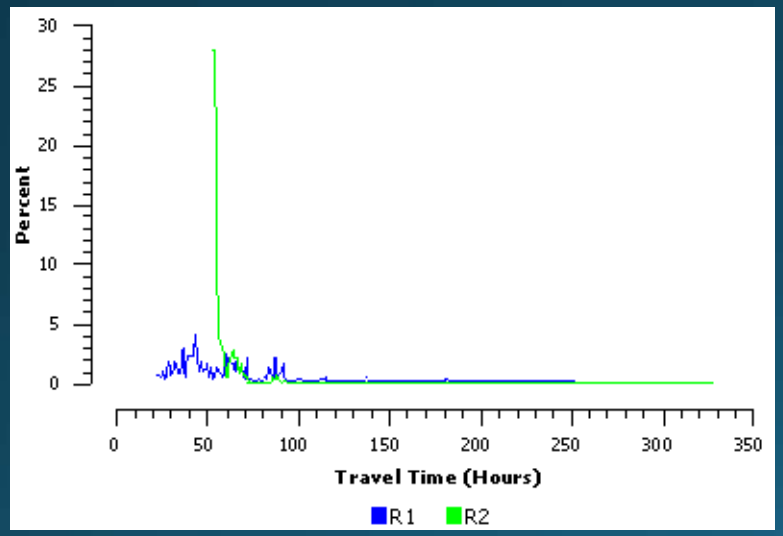
Site	Lot	Vernita Bridge	White Bluffs
Wanapum	1 & 2	0.9859 (00056)	0.9851 (0.0059)
	3	1.0000 (0.0000)	1.0000 (0.0000)
P. Rapids	1 & 2	0.9862 (0.0055)	0.9845 (0.0061)
	3	1.0000 (nan)	1.0000 (0.0000)

In all cases, $\hat{L} \geq 0.982$

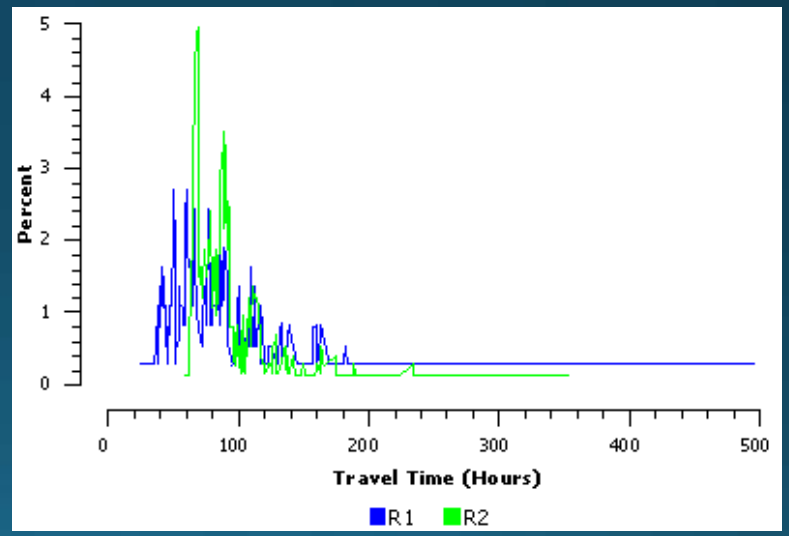
Downstream Mixing

Yearling Chinook salmon below Wanapum Dam

a. Mattawa array



b. Priest Rapids array

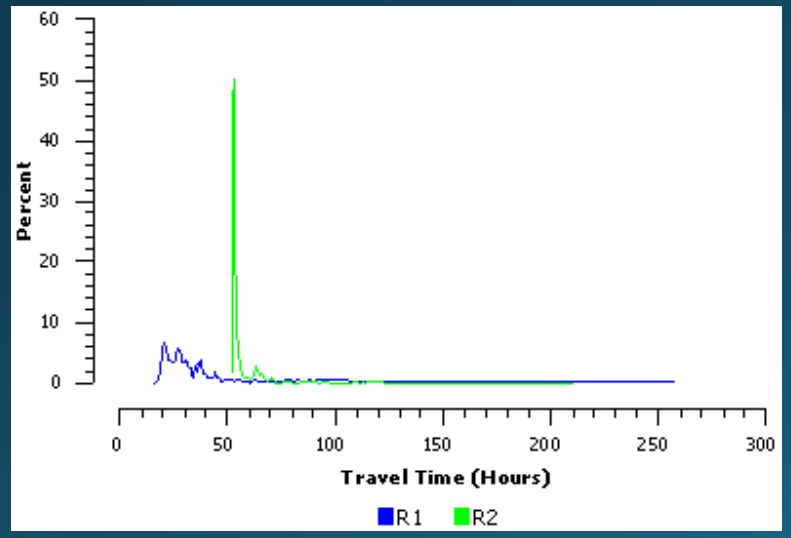


*Similar plots for R_2 and R_3 below Priest Rapids Dam

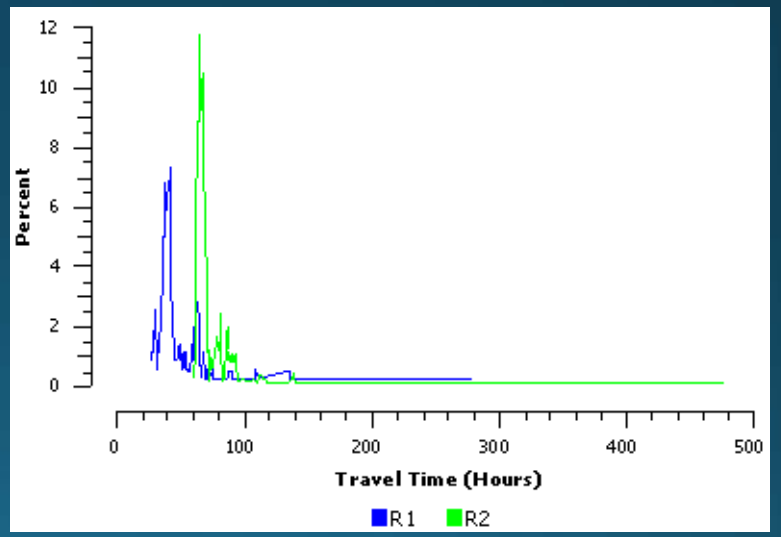
Downstream Mixing

Steelhead below Wanapum Dam

a. Mattawa array



b. Priest Rapids array



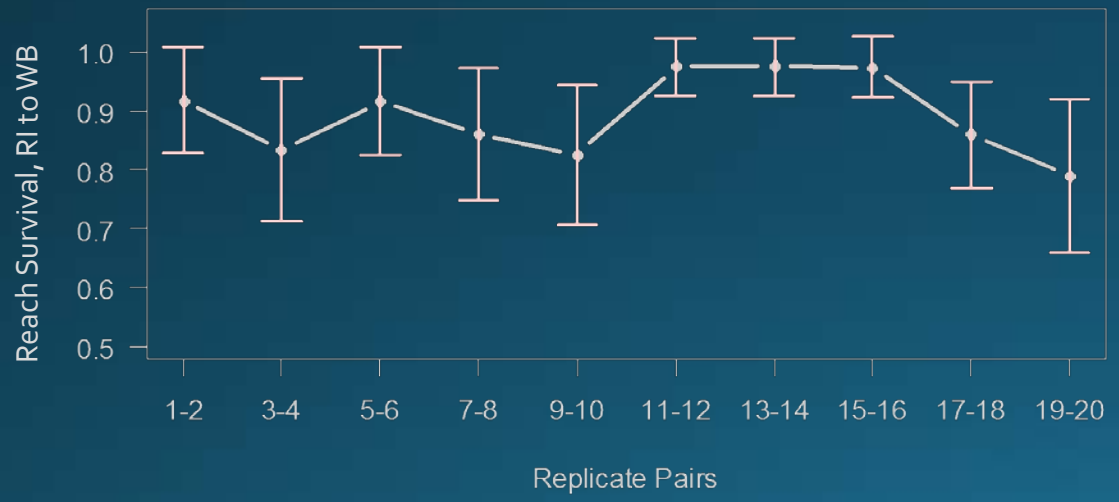
*Similar plots for R_2 and R_3 below Priest Rapids Dam

Survival Trends

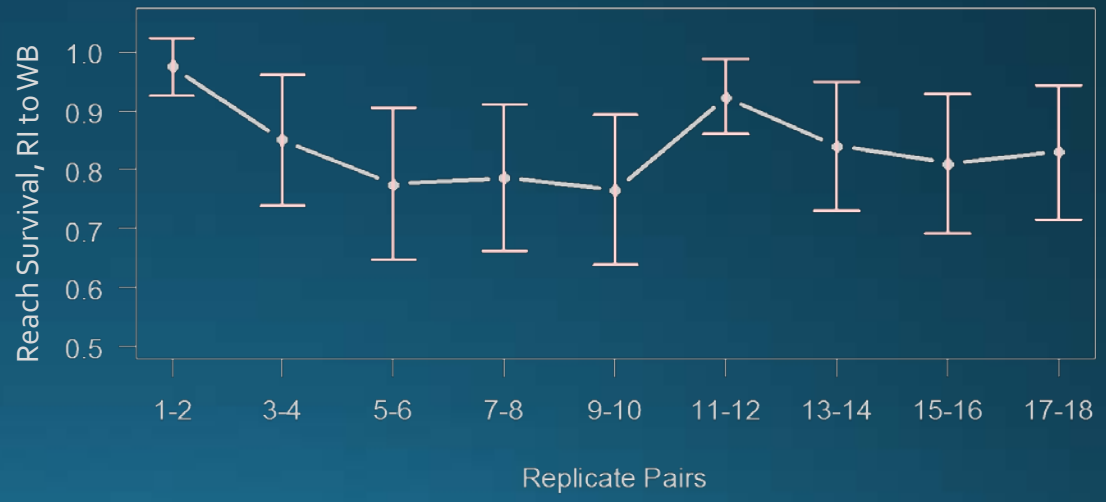
Seasonal Survival Trends

R_1 release to White Bluffs, unadjusted for tag life

a. Yearling Chinook salmon



b. Steelhead

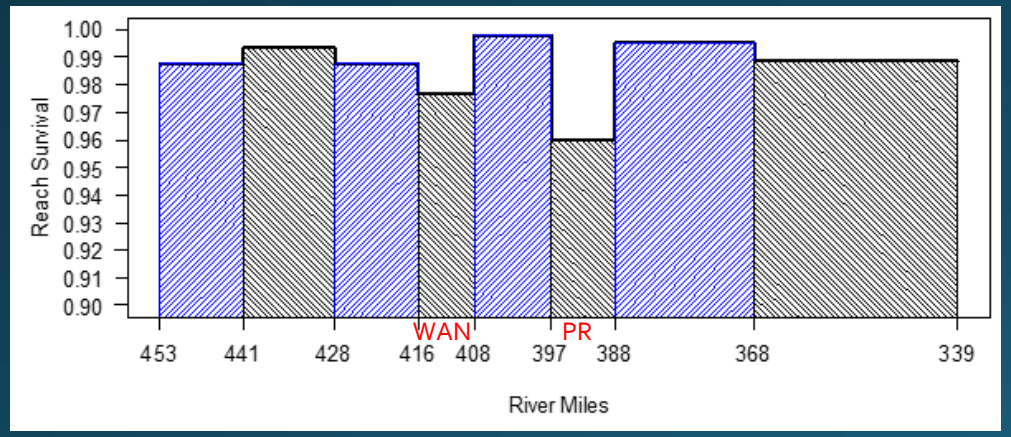


Vertical lines are 95% CIs

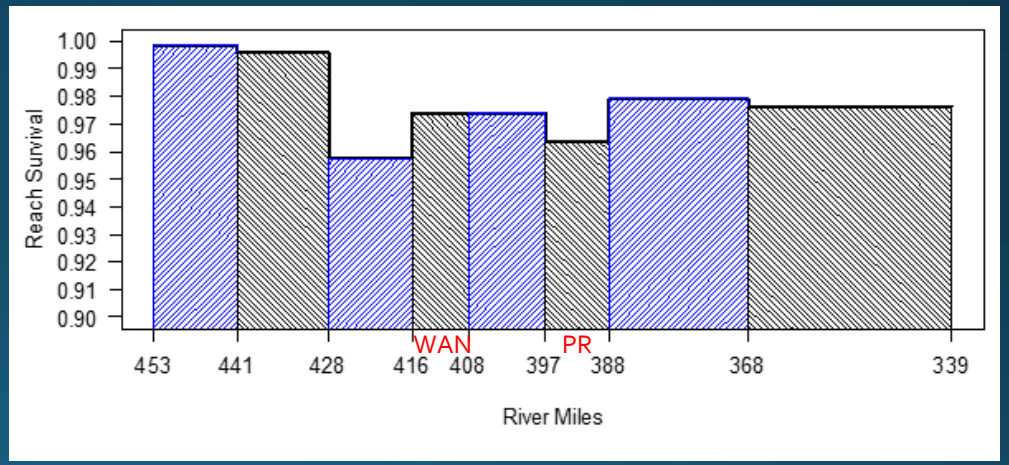
Reach Survivals

Rock Island tailrace to White Bluffs

a. Yearling Chinook salmon



b. Steelhead



Reach Survivals

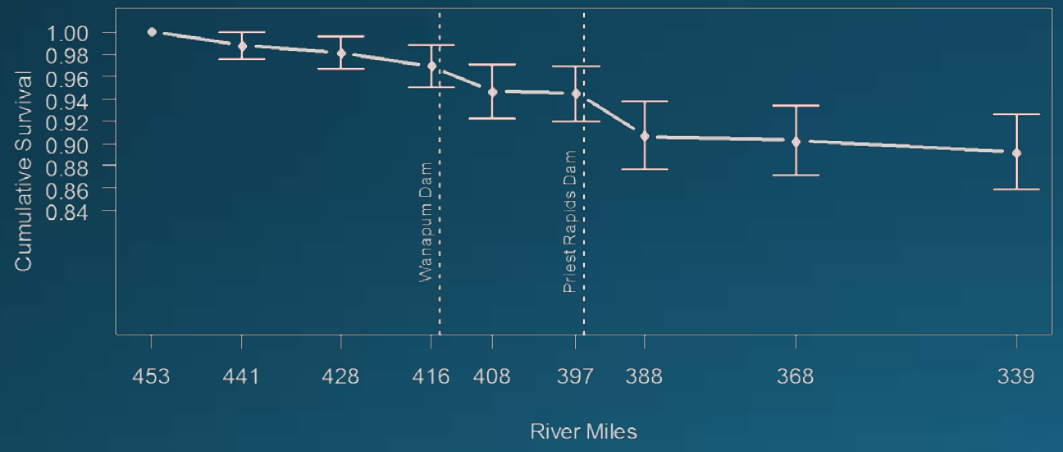
Rock Island tailrace to White Bluffs

Reach	Chinook		Steelhead	
Release to W441	0.9875	(0.0060)	0.9986	(0.0049)
W441 to W428	0.9933	(0.0045)	0.9957	(0.0036)
W428 to W416	0.9877	(0.0063)	0.9575	(0.0102)
W416 to P408	0.9770	(0.0077)	0.9739	(0.0083)
P408 to P397	0.9979	(0.0039)	0.9742	(0.0086)
P397 to M388	0.9599	(0.0103)	0.9638	(0.0101)
M388_6 to M368	0.9951	(0.0041)	0.9794	(0.0078)
M368 to M339	0.9887	(0.0064)	0.9765	(0.0085)

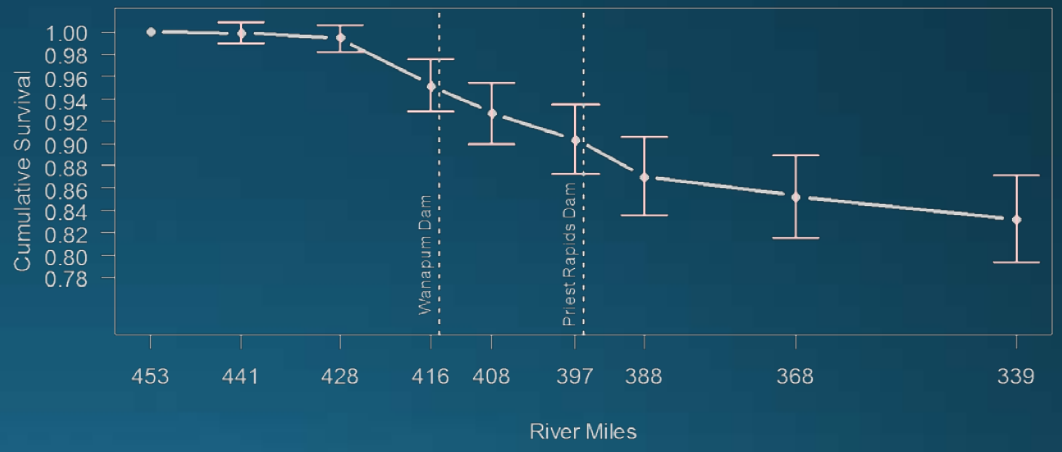
Cumulative Survivals

Rock Island tailrace to White Bluffs

a. Yearling Chinook



b. Steelhead



Vertical lines are 95% CIs

Project Passage Survival

Project Passage Survival Calculations

Yearling Chinook salmon and steelhead

- All taggers
- 2 tag lots (lots 1 & 2 pooled, lot 3)

Wanapum Project Survival

Yearling Chinook salmon

Paired Survival:

Estimate	SE
0.9448	0.0128

Survival Detail for Fitted Model:

	Release to Mattawa	
	Estimate	SE
Rock Island tailrace	0.9448	0.0124
Wanapum tailrace	1.0000	0.0054

Survival Detail for Fitted Model:

	Mattawa		P397 Survival*Capture	
	Estimate	SE	Estimate	SE
Rock Island tailrace	1.0000	0.0000	0.9986	0.0038
Wanapum tailrace	1.0000	0.0000	0.9873	0.0045

Wanapum Project Survival

Steelhead

Paired Survival:

Estimate	SE
0.9294	0.0140

Survival Detail for Fitted Model:

	Release to Mattawa	
	Estimate	SE
Rock Island tailrace	0.9246	0.0138
Wanapum tailrace	0.9949	0.0029

Survival Detail for Fitted Model:

	Mattawa		P397 Survival*Capture	
	Estimate	SE	Estimate	SE
Rock Island tailrace	1.0000	0.0000	0.9741	0.0085
Wanapum tailrace	1.0000	0.0000	0.9787	0.0053

Priest Rapids Project Survival

Yearling Chinook salmon

Paired Survival:

Estimate	SE
0.9612	0.0087

Survival Detail for Fitted Model:

	Release to Vernita Bridge	
	Estimate	SE
Wanapum tailrace	0.9596	0.0085
Priest Rapids tailrace	0.9983	0.0018

Survival Detail for Fitted Model:

	Vernita Bridge		M368 Survival*Capture	
	Estimate	SE	Estimate	SE
Wanapum tailrace	0.9972	0.0020	0.9877	0.0043
Priest Rapids tailrace	0.9944	0.0032	0.9707	0.0075

Priest Rapids Project Survival

Steelhead

Paired Survival:

Estimate	SE
0.9613	0.0098

Survival Detail for Fitted Model:

	Release to Vernita Bridge	
	Estimate	SE
Wanapum tailrace	0.9512	0.0084
Priest Rapids tailrace	0.9895	0.0055

Survival Detail for Fitted Model:

	Vernita Bridge		M368 Survival*Capture	
	Estimate	SE	Estimate	SE
Wanapum tailrace	0.9972	0.0020	0.9687	0.0065
Priest Rapids tailrace	0.9901	0.0044	0.9319	0.0110

Joint Wanapum/Priest Rapids Project Survival

Yearling Chinook salmon

$\hat{S}_{\mathrm{WAN/PR}} = 0.9082, \widehat{\mathrm{SE}} = 0.0145$

Steelhead

$\hat{S}_{\mathrm{WAN/PR}} = 0.8934, \widehat{\mathrm{SE}} = 0.0162$

Survival Summary

Project	Yearling Chinook salmon	Steelhead
Wanapum	0.9448 (0.0128)	0.9294 (0.0140)
Priest Rapids	0.9612 (0.0087)	0.9613 (0.0098)
Wanapum – Priest Rapids	0.9082 (0.0148)	0.8934 (0.0163)

Survival standard: $\hat{S} \geq 0.93$ and $\widehat{\mathrm{SE}} \leq 0.025$

Passage Efficiency and Relative Route Survivals

Routes of Passage

Wanapum

Species	Fish Bypass	Spill	Powerhouse (+ GW)
Yearling Chinook salmon	0.0750	0.2750	0.6500
Steelhead	0.0994	0.4530	0.4475

Priest Rapids

Species	Top Spill	Spill	Powerhouse (+GW)
Yearling Chinook salmon	0.3814	0.2693	0.3493
Steelhead	0.4716	0.2195	0.3088

Fish Passage Efficiency (FPE)

Project	Yearling Chinook salmon	Steelhead
Wanapum	0.3500 (0.0251)	0.5525 (0.0261)
Priest Rapids	0.6520 (0.0144)	0.6920 (0.0141)

Wanapum: $$\mathrm{FPE} = \frac{\mathrm{BYP} + \mathrm{Spill}}{\mathrm{BYP} + \mathrm{Spill} + \mathrm{PH} + \mathrm{GW}}$$

Priest Rapids: $$\mathrm{FPE} = \frac{\mathrm{Top\ Spill} + \mathrm{Spill}}{\mathrm{Top\ Spill} + \mathrm{Spill} + \mathrm{PH} + \mathrm{GW}}$$

Relative Route Survivals

Survival relative to spillway survival , i.e., $RS = \frac{S_i}{S_{\text{Spill}}}$

Wanapum

Stock	S_{PH}/S_{Spill}	S_{BY}/S_{Spill}
CH1	1.0048 (0.0208)	0.9931 (0.0414)
ST	0.9502 (0.0190)*	1.0061 (0.0062)

Priest Rapids

Stock	S_{PH}/S_{Spill}	S_{TS}/S_{Spill}
CH1	0.9501 (0.0156)*	1.0184 (0.0089)*
ST	0.9636 (0.1790)*	1.0265 (0.0120)*

* Significantly different from 1 ($P < 0.05$)

PA Date	PA Project Number	PA Project Name	PA Document No.	Vendor Name	Item Description	Total Cost
2/5/2014	60100008H	Fish Screen Monitor Program	RCT000000000091066	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H FISH SCREEN MONITORING	$27,263.43
2/13/2014	60100015H	Chewuch River Instream Flow	RCT000000000091597	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H CHEWUCH RIVER FLOW PRO	$3,800.00
2/26/2014	60100011H	Geochemical Analysis S F Rays	RCT000000000092388	BATTELLE-NORTHWEST CORP	601-11H	$8,832.27
2/26/2014	60100011H	Geochemical Analysis S F Rays	RCT000000000092345	BATTELLE-NORTHWEST CORP	601-11H GEOCHEMICAL ANALYSIS O	$16,031.76
2/26/2014	60100011H	Geochemical Analysis S F Rays	RCT000000000092344	BATTELLE-NORTHWEST CORP	601-11H GEOCHEMICAL ANALYSIS O	$8,201.08
3/6/2014	60100008H		RCT000000000092806	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$29,832.39
3/17/2014	60100012H		RCT000000000093591	OSU OREGON STATE UNIVERSITY	601-12H	$8,510.17
3/17/2014	60100012H		RCT000000000093589	OSU OREGON STATE UNIVERSITY	601-12H	$32,142.36
3/19/2014	60100012H		RCT000000000093707	OSU OREGON STATE UNIVERSITY	601-12H CASPIAN TERN M & E GOO	$17,864.13
3/20/2014	60100017H		RCT000000000093811	BATTELLE-NORTHWEST CORP	JSATS SURVIVAL STUDY LOWER HAN	$39,953.00
5/6/2014	60100008H		RCT000000000096977	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$38,176.47
4/8/2014	60100008H		RCT000000000094921	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$40,478.31
5/28/2014	60100012H		RCT000000000098928	OSU OREGON STATE UNIVERSITY	601-12H	$145,721.58
4/28/2014	60100015H		RCT000000000096535	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H	$3,000.00
5/28/2014	60100015H		RCT000000000098925	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H	$128,910.15
5/28/2014	60100018H		RCT000000000098756	BLUE LEAF ENVIRONMENTAL, INC	601-18H	$19,096.41
5/28/2014	60100018H		RCT000000000098755	BLUE LEAF ENVIRONMENTAL, INC	601-18H	$23,174.40
6/10/2014	60100008H		RCT000000000099670	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$25,340.55
6/17/2014	60100012H		RCT000000000100291	OSU OREGON STATE UNIVERSITY	601-12H	$71,643.42
6/12/2014	60100014H		RCT000000000099933	MIDWEST LAKE MANAGEMENT, INC	CONTROL BOX CASE	$385.00
6/12/2014	60100014H		RCT000000000099933	MIDWEST LAKE MANAGEMENT, INC	SPHERE ANODES	$1,860.00
6/12/2014	60100014H		RCT000000000099933	MIDWEST LAKE MANAGEMENT, INC	GPS SONAR PER ATTACHED	$2,157.00
6/12/2014	60100014H		RCT000000000099933	MIDWEST LAKE MANAGEMENT, INC	MODEL 18CV ELECTROFISHING BOAT	$115,949.00
6/17/2014	60100015H		RCT000000000100294	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H	$215,995.75
6/24/2014	60100017H		RCT000000000100885	BATTELLE-NORTHWEST CORP	601-17H	$29,229.79
6/3/2014	60100018H		RCT000000000099120	SKALSKI STATISTICAL SERVICES	430-3768	$1,864.20
7/7/2014	60100008H		RCT000000000101592	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$18,322.79
7/1/2014	60100012H		RCT000000000101374	OSU OREGON STATE UNIVERSITY	601-12H	$50,308.63
7/1/2014	60100014H		RCT000000000101313	WA ST DEPT OF LICENSING-GRANT COUNTY	2014 CLARK ALUM BOAT AND TRLR	$9,545.48
7/1/2014	60100018H		RCT000000000101334	BLUE LEAF ENVIRONMENTAL, INC	601-18H	$18,260.03
7/22/2014	60100018H		RCT000000000102724	BLUE LEAF ENVIRONMENTAL, INC	430-3733	$27,288.28
7/1/2014	60100018H		RCT000000000101332	BLUE LEAF ENVIRONMENTAL, INC	430-3733	$38,830.01
7/29/2014	60100018H		RCT000000000103168	BLUE LEAF ENVIRONMENTAL, INC	601-18H	$94,970.87
8/25/2014	60100012H		RCT000000000104875	OSU OREGON STATE UNIVERSITY	601-12H	$12,371.11
8/13/2014	60100012H		RCT000000000104237	OSU OREGON STATE UNIVERSITY	601-12H	$87,062.47
8/26/2014	60100015H		RCT000000000105218	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H	$57,027.33
8/5/2014	60100018H		RCT000000000103699	BLUE LEAF ENVIRONMENTAL, INC	601-18H	$1,027.93
9/30/2014	60100008H		RCT000000000107518	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$16,380.84
9/8/2014	60100008H		RCT000000000105823	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-8H	$27,432.90
9/23/2014	60100015H		RCT000000000107054	TROUT UNLIMITED - WASH. WATER PROJECT	601-15H	$8,699.17
9/8/2014	60100016H		RCT000000000105827	WASHINGTON ST DEPT OF FISH & WILDLIFE	601-16H	$588.67
				Fund 601 - Total Expenditures Year to Date Through 09/30/2014		**$1,523,529.13**
1/22/2014	60200017H	Robinson Acquisition	RCT000000000090167	METHOW SALMON RECOVERY FNDN	602-17H	$241.50
2/19/2014	60200016H	Roaring Ck Restor/Div Removal	RCT000000000091911	TROUT UNLIMITED - WASH. WATER PROJECT	602-16H	$708.73
2/26/2014	60200020H	Entiat Riv Cottonwood Phs 2	RCT000000000092308	CHELAN-DOUGLAS LAND TRUST	602-20H	$5,000.00
3/7/2014	60200006H		RCT000000000092941	OKANAGAN NATION ALLIANCE	602-6H	$82.11
3/7/2014	60200012H		RCT000000000092942	OKANAGAN NATION ALLIANCE	602-12H	$13,258.07
4/28/2014	60200010H		RCT000000000096514	CHELAN-DOUGLAS LAND TRUST	602-10H	$1,142.63
4/28/2014	60200010H		RCT000000000096506	CHELAN-DOUGLAS LAND TRUST	602-10H	$3,772.53
4/28/2014	60200016H		RCT000000000096525	TROUT UNLIMITED - WASH. WATER PROJECT	602-16H	$2,400.00
5/15/2014	60200006H		RCT000000000097769	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.	602-6H	$4,976.02
5/15/2014	60200012H		RCT000000000097768	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.	602-12H	$7,980.10
5/20/2014	60200007H		RCT000000000098095	METHOW SALMON RECOVERY FNDN	602-7	$319.00
5/20/2014	60200016H		RCT000000000098123	TROUT UNLIMITED - WASH. WATER PROJECT	602-16H	$1,181.30
6/16/2014	60200022H		RCT000000000100131	STRICKLAND, HEISCHMAN & HOSS, INC	APPRAISAL SERVICES	$20,000.00
6/17/2014	60200012H		RCT000000000100278	OKANAGAN NATION ALLIANCE	602-12H	$882.57
6/17/2014	60200014H		RCT000000000100277	OKANAGAN NATION ALLIANCE	602-14H	$41,787.06
6/24/2014	60200014H		RCT000000000100734	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.	602-14H	$69,490.27
7/8/2014	60200010H		RCT000000000101807	CHELAN-DOUGLAS LAND TRUST	602-10H	$10,000.00
7/8/2014	60200010H		RCT000000000101808	CHELAN-DOUGLAS LAND TRUST	602-10H	$535,211.32
7/11/2014	60200006H		RCT000000000101991	OKANAGAN NATION ALLIANCE	602-6H	$252.05
7/11/2014	60200012H		RCT000000000101992	OKANAGAN NATION ALLIANCE	602-12H	$3,227.66
7/15/2014	60200010H		RCT000000000102229	CHELAN-DOUGLAS LAND TRUST	602-10H	$10,372.59
7/15/2014	60200024H		RCT000000000102251	OKANAGAN NATION ALLIANCE	602-24H	$33,572.50
7/29/2014	60200015H		RCT000000000103118	CASCADIA CONSERVATION DISTRICT	602-15H	$34,055.56
8/12/2014	60200012H		RCT000000000104189	OKANAGAN NATION ALLIANCE	602-12H	$4,428.19
8/12/2014	60200014H		RCT000000000104188	OKANAGAN NATION ALLIANCE	602-14H	$24,508.75
9/23/2014	60200012H		RCT000000000106941	OKANAGAN NATION ALLIANCE	602-12H	$3,009.49
9/23/2014	60200014H		RCT000000000107071	OKANAGAN NATION ALLIANCE	602-14H	$240.49
9/2/2014	60200017H		RCT000000000105486	METHOW SALMON RECOVERY FNDN	602-17H ROBINSON ACQUISITIION	$3,269.44
9/23/2014	60200023H		RCT000000000107070	OKANAGAN NATION ALLIANCE	602-23H	$4,117.48
9/23/2014	60200024H		RCT000000000107069	OKANAGAN NATION ALLIANCE	602-24H	$36,732.97
9/23/2014	60200024H		RCT000000000107067	OKANAGAN NATION ALLIANCE	602-24H	$57,034.78

PA Date	PA Project Number	PA Project Name	PA Document No.	Vendor Name	Item Description	Total Cost
9/23/2014	60200025H		RCT00000000106943	CASCADE CHELAN APPRAISAL, INC	602-25	$10,800.00
				Fund 602 - Total Expenditures Year to Date Through 09/30/2014		**$944,055.16**
1/20/2014	60300024H	Barkley Irrigation Diversion	ML000000000005495			($11,167.86)
1/22/2014	60300022H	White River Gage Station	RCT00000000090183	WASHINGTON ST DEPT OF ECOLOGY	603.22H WHITE RIVER GAGE STATI	$13.82
2/5/2014	60300016H	Libby Ck Riparian Acquisition	RCT00000000091068	WASHINGTON ST DEPT OF FISH & WILDLIFE	603-16H	$408.51
2/19/2014	60300027H	Icicle Irr Pump Exch Analysis	RCT00000000091872	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H ICICLE-PESHASTIN IRRIG	$4,285.00
2/26/2014	60300022H	White River Gage Station	RCT00000000092387	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$3,233.43
3/17/2014	60300022H		RCT00000000093607	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$1,081.97
3/17/2014	60300027H		RCT00000000093598	TROUT UNLIMITED - WASH. WATER PROJECT	ICICLE-PESHASTIN ANALYSIS FOR	$12,720.00
1/31/2014	60300024H	Barkley Irrigation Diversion		reversed ML5495. It was done incorrectly. So reversed and corrected.		$11,167.86
1/31/2014	60300024H	Barkley Irrigation Diversion				$11,167.86
5/20/2014	60300022H		RCT00000000098092	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$1,336.73
4/28/2014	60300022H		RCT00000000096536	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$1,655.10
5/9/2014	60300026H		RCT00000000097360	COLVILLE CONFEDERATED TRIBES	603-26H	$13,430.00
5/20/2014	60300027H		RCT00000000098121	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H	$21,630.00
4/28/2014	60300027H		RCT00000000096537	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H	$30,006.90
6/23/2014	60300022H		RCT00000000100593	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$748.43
6/17/2014	60300026H		RCT00000000100280	COLVILLE CONFEDERATED TRIBES	603-26H	$13,430.00
6/17/2014	60300027H		RCT00000000100298	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H	$17,733.75
7/7/2014	60300016H		RCT00000000101594	WASHINGTON ST DEPT OF FISH & WILDLIFE	603-16H	$23.81
7/28/2014	60300022H		RCT00000000103097	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$647.59
7/29/2014	60300027H		RCT00000000103144	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H	$13,443.75
7/15/2014	60300028H		RCT00000000102230	WASHINGTON ST DEPT OF FISH & WILDLIFE	603-28H	$213.01
8/15/2014	60300027H		RCT00000000104443	TROUT UNLIMITED - WASH. WATER PROJECT	603-27H	$16,343.00
9/9/2014	60300022H		RCT00000000105973	WASHINGTON ST DEPT OF ECOLOGY	603-22H	$1,807.75
9/23/2014	60300024H		RCT00000000107064	TROUT UNLIMITED - WASH. WATER PROJECT	603-24H	$3,920.59
9/2/2014	60300025H		RCT00000000105491	CONFEDERATED TRIBES & BANDS OF THE YAKAMA NATI	603-25H	$75,000.00
9/9/2014	60300028H		RCT00000000105984	WASHINGTON ST DEPT OF FISH & WILDLIFE	603-28H	$11,331.77
9/30/2014	60300028H		RCT00000000107519	WASHINGTON ST DEPT OF FISH & WILDLIFE	603-28H	$13,829.40
				Fund 603 - Total Expenditures Year to Date Through 09/30/2014		**$269,442.17**

PRCC - Habitat Funds

Report of Unencumbered Fund Balances

As of September 30, 2014

No Net Impact (NNI) Fund 601:

Cash & Investments Fund Balance per Monthly Report					$ 6,243,745
	Less remaining balance with Open Project ID's:			Project Balance	
1.	Open	60100008H	Fish Screen Monitor Program	737,023	
2.	Open	60100009H	Juv NPM Population Control	40,204	
3.	Open	60100011H	Geochemical Analysis of Scales & Fin Rays	990	
4.	Open	60100012H	Goose Is. Terns Eval & Behavio	568,518	
5.	Open	60100014H	Electrofishing Boat	(4,896)	
7.	Open	60100016H	Mid-Columbia Intake Screen & Diversion Assess	102,839	
8.	Open	60100017H	JSATS Subyearling Survival Study Lower Hanfo	10,723	
9.	Open	60100018H	WAN Drawdown Migrat Study	488	
10.	Open	60100019H	Lw Wenatchee Instream Flow Ph II	456,241	
11.	Open	60100020H	Methow Valley Irrigation District Instream Flow	1,400,000	
				3,312,129 →	3,312,129
Fund 601 Unencumbered Balance					**$ 2,931,616**

Habitat Supplemental Fund 602:

Cash & Investments Fund Balance per Monthly Report					$ 5,185,517
	Less remaining balance with Open Project ID's:			Project Balance	
1.	Open	60200003H	Trinidad Creek	$ 32,149	
2.	Open	60200006H	ORRI Spawning Hab Improvement	8,570	
3.	Open	60200007H	Methow Sugar Dike Acquisition 1	15,402	
4.	Open	60200008H	Nason Ck LWP B+ Enhance	160,000	
5.	Open	60200009H	Wen Nutrient Enhance Treatment	175	
6.	Open	60200010H	Entiat Stormy Rch Phs III Acq	132,381	
7.	Open	60200012H	ORRI Construction Phase II	65,988	
9.	Open	60200014H	Shuttleworth Crk Diversion and Well Implementa	20,563	
11.	Open	60200016H	Roaring Ck Restor/Div Removal	151,577	
12.	Open	60200017H	Robinson Acquisition	5,051	
13.	Open	60200020H	Entiat Riv Cottonwood Phs 2	5,000	
14.	Open	60200021H	Barkley Irr Co. Diverson	299,380	
16.	Open	60200023H	Fish Jump Passage McIntyre	28,823	
17.	Open	60200024H	ORRI-Spawning Platforms in Penticton Channel	263,860	
18.	Open	60200025H	Primary Appraiser Land Acq & Conservation Eas	39,200	
19.	Open	60200026H	Lwr Nason Channel RM 2.4 Land	10,000	
20.	Open	60200027H	Silver Side Channel Pittag Array	123,638	
				1,361,757 →	1,361,757
Fund 602 Unencumbered Balance					**$ 3,823,760**

Habitat Fund 603:

Cash & Investments Fund Balance per Monthly Report					$ 1,202,697
	Less remaining balance with Open Project ID's:			Project Balance	
1.	Open	60300016H	Libby Ck Riparian Acquisition	64,405	
2.	Open	60300022H	White River Gage Station	7,712	
3.	Open	60300024H	Barkley Irrigation Ditch Diversion Project	13,307	
4.	Open	60300025H	Methow River 1890's Side Channel Acquisition	15,000	
5.	Open	60300026H	Okan River Discharge Monitor	64,092	
6.	Open	60300027H	Icicle IRR Pump Exch Analysis	10,042	
7.	Open	60300028H	Icicle Creek Boulder Pit Tag Array	141,724	
				316,282 →	316,282
Fund 603 Unencumbered Balance					**$ 886,415**

Total Unencumbered Balance for all PRCC Funds **$ 7,641,792**

PRCC - Habitat Funds

No Net Impact (NNI) - Fund 601

As of September 30, 2014

Activity Detail and Project Balance

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100008H	Open	601-08	Fish Screen Monitor Program			1,377,873.21

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100008H	7/9/2012	RCT00000000053545	WASHINGTON ST DEPT OF FISH & WILDLIFE		FISH SCREEN PROGRAM	$1,279.33
60100008H	8/28/2012	RCT00000000056803	WASHINGTON ST DEPT OF FISH & WILDLIFE		FISH SCREEN PROGRAM 2012	$13,009.44
60100008H	10/22/2012	RCT00000000060120	WASHINGTON ST DEPT OF FISH & WILDLIFE		FISH SCREEN MONITORING PROGRA	$21,226.09
60100008H	11/28/2012	RCT00000000065971	WASHINGTON ST DEPT OF FISH & WILDLIFE		FISH SCREEN MONITORING PROGRA	$5,756.11
60100008H	12/19/2012	RCT00000000063920	WASHINGTON ST DEPT OF FISH & WILDLIFE		301-8H	$24,811.09
60100008H	12/19/2012	RCT00000000063916	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$26,254.18
60100008H	12/31/2012	RCT00000000065812	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8 2012	$17,711.55
60100008H	12/31/2012	RCT00000000065892	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$1,485.73
60100008H	12/31/2012	RCT00000000065893	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$2,017.63
60100008H	12/31/2012	RCT00000000065807	WASHINGTON ST DEPT OF FISH & WILDLIFE		FISH SCREEN MONITORING PROGRA	$3,217.73
60100008H	2/7/2013	RCT00000000067195	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H FISH SCREEN MONITORING	$22,288.85
60100008H	3/21/2013	RCT00000000070233	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$18,690.24
60100008H	4/4/2013	RCT00000000071048	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$56,047.79
60100008H	5/1/2013	RCT00000000072948	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H FISH SCREEN MONITORING	$20,834.05
60100008H	5/15/2013	RCT00000000073824	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$7,985.66
60100008H	7/2/2013	RCT00000000076894	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$38,105.82
60100008H	7/9/2013	RCT00000000077071	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$45.49
60100008H	7/9/2013	RCT00000000077070	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$303.84
60100008H	7/9/2013	RCT00000000077069	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$218.03
60100008H	7/9/2013	RCT00000000077068	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$333.56
60100008H	7/9/2013	RCT00000000077050	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$35,777.12
60100008H	7/9/2013	RCT00000000077040	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$71.20
60100008H	7/9/2013	RCT00000000077039	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$176.34
60100008H	7/9/2013	RCT00000000077036	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$226.24
60100008H	7/9/2013	RCT00000000077038	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$80.92
60100008H	9/4/2013	RCT00000000080739	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$10,818.54
60100008H	9/4/2013	RCT00000000080741	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$241.13
60100008H	10/1/2013	RCT00000000082565	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SCREEN MONITORING	$4,244.69
60100008H	10/8/2013	RCT00000000083198	WASHINGTON ST DEPT OF FISH & WILL		601-8H	$12,190.94
60100008H	11/13/2013	RCT00000000085383	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$21,172.48
60100008H	12/11/2013	RCT00000000087463	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$24,559.60
60100008H	12/31/2013	RCT00000000088817	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$26,441.27
60100008H	2/5/2014	RCT00000000091066	WASHINGTON ST DEPT OF FISH & WILL		601-8H FISH SC	$27,263.43
60100008H	3/6/2014	RCT00000000092806	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$29,832.39
60100008H	4/8/2014	RCT00000000094921	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$40,478.31
60100008H	5/6/2014	RCT00000000096977	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$38,176.47
60100008H	6/10/2014	RCT00000000099670	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$25,340.55
60100008H	7/7/2014	RCT00000000101592	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$18,322.79
60100008H	9/8/2014	RCT00000000105823	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$27,432.90
60100008H	9/30/2014	RCT00000000107518	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-8H	$16,380.84
					Total Project Expenditures	$640,850.36
					Remaining Project Balance	**737,022.85**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100009H	Open	601-09	Juv NPM Population Control			267,306.23

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100009H	9/20/2012	RCT00000000058134	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$75,278.70
60100009H	10/4/2012	RCT00000000059082	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$822.45
60100009H	10/22/2012	RCT00000000060118	WASHINGTON ST DEPT OF FISH & WILDLIFE		JUVENILE NORTHERN PIKEMINNOW	$37,246.15
60100009H	12/20/2012	RCT00000000064040	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$23,151.27
60100009H	12/20/2012	RCT00000000064036	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$27,976.40
60100009H	12/31/2012	RCT00000000065895	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$19,284.97
60100009H	2/6/2013	RCT00000000067116	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$152.75
60100009H	2/14/2013	RCT00000000067820	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$18,197.65
60100009H	3/21/2013	RCT00000000070262	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H JUVENILE NORTHERN PIKEM	$12,600.59
60100009H	4/15/2013	RCT00000000071727	WASHINGTON ST DEPT OF FISH & WILDLIFE		601-9H	$2,191.99
60100009H	7/9/2013	RCT00000000077080	WASHINGTON ST DEPT OF FISH & WILL		601-9H JUVENILE NORTHERN PIKEM	$1,089.78
60100009H	7/9/2013	RCT00000000077059	WASHINGTON ST DEPT OF FISH & WILL		601-9H	$3,515.66
60100009H	7/9/2013	RCT00000000077060	WASHINGTON ST DEPT OF FISH & WILL		601-9H	$12,221.06
60100009H	7/9/2013	RCT00000000077061	WASHINGTON ST DEPT OF FISH & WILL		601-9H	$1,611.79
60100009H	7/9/2013	RCT00000000077062	WASHINGTON ST DEPT OF FISH & WILL		601-9H	$1,318.72
60100009H	7/9/2013	RCT00000000077072	WASHINGTON ST DEPT OF FISH & WILL		601-9H JUVENILE NORTHERN PIKEM	$1,314.24
60100009H	7/9/2013	RCT00000000077074	WASHINGTON ST DEPT OF FISH & WILL		601-9H JUVENILE NORTHERN PIKEM	$1,723.75
60100009H	7/9/2013	RCT00000000077079	WASHINGTON ST DEPT OF FISH & WILL		601-9H JUVENILE NORTHERN PIKEM	$1,792.37
60100009H	8/27/2013	ML000000000004844				($14,388.18)
					Total Project Expenditures	$227,102.11
					Remaining Project Balance	**40,204.12**

PRCC - Habitat Funds

No Net Impact (NNI) - Fund 601

As of September 30, 2014

Activity Detail and Project Balance

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100011H	Open	601-11	Geochemical Analysis S F Rays		To determine the accuracy of geochemical analysis for identifying the	513,342.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100011H	9/10/2012	RCT00000000057345	BATTELLE-NORTHWEST CORP		601-11	$16,538.22
60100011H	9/27/2012	RCT00000000058570	BATTELLE-NORTHWEST CORP		601-11H	$9,194.62
60100011H	10/25/2012	RCT00000000060477	BATTELLE-NORTHWEST CORP		601-11H	$28,084.84
60100011H	11/7/2012	RCT00000000061321	BATTELLE-NORTHWEST CORP		601-11H	$53,213.21
60100011H	1/13/2013	RCT00000000066790	BATTELLE-NORTHWEST CORP		601-11H GEOCHEMICAL ANALYSIS	$69,074.89
60100011H	2/19/2013	RCT00000000068161	BATTELLE-NORTHWEST CORP		601-11H	$58,767.38
60100011H	3/18/2013	RCT00000000069970	BATTELLE-NORTHWEST CORP		601-11H	$44,293.89
60100011H	5/2/2013	RCT00000000073003	BATTELLE-NORTHWEST CORP		601-11H ANALYSIS OF SCALES & F	$31,840.41
60100011H	5/15/2013	RCT00000000073818	BATTELLE-NORTHWEST CORP		601-11H	$42,901.80
60100011H	8/27/2013	RCT00000000080449	BATTELLE-NORTHWEST CORP		601-11H GEOCHEMICAL ANALYSIS O	$67,679.06
60100011H	8/27/2013	RCT00000000080450	BATTELLE-NORTHWEST CORP		601-11H GEOCHEMICAL ANALYSIS O	$27,756.51
60100011H	11/12/2013	RCT00000000085238	BATTELLE-NORTHWEST CORP		601-11H	$29,941.83
60100011H	2/26/2014	RCT00000000092388	BATTELLE-NORTHWEST CORP		601-11H	$8,832.27
60100011H	2/26/2014	RCT00000000092345	BATTELLE-NORTHWEST CORP		601-11H GEOCHEMICAL ANALYSIS O	$16,031.76
60100011H	2/26/2014	RCT00000000092344	BATTELLE-NORTHWEST CORP		601-11H GEOCHEMICAL ANALYSIS O	$8,201.08
					Total Project Expenditures	$512,351.77
					Remaining Project Balance	**990.23**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100012H	Open	601-12	Evaluation and Behavior Analysis of Caspian Terns on Goose Island		Study to evaluate the foraging behavior and colony connectivity of Caspian terns	1,342,977.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100012H	5/30/2013	RCT00000000074721	OUS OREGON STATE UNIVERSITY		601-12H	$16,055.14
60100012H	6/20/2013	RCT00000000076023	OUS OREGON STATE UNIVERSITY		601-12H CASPIAN TERN M & E GOO	$106,436.69
60100012H	7/24/2013	RCT00000000078363	OSU OREGON STATE UNIVERSITY		601-12H	$63,827.32
60100012H	8/14/2013	RCT00000000079591	OSU OREGON STATE UNIVERSITY		601-12H	$65,667.14
60100012H	8/26/2013	RCT00000000080258	OSU OREGON STATE UNIVERSITY		601-12H CASPIAN TERN M & E GOO	$7,623.88
60100012H	10/1/2013	RCT00000000082584	OSU OREGON STATE UNIVERSITY		601-12H	$24,641.52
60100012H	11/12/2013	RCT00000000085284	OSU OREGON STATE UNIVERSITY		601-12H CASPIAN TERN M & E GOO	$38,409.96
60100012H	12/31/2013	RCT00000000088819	OSU OREGON STATE UNIVERSITY		601-12H	$26,173.84
60100012H	3/17/2014	RCT00000000093591	OSU OREGON STATE UNIVERSITY		601-12H	$8,510.17
60100012H	3/17/2014	RCT00000000093589	OSU OREGON STATE UNIVERSITY		601-12H	$32,142.36
60100012H	3/19/2014	RCT00000000093707	OSU OREGON STATE UNIVERSITY		601-12H CASPIAN TERN M & E GOO	$17,864.13
60100012H	5/28/2014	RCT00000000098928	OSU OREGON STATE UNIVERSITY		601-12H	$145,721.58
60100012H	6/17/2014	RCT00000000100291	OSU OREGON STATE UNIVERSITY		601-12H	$71,643.42
60100012H	7/1/2014	RCT00000000101374	OSU OREGON STATE UNIVERSITY		601-12H	$50,308.63
60100012H	8/13/2014	RCT00000000104237	OSU OREGON STATE UNIVERSITY		601-12H	$87,062.47
60100012H	8/25/2014	RCT00000000104875	OSU OREGON STATE UNIVERSITY		601-12H	$12,371.11
					Total Project Expenditures	$774,459.36
					Remaining Project Balance	**568,517.64**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100014H	Open	601-14	Electrofishing Boat			125,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100014H	6/12/2014	RCT00000000099933	MIDWEST LAKE MANAGEMENT, INC		601-14H	$120,351.00
60100014H	7/1/2014	RCT00000000101313	WA ST DEPT OF LICENSING-GRANT COUNTY		601-14H	$9,545.48
					Total Project Expenditures	$129,896.48
					Remaining Project Balance	**(4,896.48)**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100016H	Open	601-16	Mid-Columbia Intake Screen & Diversion Assessment			102,838.58

Project Expenditure Activity:

PRCC - Habitat Funds

No Net Impact (NNI) - Fund 601

As of September 30, 2014

Activity Detail and Project Balance

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100016H	9/8/2014	RCT00000000105827	TROUT UNLIMITED - WASH. WATER PROJECT		601-15H	$588.67
					Total Project Expenditures	$0.00
					Remaining Project Balance	**102,838.58**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100017H	Open	601-17	JSATS Subyearling Survival Study Lower Hanford Reach			79,906.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100017H	3/20/2014	RCT00000000093811	BATTELLE-NORTHWEST CORP		JSATS SURVIVAL STUDY LOWER HA	$39,953.00
60100017H	6/24/2014	RCT00000000100885	BATTELLE-NORTHWEST CORP		601-17H	$29,229.79
					Total Project Expenditures	$69,182.79
					Remaining Project Balance	**10,723.21**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100018H	Open	601-18	WAN Drawdown Migrat Study			225,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60100018H	5/28/2014	RCT00000000098756	BLUE LEAF ENVIRONMENTAL, INC			$19,096.41
60100018H	5/28/2014	RCT00000000098755	BLUE LEAF ENVIRONMENTAL, INC			$23,174.40
60100018H	6/3/2014	RCT00000000099120	SKALSKI STATISTICAL SERVICES			$1,864.20
60100018H	7/1/2014	RCT00000000101334	BLUE LEAF ENVIRONMENTAL, INC			$18,260.03
60100018H	7/22/2014	RCT00000000102724	BLUE LEAF ENVIRONMENTAL, INC			$27,288.28
60100018H	7/1/2014	RCT00000000101332	BLUE LEAF ENVIRONMENTAL, INC			$38,830.01
60100018H	7/29/2014	RCT00000000103168	BLUE LEAF ENVIRONMENTAL, INC			$94,970.87
60100018H	8/5/2014	RCT00000000103699	BLUE LEAF ENVIRONMENTAL, INC			$1,027.93
					Total Project Expenditures	$224,512.13
					Remaining Project Balance	**487.87**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100019H	Open	601-19	Lw Wenatchee Instream Flow Ph II			456,241.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
					Total Project Expenditures	$0.00
					Remaining Project Balance	**456,241.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60100020H	Open	601-20	Methow Valley Irrigation District Instream Flow Improvement Project			1,400,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
					Total Project Expenditures	$0.00
					Remaining Project Balance	**1,400,000.00**

PRCC - Habitat Funds

Habitat Supplemental - Fund 602

As of September 30, 2014

Activity Detail and Project Balance

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200003H	Open	602-03	Trinidad Creek Land Purchase	WDFW	63 acres of shrub steppe land purchase	117,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200003H	7/29/2010	RCT00000000011359	WASHINGTON ST DEPT OF FISH & WILDLIFE		TRINIDAD CREEK	$6,019.88
60200003H	10/5/2010	RCT00000000015264	WASHINGTON ST DEPT OF FISH & WILDLIFE		TRINIDAD CREEK ACQUISITION-CR	$124.19
60200003H	10/5/2010	RCT00000000015263	WASHINGTON ST DEPT OF FISH & WILDLIFE		TRINIDAD CREEK ACQUISITION	$1,733.12
60200003H	11/4/2010	RCT00000000017797	WASHINGTON ST DEPT OF FISH & WILDLIFE		TRINIDAD CREEK/CRESCENT VIEW	$837.85
60200003H	11/12/2010	RCT00000000018637	WASHINGTON ST DEPT OF FISH & WILDLIFE		HABITAT 603-14	$11.26
60200003H	11/12/2010	RCT00000000018632	WASHINGTON ST DEPT OF FISH & WILDLIFE		ENVIRONMENTAL AUDIT	$1,375.81
60200003H	7/28/2011	RCT00000000033309	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-14H TRINIDAD CREEK	$1,363.70
60200003H	11/17/2011	RCT00000000039958	WASHINGTON ST DEPT OF FISH & WILDLIFE		CRESCENT VIEW ESTATES	$1,363.79
60200003H	11/17/2011	RCT00000000039959	WASHINGTON ST DEPT OF FISH & WILDLIFE		CRESCENT VIEW ESTATES	$4,938.99
60200003H	12/31/2011	RCT00000000042888	WASHINGTON ST DEPT OF FISH & WILDLIFE		NOV-11 TRINIDAD CREEK ACQUISIT	$611.10
60200003H	12/31/2011	RCT00000000042918	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-14	$677.18
60200003H	2/15/2012	RCT00000000044747	WASHINGTON ST DEPT OF FISH & WILDLIFE		ACQUISITION T CREEK/ C VIEW ES	$622.25
60200003H	3/8/2012	RCT00000000045996	WASHINGTON ST DEPT OF FISH & WILDLIFE		456,241.00	$53,613.50
60200003H	4/5/2012	RCT00000000047730	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-14	$1,321.98
60200003H	5/2/2012	RCT00000000049429	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-14 TRINIDAD CREEK ACQUISIT	$140.69
					Total Project Expenditures	$84,851.44
					Remaining Project Balance	**32,148.56**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200006H	Open	602-06	ORRI Spawning Hab Improvement	ONA	Okanogan River in BC	65,141.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200006H	10/3/2012	RCT00000000058957	OKANAGAN NATION ALLIANCE		HFA 602-6	$2,576.02
60200006H	3/26/2013	RCT00000000070529	OKANAGAN NATION ALLIANCE		FEB-13 OKANAGAN RIVER VERTICA	$481.82
60200006H	12/18/2013	RCT00000000087910	OKANAGAN NATION ALLIANCE		602-6 OKANAGAN RIVER VERTICAL	$2,710.29
60200006H	12/23/2013	RCT00000000088207	OKANAGAN NATION ALLIANCE		602-6H	$42,518.87
60200006H	3/7/2014	RCT00000000092941	OKANAGAN NATION ALLIANCE		602-6H	$82.11
60200006H	5/15/2014	RCT00000000097769	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.		602-6H	$4,976.02
60200006H	7/11/2014	RCT00000000101991	OKANAGAN NATION ALLIANCE		602-6H	$252.05
					Total Project Expenditures	$56,570.93
					Remaining Project Balance	**8,570.07**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200007H	Open	602-07	Methow Sugar Dike Acquisition 1	Methow Salmor	Purchase 10.4 acre parcel lower segment M	190,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200007H	8/31/2011	RCT00000000035447	BAINES TITLE & ESCROW		HFA-6027H METHOW DIKE ACQUISI	$168,366.48
60200007H	5/24/2012	RCT00000000050829	METHOW SALMON RECOVERY FNDN		602-7 ACQUISITION	$3,016.73
60200007H	10/2/2012	RCT00000000058851	METHOW SALMON RECOVERY FNDN		602-7H	$2,747.11
60200007H	8/7/2013	RCT00000000079172	METHOW SALMON RECOVERY FNDN		602-7H METHOW SUGAR DIKE ACQU	$148.50
60200007H	5/20/2014	RCT00000000098095	METHOW SALMON RECOVERY FNDN		602-7	$319.00
					Total Project Expenditures	174,597.82
					Remaining Project Balance	**15,402.18**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200008H	Open	602-8	Nason Ck LWP B+ Enhance	Chelan PUD NF	Design and permitting of an in-stream vor	160,000.00

PRCC - Habitat Funds

Habitat Supplemental - Fund 602

As of September 30, 2014

Activity Detail and Project Balance

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount

Total Project Expenditures -

Remaining Project Balance 160,000.00

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200009H	Open	602-09	Wen Nutrient Enhance Treatment			120,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200009H	9/27/2012	RCT00000000058569	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9H NUTRIENT ENHANCEMENT	$19,953.56
60200009H	11/1/2012	RCT00000000060926	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9H WENATCHEE NUTRIENT ENH	$14,443.55
60200009H	12/27/2012	RCT00000000064512	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9H	$10,526.87
60200009H	12/30/2012	RCT00000000064706	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9H	$9,570.92
60200009H	3/4/2013	RCT00000000068856	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9 WENATCHEE NUTRIENT ENHA	$8,048.58
60200009H	4/4/2013	RCT00000000071028	CASCADE COLUMBIA FISHERIES ENHC GRP		602-9 WENATCHEE NUTRIENT ENHA	$7,623.87
60200009H	6/6/2013	RCT00000000075154	CASCADE COLUMBIA FISHERIES ENHC		602-9	$9,316.85
60200009H	6/27/2013	RCT00000000076523	CASCADE COLUMBIA FISHERIES ENHC		602-9	$13,231.82
60200009H	7/24/2013	RCT00000000078296	CASCADE COLUMBIA FISHERIES ENHC		602-9H WENATCHEE NUTRIENT ENH	$5,144.75
60200009H	9/25/2013	RCT00000000082163	CASCADE COLUMBIA FISHERIES ENHC		WENATCHEE NUTRIENT ASSESSME	$8,800.75
60200009H	11/4/2013	RCT00000000084775	CASCADE COLUMBIA FISHERIES ENHC GRP		602.9H WENATCHEE NUTRIENT ENH	$13,163.51

Total Project Expenditures $119,825.03

Remaining Project Balance 174.97

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200010H	Open	602-10	Eniat Stormy Rch Phs III Acq			711,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200010H	3/14/2013	RCT00000000069772	CHELAN-DOUGLAS LAND TRUST		ENTIAT STORMY REACH PHASE 3	$3,083.27
60200010H	6/19/2013	RCT00000000075844	CHELAN-DOUGLAS LAND TRUST		602-10H ENTIAT STORMY REACH PH	$3,633.52
60200010H	12/23/2013	RCT00000000088193	CHELAN-DOUGLAS LAND TRUST		602-10H ENTIAT STORMY REACH PH	$11,402.78
60200010H	4/28/2014	RCT00000000096514	CHELAN-DOUGLAS LAND TRUST		602-10H	$1,142.63
60200010H	4/28/2014	RCT00000000096506	CHELAN-DOUGLAS LAND TRUST		602-10H	$3,772.53
60200010H	7/8/2014	RCT00000000101807	CHELAN-DOUGLAS LAND TRUST		602-10H	$10,000.00
60200010H	7/15/2014	RCT00000000102229	CHELAN-DOUGLAS LAND TRUST		602-10H	$10,372.59
60200010H	7/8/2014	RCT00000000101808	CHELAN-DOUGLAS LAND TRUST		602-10H	$535,211.32

Total Project Expenditures 578,618.64

Remaining Project Balance 132,381.36

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200012H	Open	602-12	ORRI Construction Phase II			599,588.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200012H	9/6/2012	RCT00000000057240	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.		HFA 602-12H	$975.43
60200012H	9/18/2013	RCT00000000081732	OKANAGAN NATION ALLIANCE		602-12H OKANAGAN RIVER RESTOR	$5,546.52
60200012H	9/25/2013	RCT00000000082349	OKANAGAN NATION ALLIANCE		602-12H OKANAGAN RIVER RESTOR	$89,953.92
60200012H	9/25/2013	RCT00000000082352	OKANAGAN NATION ALLIANCE		602-12H OKANAGAN RIVER RESTOR	$15,700.57
60200012H	10/8/2013	RCT00000000083144	OKANAGAN NATION ALLIANCE		602-12H	$108,619.11
60200012H	10/15/2013	RCT00000000083574	OKANAGAN NATION ALLIANCE		602-12H	$104,665.35
60200012H	11/12/2013	RCT00000000085285	OKANAGAN NATION ALLIANCE		602-12H OKANAGAN RIVER RESTOR	$2,614.78

PRCC - Habitat Funds

Habitat Supplemental - Fund 602

As of September 30, 2014

Activity Detail and Project Balance

60200012H	11/20/2013	RCT00000000085968	OKANAGAN NATION ALLIANCE	601-124	$141,814.27
60200012H	12/31/2013	RCT00000000089775	OKANAGAN NATION ALLIANCE	602-12H OKANAGAN RIVER RESTOR	$4,650.90
60200012H	12/31/2013	RCT00000000089691	OKANAGAN NATION ALLIANCE	602-12H	$26,273.03
60200012H	3/7/2014	RCT00000000092942	OKANAGAN NATION ALLIANCE	602-12H	$13,258.07
60200012H	5/15/2014	RCT00000000097768	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.	602-12H	$7,980.10
60200012H	6/17/2014	RCT00000000100278	OKANAGAN NATION ALLIANCE	602-12H	$882.57
60200012H	7/11/2014	RCT00000000101992	OKANAGAN NATION ALLIANCE	602-12H	$3,227.66
60200012H	8/12/2014	RCT00000000104189	OKANAGAN NATION ALLIANCE	602-12H	$4,428.19
60200012H	9/23/2014	RCT00000000106941	OKANAGAN NATION ALLIANCE	602-12H	$3,009.49
				Total Project Expenditures	$533,599.96
				Remaining Project Balance	**65,988.04**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200014H	Open	602-14	Shuttleworth Ck Diversion/Well			477,230.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200014H	11/7/2012	RCT00000000061325	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.		602-14H	$4,272.27
60200014H	11/26/2012	RCT00000000062444	OKANAGAN NATION ALLIANCE		602-14H SHUTTLEWORTH CREEK DI	$39,412.89
60200014H	12/10/2012	RCT00000000063308	OKANAGAN NATION ALLIANCE		SHUTTLEWORTH CREEK DIVERSIOI	$3,846.99
60200014H	12/27/2012	RCT00000000064481	OKANAGAN NATION ALLIANCE		SHUTTLEWORTH CREEK DIVERSIOI	$116,699.77
60200014H	12/30/2012	RCT00000000064709	OKANAGAN NATION ALLIANCE		SHUTTLEWORTH CREEK DIVERSIOI	$59,159.92
60200014H	1/23/2013	RCT00000000066264	OKANAGAN NATION ALLIANCE		602-14H SHUTTLEWORTH CREEK DI	$225.92
60200014H	2/27/2013	RCT00000000068657	OKANAGAN NATION ALLIANCE		602-14H	$13,824.93
60200014H	3/20/2013	RCT00000000070194	OKANAGAN NATION ALLIANCE		302-14H SHUTTLEWORTH CREEK DI	$6,733.07
60200014H	4/4/2013	RCT00000000071050	OKANAGAN NATION ALLIANCE		302-14H SHUTTLEWORTH CREEK DI	$18,770.05
60200014H	5/16/2013	RCT00000000073947	OKANAGAN NATION ALLIANCE		678-010 MAR-13 SHUTTLEWORTH CI	$30,912.15
60200014H	6/18/2013	RCT00000000075738	OKANAGAN NATION ALLIANCE		SHUTTLEWORTH CREEK DIVERSIOI	$2,966.69
60200014H	7/12/2013	RCT00000000077484	OKANAGAN NATION ALLIANCE		602-14H SHUTTLEWORTH CREEK DI	$4,664.18
60200014H	9/18/2013	RCT00000000081731	OKANAGAN NATION ALLIANCE		678-013 JUL-13 SHUTTLEWORTH CR	$5,862.34
60200014H	10/2/2013	RCT00000000082697	OKANAGAN NATION ALLIANCE		602-14H	$1,761.06
60200014H	12/18/2013	RCT00000000087909	OKANAGAN NATION ALLIANCE		678-015 OCT-13 SHUTTLEWORK CRD	$8,158.03
60200014H	12/23/2013	RCT00000000088076	OKANAGAN NATION ALLIANCE		602-14H SHUTTLEWORTH CREEK DI	$0.90
60200014H	12/31/2013	RCT00000000089689	OKANAGAN NATION ALLIANCE		602-14H	$3,369.18
60200014H	6/24/2014	RCT00000000100734	OKANAGAN NATION AQUATIC ENTERPRISES, LTD.		602-14H	$69,490.27
60200014H	6/17/2014	RCT00000000100277	OKANAGAN NATION ALLIANCE		602-14H	$41,787.06
60200014H	8/12/2014	RCT00000000104188	OKANAGAN NATION ALLIANCE		602-14H	$24,508.75
60200014H	9/23/2014	RCT00000000107071	OKANAGAN NATION ALLIANCE		602-14H	$240.49
					Total Project Expenditures	$456,666.91
					Remaining Project Balance	**20,563.09**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200016H	Open	602-16	Roaring Ck Restor/Div Removal			160,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200016H	9/18/2013	RCT00000000081693	TROUT UNLIMITED - WASH. WATER PR		602-16H	$846.00
60200016H	12/18/2013	RCT00000000087908	TROUT UNLIMITED - WASH. WATER PROJECT		602-16 ROARING CREEK FLOW REST	$3,287.26
60200016H	2/19/2014	RCT00000000091911	TROUT UNLIMITED - WASH. WATER PR		602-16H	$708.73
60200016H	4/28/2014	RCT00000000096525	TROUT UNLIMITED - WASH. WATER PR		602-16H	$2,400.00
60200016H	5/20/2014	RCT00000000098123	TROUT UNLIMITED - WASH. WATER PR		602-16H	$1,181.30
					Total Project Expenditures	8,423.29
					Remaining Project Balance	**151,576.71**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200017H	Open	602-17	Robinson Acquisition		For the purchase of 18 acres including abo	270,065.00

Project Expenditure Activity:

PRCC - Habitat Funds

Habitat Supplemental - Fund 602

As of September 30, 2014

Activity Detail and Project Balance

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200017H	6/25/2013	RCT00000000076270	INLAND PROFESSIONAL TITLE, LLC		ROBINSON LAND ACQUISITION	$257,466.96
60200017H	8/7/2013	RCT00000000079220	METHOW SALMON RECOVERY FNDN		602-17H ROBINSON LAND ACQUISIT	$4,036.50
60200017H	1/22/2014	RCT00000000090167	METHOW SALMON RECOVERY FNDN		602-17H	$241.50
60200017H	9/2/2014	RCT00000000105486	METHOW SALMON RECOVERY FNDN		602-17H	$3,269.44
					Total Project Expenditures	$265,014.40
					Remaining Project Balance	**5,050.60**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200020H	Open	602-20	Entiat Riv Cottonwood Phs 2			10,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200020H	2/26/2014	RCT00000000092308	CHELAN-DOUGLAS LAND TRUST		602-20H	$5,000.00
					Total Project Expenditures	5,000.00
					Remaining Project Balance	**5,000.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200021H	Open	602-21	Barkley Irr Co. Diverson			299,380.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
					Total Project Expenditures	-
					Remaining Project Balance	**299,380.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200023H	Open	602-23	Fish Jump Passage McIntyre			32,940.60

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200023H	9/23/2014	RCT000000000107070	OKANAGAN NATION ALLIANCE		602-23H	$4,117.48

PRCC - Habitat Funds

Habitat Supplemental - Fund 602

As of September 30, 2014

Activity Detail and Project Balance

Total Project Expenditures	$4,117.48
Remaining Project Balance	**28,823.12**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200024H	Open	602-24	ORRI-Spawning Platforms in Penticton Channel			391,200.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200024H	7/15/2014	RCT000000000102251	OKANAGAN NATION ALLIANCE		602-24H	$33,572.50
60200024H	9/23/2014	RCT000000000107067	OKANAGAN NATION ALLIANCE		602-24H	$36,732.97
60200024H	9/23/2014	RCT000000000107069	OKANAGAN NATION ALLIANCE		602-24H	$57,034.78

Total Project Expenditures	127,340.25
Remaining Project Balance	**263,859.75**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200025H	Open	602-25	Primary Appraiser Land Acq & Conservation Ease			50,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60200025H	9/23/2014	RCT000000000106943	CASCADE CHELAN APPRAISAL, INC		602-25H	$10,800.00

Total Project Expenditures	$10,800.00
Remaining Project Balance	**39,200.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200026H	Open	602-26	Lwr Nason Channel RM 2.4 Land			10,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount

Total Project Expenditures	-
Remaining Project Balance	**10,000.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60200027H	Open	602-27	Silver Side Channel Pittag Array			123,638.30

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount

Total Project Expenditures	-
Remaining Project Balance	**123,638.30**

PRCC - Habitat Funds

Habitat Supplemental - Fund 603

As of September 30, 2014

Activity Detail and Project Balance

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300016H	Open	603-16	Libby Ck Riparian Acquisition	WDFW	18.5 acres on Libby Creek, Methow basin	206,600.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300016H	10/7/2010	RCT00000000015539	WASHINGTON ST DEPT OF FISH & WILDLIFE		PR HABITAT CONSERVATION-LIBBY	$714.92
60300016H	11/4/2010	RCT00000000017798	WASHINGTON ST DEPT OF FISH & WILDLIFE		PR HABITAT CONSV.LIBBY CREEK	$489.56
60300016H	11/4/2010	RCT00000000017800	WASHINGTON ST DEPT OF FISH & WILDLIFE		PR HABITAT CONSERVATION-LIBBY	$643.96
60300016H	11/12/2010	RCT00000000018635	WASHINGTON ST DEPT OF FISH & WILDLIFE		LIBBY CREEK HABITAT	$5,731.52
60300016H	12/31/2010	RCT00000000021924	WASHINGTON ST DEPT OF FISH & WILDLIFE		LIBBY CREEK HABITAT	$258.23
60300016H	12/31/2010	RCT00000000021454	WASHINGTON ST DEPT OF FISH & WILDLIFE		LIBBY CREEK HABITAT	$2,053.16
60300016H	2/23/2011	RCT00000000024036	WASHINGTON ST DEPT OF FISH & WILDLIFE		LIBBY CREEK	$130,387.58
60300016H	7/22/2011	RCT00000000033027	WASHINGTON ST DEPT OF FISH & WILDLIFE		LOWER LIBBY CREEK	$189.08
60300016H	8/31/2011	RCT00000000035330	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-16 LIBBY CREEK JUN-11	$521.61
60300016H	12/19/2012	RCT00000000063918	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-164	$334.18
60300016H	2/5/2014	RCT00000000091068	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-16H	$408.51
60300016H	7/7/2014	RCT00000000101594	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-16H	$23.81
					456,241.00 al Project Expenditures	$142,195.15
					Remaining Project Balance	**64,404.85**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300022H	Open	603-22	White River Gage Station			22,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300022H	10/25/2012	RCT00000000060464	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$103.09
60300022H	11/19/2012	RCT00000000062010	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$115.98
60300022H	1/24/2013	RCT00000000066317	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$343.86
60300022H	3/5/2013	RCT00000000068904	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$181.18
60300022H	5/1/2013	RCT00000000072960	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$811.71
60300022H	6/26/2013	RCT00000000076515	WASHINGTON ST DEPT OF ECOLOGY		603-22H WHITE RIVER GAGE STAT	$354.48
60300022H	7/29/2013	RCT00000000078501	WASHINGTON ST DEPT OF ECOLOGY		603-22 WHITE RIVER GAGE STATIO	$360.76
60300022H	8/14/2013	RCT00000000079600	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$249.34
60300022H	11/4/2013	RCT00000000084776	WASHINGTON ST DEPT OF ECOLOGY		603-22 WHITE RIVER GAGE STATIO	$571.21
60300022H	12/31/2013	RCT00000000088821	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$671.76
60300022H	1/22/2014	RCT00000000090183	WASHINGTON ST DEPT OF ECOLOGY		603.22H WHITE	$13.82
60300022H	2/26/2014	RCT00000000092387	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$3,233.43
60300022H	3/17/2014	RCT00000000093607	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$1,081.97
60300022H	4/28/2014	RCT00000000096536	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$1,655.10
60300022H	5/20/2014	RCT00000000098092	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$1,336.73
60300022H	6/23/2014	RCT00000000100593	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$748.43
60300022H	7/28/2014	RCT00000000103097	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$647.59
60300022H	9/9/2014	RCT00000000105973	WASHINGTON ST DEPT OF ECOLOGY		603-22H	$1,807.75
					Total Project Expenditures	$14,288.19
					Remaining Project Balance	**7,711.81**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300024H	Open	603-24	Barkley Irrigation Diversion			220,866.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300024H	10/24/2012	RCT00000000060356	TROUT UNLIMITED - WASH. WATER PROJECT		BARKLEY IRRIGATION DITCH DIVE	$168,288.39
60300024H	12/6/2012	RCT00000000063151	TROUT UNLIMITED - WASH. WATER PROJECT		BARKLEY IRRIGATION DITCH DIVE	$2,018.22
60300024H	12/21/2012	RCT00000000064115	TROUT UNLIMITED - WASH. WATER PROJECT		603-24 BARKLEY IRRIG DITCH DIV	$1,294.58
60300024H	10/24/2013	RCT00000000084177	TROUT UNLIMITED - WASH. WATER PROJECT		603-24H	$28,036.95

PRCC - Habitat Funds

Habitat Supplemental - Fund 603

As of September 30, 2014

Activity Detail and Project Balance

60300024H	12/18/2013	RCT00000000087930	TROUT UNLIMITED - WASH. WATER PROJECT	603-24H	$3,999.91
60300024H	9/23/2014	RCT00000000107064	TROUT UNLIMITED - WASH. WATER PROJECT	603-24H	$3,920.59
				Total Project Expenditures	$207,558.64
				Remaining Project Balance	**13,307.36**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300025H	Open	603-25	Methow River 1890's Side Channel Acquisition			90,000.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300025H	9/2/2014	RCT00000000105491	CONFEDERATED TRIBES & BANDS OF THE YAKAMA N		603-25H	$75,000.00
					Total Project Expenditures	$75,000.00
					Remaining Project Balance	**15,000.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300026H	Open	603-26	Okan River Discharge Monitor		0	90,952.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300026H	5/9/2014	RCT00000000097360	COLVILLE CONFEDERATED TRIBES		603-26H	$13,430.00
60300026H	6/17/2014	RCT00000000100280	COLVILLE CONFEDERATED TRIBES		603-26H	$13,430.00
					Total Project Expenditures	$26,860.00
					Remaining Project Balance	**64,092.00**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount
60300027H	Open	603-27	Icicle IRR Pump Exch Analysis		To determine the feasibility, of constructing additional pumping	174,847.00

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300027H	12/18/2013	RCT00000000087932	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$9,960.00
60300027H	12/31/2013	RCT00000000089688	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$38,682.11
60300027H	2/19/2014	RCT00000000091872	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H ICICLE-PESHASTIN IRRIG	$4,285.00
60300027H	3/17/2014	RCT00000000093598	TROUT UNLIMITED - WASH. WATER PROJECT		ICICLE-PESHASTIN ANALYSIS FOR	$12,720.00
60300027H	4/28/2014	RCT00000000096537	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$30,006.90
60300027H	5/20/2014	RCT00000000098121	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$21,630.00
60300027H	6/17/2014	RCT00000000100298	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$17,733.75
60300027H	7/29/2014	RCT00000000103144	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$13,443.75
60300027H	8/15/2014	RCT00000000104443	TROUT UNLIMITED - WASH. WATER PROJECT		603-27H	$16,343.00
					Total Project Expenditures	$164,804.51
					Remaining Project Balance	**10,042.49**

PID	Status	HCFA	Name/Description	Contractor	Description	Project Budget Amount

PRCC - Habitat Funds

Habitat Supplemental - Fund 603

As of September 30, 2014

Activity Detail and Project Balance

60300028H	Open	603-28	Icicle Creek Boulder Pit Tag Array		0	167,097.87

Project Expenditure Activity:

Project ID	Acctg Date	Voucher / PA Document No.	Vendor Name	Invoice Ref	Item Description	Expenditure Amount
60300028H	7/15/2014	RCT00000000102230	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-28H	$213.01
60300028H	9/9/2014	RCT00000000105984	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-28H	$11,331.77
60300028H	9/30/2014	RCT00000000107519	WASHINGTON ST DEPT OF FISH & WILDLIFE		603-28H	$13,829.40
					Total Project Expenditures	$25,374.18
					Remaining Project Balance	**141,723.69**

BioAnalysts, Inc.
4725 N. Cloverdale Rd.
Suite 102
Boise, Idaho 83713
Phone: 208.321.0363
Fax: 208.321.0364

Memorandum

To: Denny Rohr

From: Tracy Hillman

Date: 17 October 2014

Re: FCWG Meeting Progress Report

The Fall Chinook Working Group (FCWG) met at Grant PUD in Ephrata, WA, on Tuesday, 7 October from 10:00 am to 12:00 pm.

Wanapum Dam Issues

- Grant PUD gave a brief update on the status of Wanapum Dam. The update described the successful passage of fish, ongoing cleaning of aquatic vegetation and other debris from the pump screens, evaluation of adult Pacific lamprey passage including adult lamprey trap and haul, and the status of installation of tendons in the monolith piers. They also explained the interim pool raise proposal, which needs to be approved by the Board of Consultants and FERC. The hope is to raise the pool to 558-562 feet later this year.

Final Report and Implementation Feasibility Study/Implementation Feasibility Plan

- Consistent with the 401 reporting requirements, Grant PUD is preparing a final report for Ecology that includes the investigation of reasonable and feasible measures to avoid, reduce, or mitigate for adverse effects (Implementation Feasibility Study; IFS) and a plan to implement approved measures (Implementation Feasibility Plan; IFP). A draft of the final report will be available for review in November. The FCWG will have 90 days to review the report. The final report will be submitted to Ecology and FERC in April 2015.
- Grant PUD described their analyses of juvenile fall Chinook stranded or entrapped in the Hanford Reach. They used two different models: zero inflation models and hurdle models. Although both models identified similar factors affecting the occurrence and number of fish entrapped, the models explained a small percentage of the variability in the entrapment data. Grant PUD will describe the analyses and modeling results in the final report.
- The FCWG has approved the outline for the final report and support the recommendations for assessing density dependence in the Hanford Reach. They also supported the analyses of stranding and entrapment data.

Hanford Reach Working Group Updates

- The Hanford Reach Annual Report is going through internal review. A draft report will be available for review by the FCWG/HRWG by 10 October 2014.
- Volunteers are needed to help capture untagged fall Chinook from the Hanford Reach on 24-26 October. The goal is to collect 500 untagged Chinook using hook-and-line gear.
- The HRWG found no need for a tour of the Reach this year.

2014 Return-Year Studies and Funding Opportunities

- The FCWG discussed different studies that could be conducted to address density dependence, which is likely to occur this year with the projected high escapement of adult fall Chinook to the Hanford Reach. The Alaska Department of Fish and Game has agreed to fund part of a redd superimposition study. Proposals by Mainstem Research and Pacific Northwest National Laboratory were developed to investigate predation in the McNary reservoir and the effect of superimposition on emergence timing. The proposals were submitted to the Northern Fund. Ecosystem Insights and WDFW developed a proposal to analyze otoliths to investigate limiting factors. The proposal will be submitted through the LOA process.

Next Steps

The FCWG will next meet on Tuesday, 4 November 2014 at Grant PUD in Ephrata, WA.

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Suite 102
Boise, Idaho 83713
Phone: 208.321.0363
Fax: 208.321.0364

Memorandum

To: Denny Rohr

From: Tracy Hillman

Date: 17 October 2014

Re: PRFF Meeting Progress Report

The Priest Rapids Fish Forum (PRFF) met at Grant PUD Natural Resources Office in Wenatchee, WA, on Wednesday, 1 October 2014, from 9:00 am to 12:00 pm.

Wanapum Dam Issues

- Grant PUD provided an update on issues at Wanapum Dam. The update described the successful passage of fish, ongoing cleaning of aquatic vegetation from the pump screens, evaluation of adult Pacific lamprey passage including adult lamprey trap and haul, and the status of installation of tendons in the monolith piers. Grant PUD has proposed an interim pool elevation of 558 to 562 feet for later this year. The proposal has to be approved by the Board of Consultants and FERC.

White Sturgeon Updates

- The remaining 2,168 juvenile sturgeon at Marion Drain from the 2013 brood year were tagged and then released into the Priest Rapids Project Area. Thus, a total of 6,500 juvenile sturgeon were released into the Project Area in 2014.
- Last month, WDFW provided the PRFF with a revised proposal on the number of juvenile white sturgeon to release into the Project Area in 2015. The PRFF approved the proposal unanimously. Although the Yakama Nation supported the proposal, they reiterated their concerns with basing releases on numbers of half-sibling families.
- Juvenile sturgeon rearing at Marion Drain and at WDFW facilities from the 2014 brood year are doing well. The first culling and health sampling was completed at the WDFW facilities.
- The Colville Tribes have been conducting sturgeon index surveys in the Priest Rapids Project Area. They completed surveys in the Priest Rapids and Wanapum reservoirs. In total, they captured 364 sturgeon. Brood year 2010 sturgeon released from the Chelan PUD hatchery program were captured in Wanapum Pool (n = 17 sturgeon) and in Priest Rapids Pool (n = 2 sturgeon). No entrained fish from the releases of 2012 or 2013 brood years were collected in the Project Area.

Pacific Lamprey Updates

- The PRFF Pacific Lamprey Subcommittee met on Wednesday, 17 September to discuss possible actions to implement over the next few years to address NNI. Grant PUD is entertaining the continuation of adult lamprey trapping for translocation and research if it contributes to their NNI obligations. Grant PUD will meet with the Yakama Nation in two or three weeks to further discuss NNI actions.

- Trap and haul activities at Priest Rapids and Wanapum dams ended on 1 October. About 2,463 adult lamprey were trapped and transported upstream from Rock Island Dam. Most adult lamprey were captured in mechanized traps.
- Approximately 133 unique PIT-tagged adult lamprey have been detected at Priest Rapids Dam. These fish were tagged downstream in the Columbia River. Two of the fish overwintered below Priest Rapids Dam. About 92% (123 fish) of the tagged fish passed Priest Rapids Dam. Of the 123 fish passing Priest Rapids Dam, 116 were detected at Wanapum Dam and 67 of these passed Wanapum Dam. The remaining 49 fish are still in the Wanapum adult ladders (most in the left-bank ladder).
- Local experts will continue to meet to fill out templates for the Pacific Lamprey Regional Implementation Planning process. Templates for all Upper Columbia areas except the Methow and Okanogan have been completed.
- Grant PUD reported that they will provide the PRFF with a draft report later this year on their assessment of benthic organisms stranded in Wanapum Reservoir due to water level reductions.

Aquatic Invasive Species

- The New Zealand Mudsnail has been documented in the Ringold Hatchery. WDFW is working at eradicating the mudsnail from the hatchery. That may be difficult given that the mudsnails are in the springs that feed the hatchery. No New Zealand mudsnails were identified during the intensive sampling in Wanapum Reservoir after it was lowered.

Next Steps

The next meeting of the PRFF will be on Wednesday, 5 November 2014 at Grant PUD in Wenatchee, WA.

PRCC-HCP Briefing

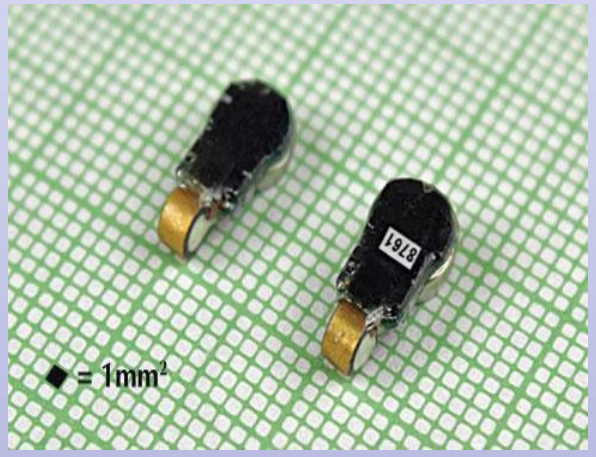
November 3, 2014

Grant County
PUBLIC UTILITY DISTRICT
Excellence in Service and Leadership

Steelhead and Yearling Chinook Acoustic Tag Study

LOTEK *Model L-AMT-1.421*

acoustic transmitters



Biomark HDX12

12 mm PIT tags

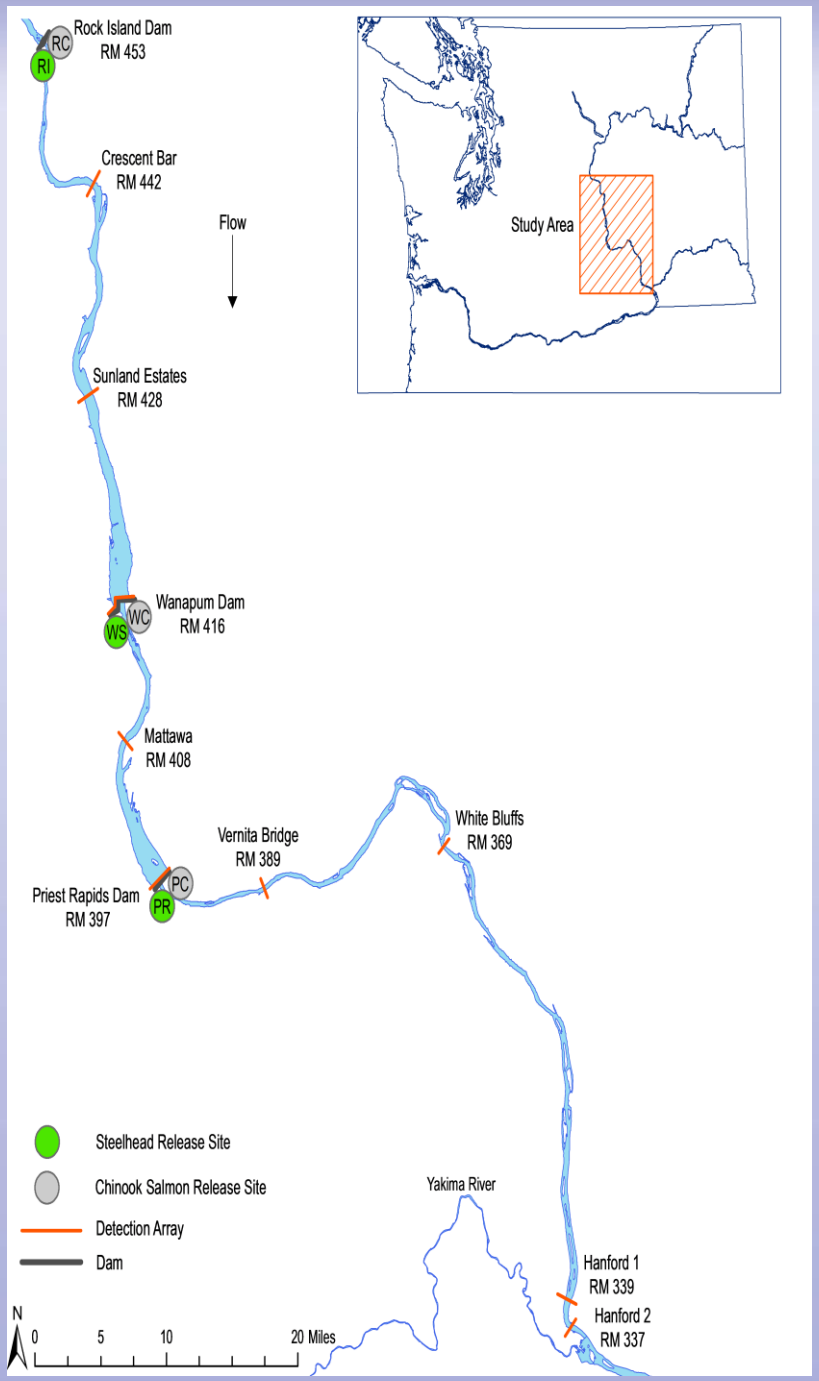
Teknologic

Autonomous

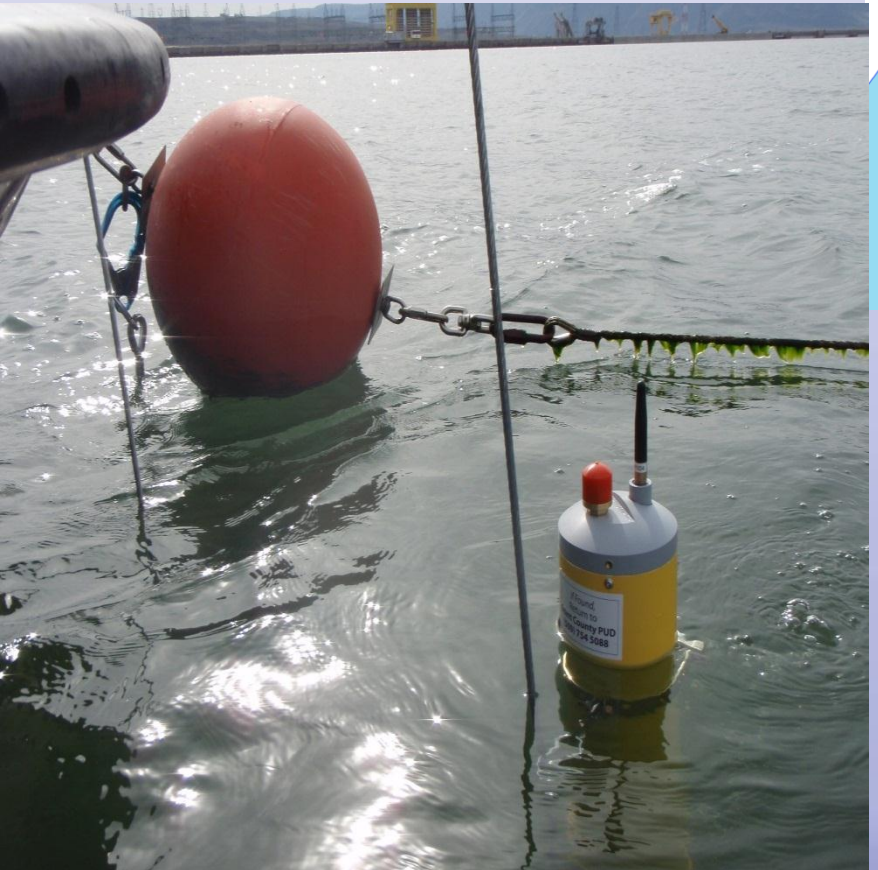
Receivers

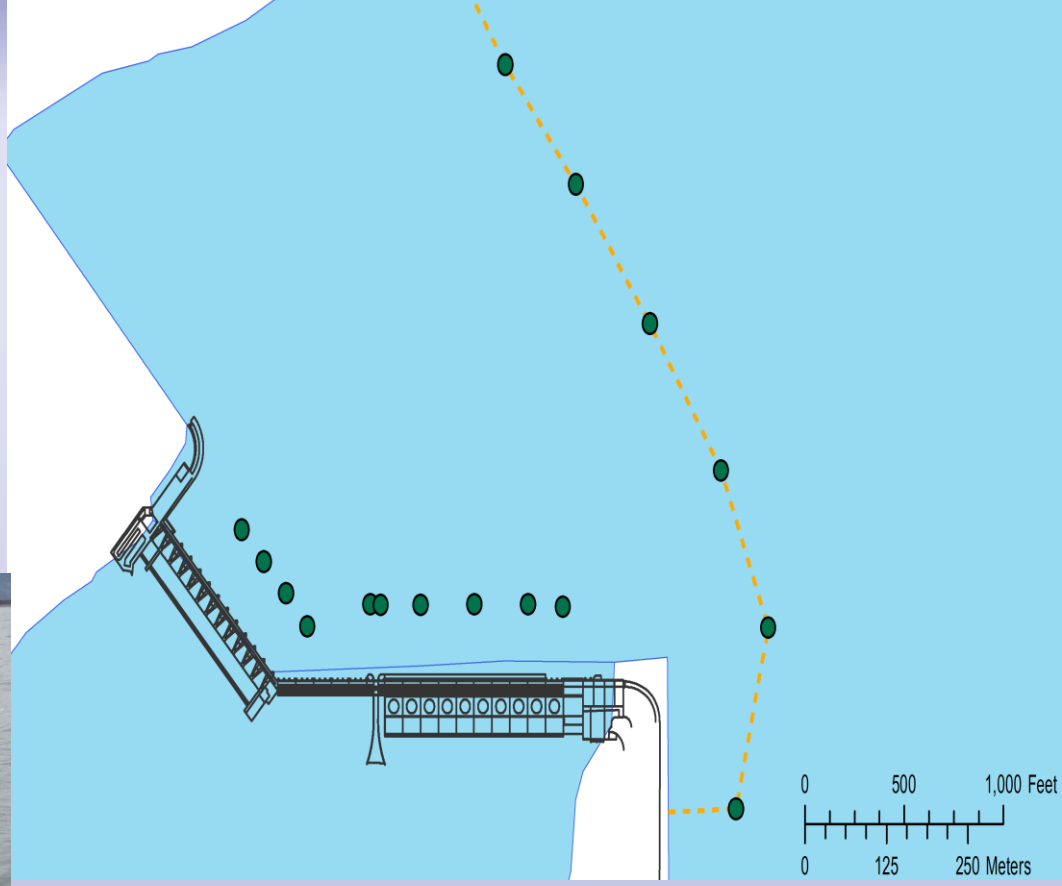
Project Overview

- Release Dates and Quantities
  - Steelhead (May 7-28)
    - Rock Island: 399
    - Wanapum: 771
    - Priest Rapids: 550
  - Yearling Chinook (Apr 30 – May 24)
    - Rock Island: 398
    - Wanapum: 769
    - Priest Rapids: 549



Wanapum Dam





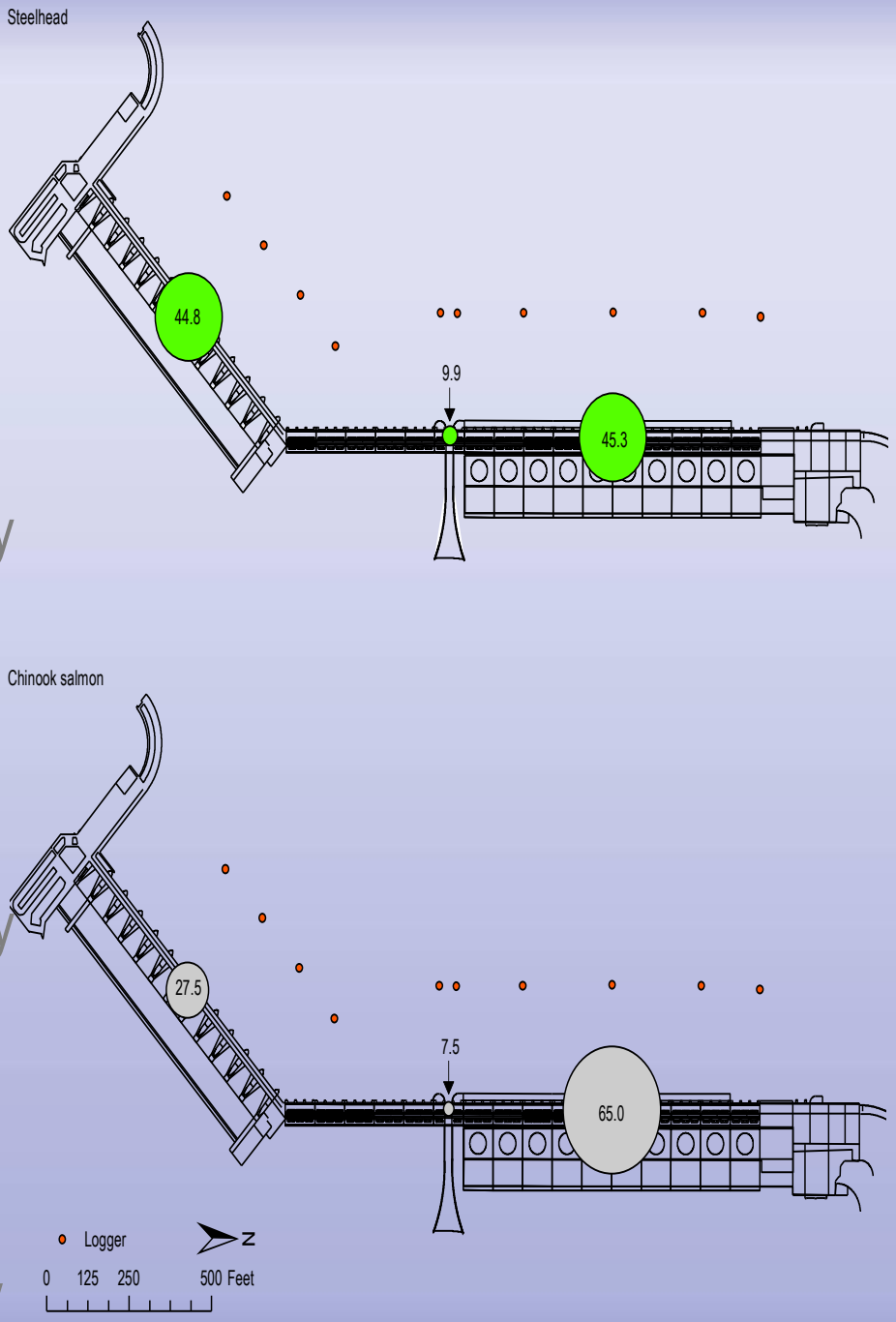
- Receivers for 0/1 and passage route determination
  - ✓ 6 BRZ (Boat Restricted Zone)
  - ✓ 10 dam

Passage Route Selection

Wanapum Dam

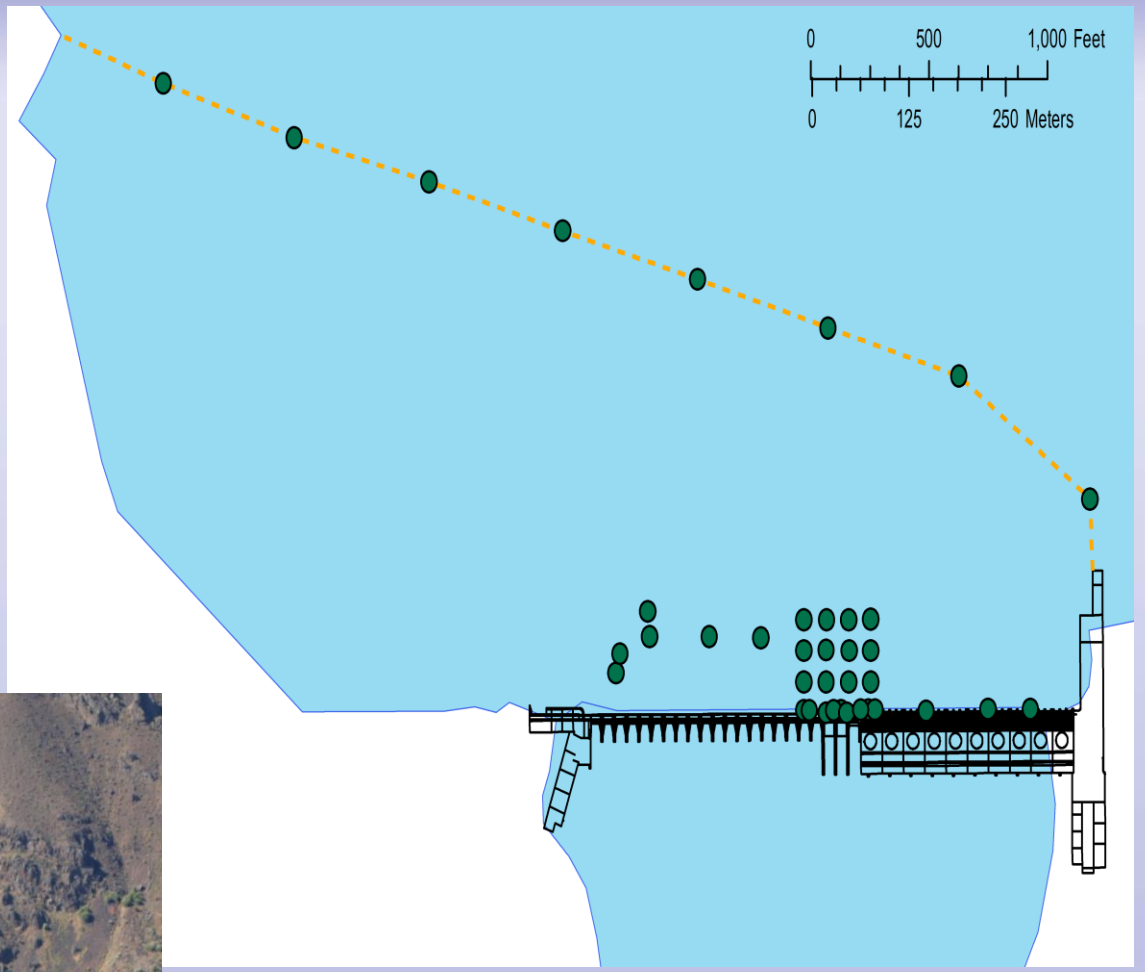
- Steelhead: Non-Turbine FPE 55%
  - 9.9% bypass, 44.8% spillway
  - 45.3% powerhouse

- Yearling Chinook: Non-Turbine FPE 35%
  - 7.5% bypass, 27.5% spillway
  - 65.0% powerhouse



FPE = Fish Passage Efficiency

Priest Rapids Dam

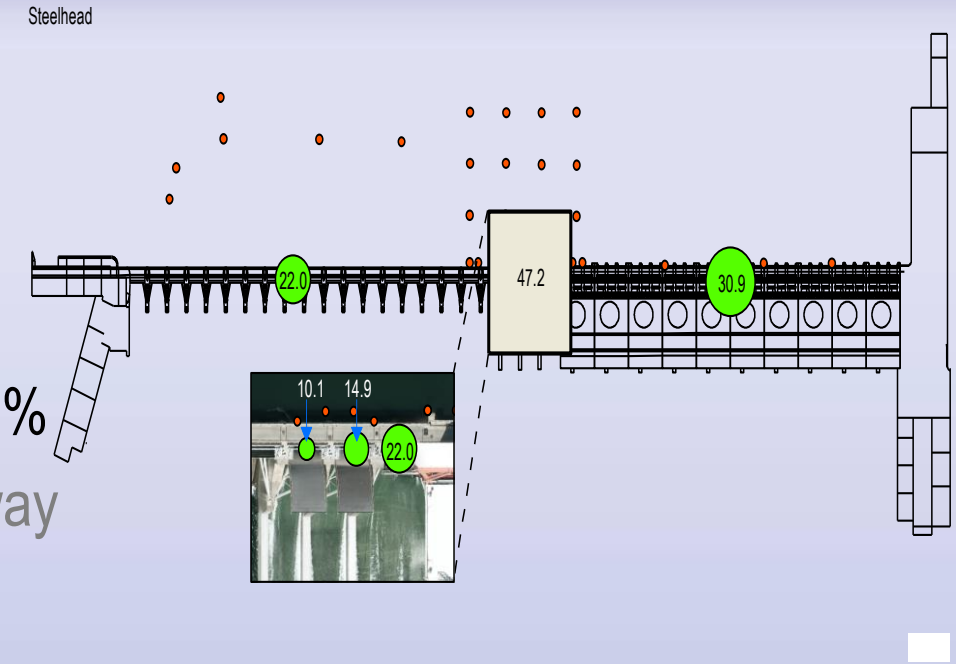


- Receivers for 0/1, passage route determination, and 3D tracking at top-spill
  - ✓ 8 BRZ (Boat Restricted Zone)
  - ✓ 28 dam

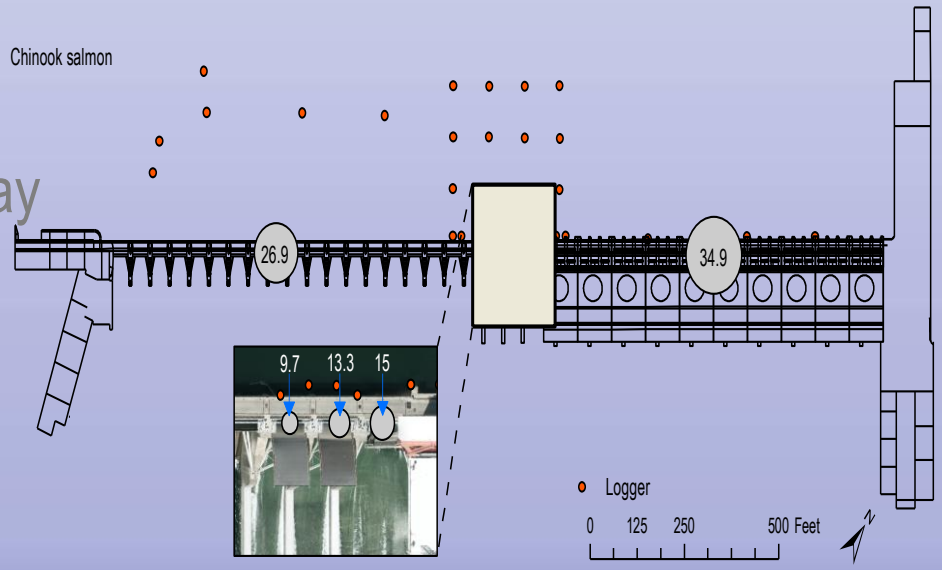
Passage Route Selection

Priest Rapids Dam

- Steelhead: Non-Turbine FPE 69%
  - 47.2% top-spill, 22.0% spillway
  - 30.9% powerhouse



- Yearling Chinook: Non-Turbine FPE 65%
  - 38.1% top-spill, 26.9% spillway
  - 34.9% powerhouse



FPE = Fish Passage Efficiency

Passage Survival by Dam

Species	Year	Wanapum	Priest Rapids
Steelhead			
	2014	0.978	0.985
Yearling Chinook			
	2014	0.988	0.971

Point estimates are based on proportions of fish detected downstream at one or more locations that passed at each dam.

Survival Summary

Project	Yearling Chinook salmon	Steelhead
Wanapum	0.9448 (0.0128)	0.9294 (0.0140)
Priest Rapids	0.9612 (0.0087)	0.9613 (0.0098)
Wanapum – Priest Rapids	0.9082 (0.0148)	0.8934 (0.0163)

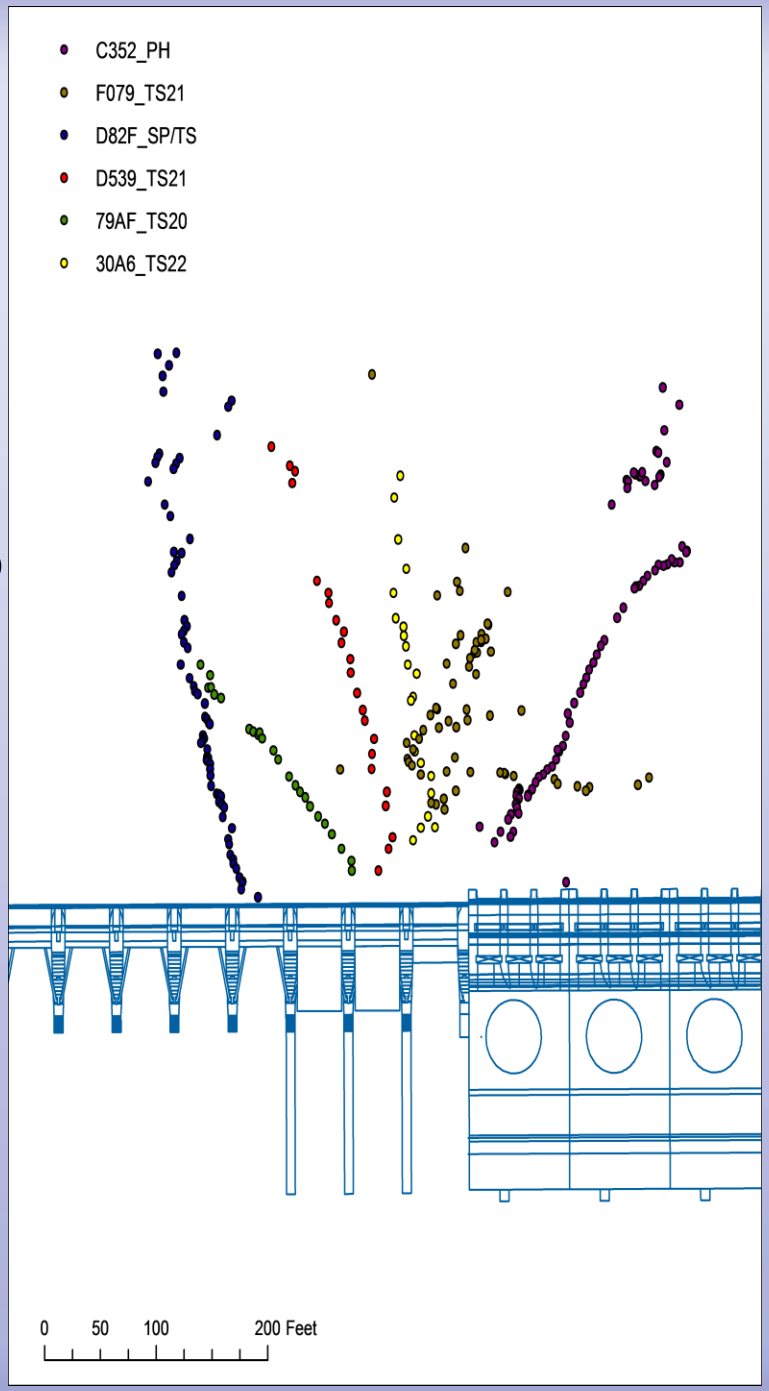
Survival standard: $\hat{S} \geq 0.93$ and $\widehat{\text{SE}} \leq 0.025$

Survival by Passage Route

	Wanapum		Priest Rapids	
Passage Route	Qty Passed	Detected Downstream	Qty Passed	Detected Downstream
Steelhead				
WFB/PRFB	36	1.000	507	0.996
Spillway	164	0.994	236	0.970
Powerhouse	152	0.941	276	0.938
Yearling Chinook				
WFB/PRFB	27	0.963	415	0.998
Spillway	99	0.970	293	0.980
Powerhouse	225	0.982	352	0.926

3D Positions

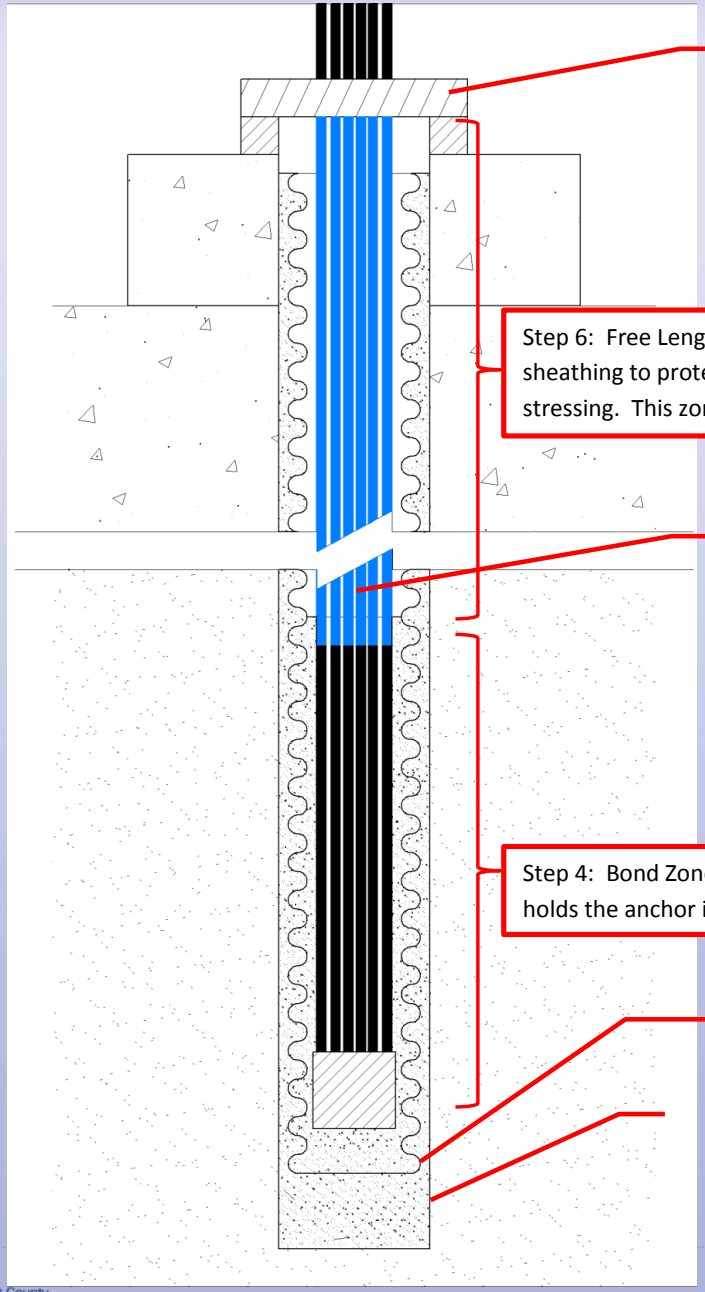
in progress



In preparation for an anticipated pool raise during 4th Quarter 2014, Grant PUD will remove the Wanapum Fishway Exit Passage System from the Wanapum Left Bank Fishway on November 17th, 2014.

Construction status

- 34 of 35 required - 4” pilot holes completed;
- 15 of 35 - 16” full sized holes completed (6 in progress);
- 10 of 35 - 10” sheaths installed and grouted;
- 11 of 35 tendon installation and tensioning in progress;



Step 5: Anchor Head and Wedge Plate – Tendon is stressed/tensioned and strands are clamped/wedge to hold tension (see photos)

Step 6: Free Length – Wire strands are encapsulated with plastic sheathing to protect from corrosion and allow for stretching during stressing. This zone is grouted after tendon is stressed.

Step 3: 61-Strand Tendon Anchor – Install 250 foot long (approximate) tendon into corrugated sheath (see photo)

Step 4: Bond Zone – Bare wires grouted into sheath prior to stressing. This holds the anchor into the rock formation.

Step 2: 10” Diameter Corrugated Sheath – Grouted into hole

Step 1: 16” Diameter Bore Hole – Drilled through spillway structure and into bedrock (see photo)

Refill Plan

- As of 11/3/2014, Grant PUD has completed 13 of the 15 tendon holes required for the pool raise (562') to the full diameter and the full depth.

- Grant PUD has completed 13 of the 15 sheaths required for the pool raise (562').

- Key elements of the plan
  - Refill elevation 558'-562'
  - Total refill maximum of 3' over a 24 hour period
  - Data collection and analysis collected along the way
  - Likely, 2 to 3 weeks to reach 561.5'