Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

FREEDOM OF INFORMATION ACT/PRIVACY PROGRAM

January 23, 2015

In reply refer to: FOIA #BPA-2014-01120-F

Todd D. True
Stephen D. Mashuda
Earthjustice
705 Second Avenue, Suite 203
Seattle, WA 98104

Messrs. True and Mashuda:

This is a final response to your request for Bonneville Power Administration (BPA) records under the Freedom of Information Act (FOIA), 5 U.S.C. § 552. Your request was received in our office on May 14, 2014, with an acknowledgement letter sent to you on May 19, 2014. We also sent you letters on August 6, 2014, October 29, 2014 and December 22, 2014 regarding date extensions.

You requested:
"(1) By, to, or between any official, employee, or contractor of the Bonneville Power Administration ("BPA"), the National Marine Fisheries Service, the U.S. Army Corps of Engineers, or the U.S. Bureau of Reclamation, regarding or relating in any way to:

> (a) the Independent Scientific Advisory Board's ("ISAB") review of the State of Oregon's recommendation to the Northwest Power and Conservation Council for an experimental spill program, or
>
> (b) a study design by the Comparative Survival Study ("CSS") or other response from the CSS regarding the ISAB's review of the Oregon recommendation;

(2) By, to, or between any official, employee, or contractor of BPA, the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, or the National Marine Fisheries Service, and any official, employee, appointed political official, representative, or contractors of any sovereign government (including, but not limited to any employee, official, or contractor of any agency or division of any such entity, and any sovereign's representatives on the Northwest Power and Conservation Council) that has executed a Memorandum of Agreement with BPA, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation concerning the Federal Columbia River Power System, regarding or relating in any way to:

> (a) the ISAB review of the State of Oregon's recommendation to the Northwest Power and Conservation Council for an experimental spill program, or

(b) a study design by the CSS or other response from the CSS regarding the ISAB's review of the Oregon recommendation[.]"

Also, Mr. Mashuda agreed to "narrow the scope of the request" to exclude the unpublished scientific document referenced in Mr. Mashuda's email communication of January 19, 2015.

Response:
We conducted a search of the electronic records of BPA's Fish & Wildlife department. We have located 655 pages of material responsive to your request. We are releasing 595 pages in full and releasing 8 pages with redactions made in accord with the 5 U.S.C. § 552(b)(6) exemption. In addition, 52 pages contain information on them redacted as Non-Responsive, 22 of which are withheld in their entirety so as to maintain the integrity of the document produced.

The FOIA generally requires the release of all government records upon request. However, FOIA permits withholding certain, limited information that falls under one or more of nine statutory exemptions (5 U.S.C. §§ 552(b)(1-9)).

Exemption 6 protects information in "personnel and medical files and similar files" when the disclosure of such information "would constitute a clearly unwarranted invasion of personal privacy" (5 U.S.C. § 552(b)(6)). Exemption 6 requires balancing the public interest in the information against the individual privacy interest at issue. Here, we assert this exemption to redact personal mobile phone numbers and personal email addresses. We find no public interest in this information and therefore redact it under Exemption 6.

Information that falls under Exemption 6 cannot be discretionarily released; the right of privacy belongs to the individual, not to the agency. Therefore, we did not analyze this information under the discretionary release guidelines in Attorney General Holder's March 19, 2009, FOIA Memorandum.

There are no fees associated with this request.

Appeal:
Pursuant to Department of Energy FOIA regulations at 10 C.F.R. § 1004.8, you may administratively appeal this response in writing within 30 calendar days. If you choose to appeal, please include the following:

(1) The nature of your appeal - denial of records, partial denial of records, adequacy of search, or denial of fee waiver;
(2) Any legal authorities relied upon to support the appeal; and
(3) A copy of the determination letter.

Clearly mark both your letter and envelope with the words "FOIA Appeal," and direct it to the following address:

Director, Office of Hearings and Appeals
Department of Energy
1000 Independence Avenue SW
Washington DC 20585-1615

Pursuant to 10 C.F.R. Part 1004.7(b)(2), I am the individual responsible for the determination withhold the information described above under Exemption 6. I appreciate the opportunity to assist you. If you have any questions, please contact Colleen Cushnie, FOIA Case Officer (BPA Contractor, ACS Group, Inc.), at (503) 230-5986 or email at cacushnie@bpa.gov.

Sincerely,

C. M. Frost
Freedom of Information Act Officer

Enclosure

From:	Kerr,Mary K (BPA) - KE-4
To:	Lut,Agnes (BPA) - KEWR-4; Klumpp,Elizabeth C (BPA) - DKR-7; Sweet,Jason C (BPA) - KEWR-4; Milstein,Michael C (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4; Bodi,Lorri (BPA) - KE-4
Subject:	RE: finalizing: Sending Smart Spill Materials to the Power Council
Date:	Monday, February 03, 2014 2:12:05 PM
Attachments:	Fish-Spill-Feb3_2014.pptx

Here are the revised slides for your last quick review.

From: Lut,Agnes (BPA) - KEWR-4
Sent: Monday, February 03, 2014 1:53 PM
To: Klumpp,Elizabeth C (BPA) - DKR-7; Kerr,Mary K (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4; Milstein,Michael C (BPA) - KE-4
Subject: RE: finalizing: Sending Smart Spill Materials to the Power Council

Liz
Yes, no problem I will get that done. I've already spoken to Mary who will have the updated slides out shortly.
As soon as I get the slides from you, Liz, I'll upload to the sharepoint site. However, I leave at 4pm, but can get to it first thing tomorrow at 7:30am.
a-

From: Klumpp,Elizabeth C (BPA) - DKR-7
Sent: Monday, February 03, 2014 1:38 PM
To: Kerr,Mary K (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Milstein,Michael C (BPA) - KE-4
Subject: finalizing: Sending Smart Spill Materials to the Power Council
Importance: High

I've talked with Lorri about having Mary send the "revised" PPT to me – likely later today. Holly and I have a couple of tweaks to make on power slides. We'll insert a statement about context and hopefully a chart comparing Oversupply MWHs with more spill MWHs.

Agnes, I'll send the final back to you for version control! Will you or someone on your staff remove the outdated ones from your sharepoint site and update both versions – with and without speaker notes?

Thanks.

From: Bodi,Lorri (BPA) - KE-4
Sent: Monday, February 03, 2014 1:21 PM
To: Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Harwood,Holly C (BPA) - PGB-5
Cc: Key,Philip S (BPA) - LC-7; Foster,Marchelle M (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Kerr,Mary K (BPA) - KE-4
Subject: RE: Sending Smart Spill Materials to the Power Council
Importance: High

Thanks all. I plan to send this out at the end of the day. I am going to use the edited version below

with a few minor tweaks and delete the reference to ISAB/RP review.

I have also made a few minor edits to the latest version of the Smart Spill slides that will accompany this. Mary is working on those and will share with Jason and Michael and Agnes. I will also be enclosing the Skalski slides.

Regarding the power and financial slides, the sentence will read: AS YOU WILL SEE, THESE MATERIALS DO NOT ADDRESS THE OPERATIONAL AND FINANCIAL IMPLICATIONS OF THE PROPOSED EXPERIMENTAL SPILL TEST. PETER PLANS TO SEND YOU BPA'S PRELIMINARY ASSESSEMENT OF THESE IMPLICATIONS in the near future.

Please feel free to comment!

From: Sweet,Jason C (BPA) - KEWR-4
Sent: Monday, February 03, 2014 10:26 AM
To: Maslen,Bill (BPA) - KEW-4; Bodi,Lorri (BPA) - KE-4; Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Harwood,Holly C (BPA) - PGB-5
Cc: Key,Philip S (BPA) - LC-7; Foster,Marchelle M (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7
Subject: Re: Sending Smart Spill Materials to the Power Council

Agnes and Michael Millstein just received feedback from Giorgi and Fergusen on the FPC comments to our ISAB presentation. They may have a few points that could be worth weaving in, but this looks pretty good to me. Agnes could also help track down the ISRP review of the Corps survival study methods, but I know that was an area that Rock and Dan were thinking of responding directly to as well.

Jason

From: Maslen,Bill (BPA) - KEW-4
Sent: Monday, February 03, 2014 09:50 AM
To: Bodi,Lorri (BPA) - KE-4; Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5
Cc: Key,Philip S (BPA) - LC-7; Foster,Marchelle M (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7
Subject: Re: Sending Smart Spill Materials to the Power Council

A few edits, below, in CAPS.

Dear Council Members.

As you continue to discuss and consider mainstem hydro mitigation as part of the Program amendments, we wanted to share with you some of the biological information BPA AND THE CORPS OF ENGINEERS presented recently to the ISAB regarding current HYDRO OPERATIONS (INCLUDING spill actions) AND PROPOSED FUTURE EXPERIMENTAL SPILL. We appreciate your attention to this issue, since spill, tailored at each dam, is at the heart of FCRPS hydro mitigation actions. In fact, spill using surface passage has been key to recent increases in fish PASSAGE EFFECTIVENESS AND survivals, as well as faster travel times for migrating fish.

The first part of these materials describes the actions and results we have seen from our efforts over the last five years, and the follow through we expect over the next five years, to achieve our dam survival performance standards (93-96% per dam) and inriver survival metrics under the BiOp. We are on track to achieve these objectives by 2018, and are also demonstrating high levels of SPE (spill passage efficiency) and improved fish travel times. Our testing for performance is rigorous and precise, having already been reviewed by the ISAB/ISRP[NEEDS FURTHER VALIDATION].

In addition, we are pleased to see that the, overall abundance of wild fish for listed species has been much improved since listing decisions were made in the 1990s. The Council certainly deserves some credit for these improvements because of the leadership it has provided through the Program.

The second part of the materials describes the questions and concerns we have identified regarding the proposal to change direction and test higher levels of spill for the next ten years or so. We believe there are significant questions regarding the correlations underlying the proposal, the asserted biological benefits of the proposal, and the nature of the test.

WE ALSO WANT TO NOTE THAT BPA WILL SOON FORWARD TO YOU OUR ANALYSIS OF BOTH OPERATIONAL AND FINANCIAL IMPLICATIONS OF THE PROPOSED EXPERIMENTAL SPILL.

We would be glad to meet with you or to answer and questions you may have regarding this information. We look forward to the completion of the latest updates to the Columbia Basin Fish and Wildlife Program and our continued partnership in implementing the Program.

From: Bodi,Lorri (BPA) - KE-4
Sent: Friday, January 31, 2014 01:39 PM
To: Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; Maslen,Bill (BPA) - KEW-4; McNary,Sarah R (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5
Cc: Key,Philip S (BPA) - LC-7; Foster,Marchelle M (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7
Subject: Sending Smart Spill Materials to the Power Council

On Monday am, I plan to send the latest smart spill materials to the individual Council members via email. Jason has added a couple of Corps slides to the package. I was going to send only parts 1 and 2, plus the Skalski slides. I was not going to include the power impact slides.

Here is my proposed message for your consideration and comments:

Dear Council Members.

As you continue to discuss and consider mainstem hydro mitigation as part of the Program amendments, we wanted to share with you some of the biological information BPA presented recently to the ISAB regarding current and future spill actions. We appreciate your attention to this issue, since spill, tailored at each dam, is at the heart of FCRPS hydro mitigation actions. In fact, spill using surface passage has been key to recent increases in fish survivals, as well as faster travel times for migrating fish.

The first part of these materials describes the actions and results we have seen from our efforts over the last five years, and the follow through we expect over the next five years, to achieve our dam

survival performance standards (93-96% per dam) and inriver survival metrics under the BiOp. We are on track to achieve these objectives by 2018, and are also demonstrating high levels of SPE (spill passage efficiency) and improved fish travel times. Our testing for performance is rigorous and precise, having already been reviewed by the ISAB/ISRP.

In addition, we are pleased to see that the, overall abundance of wild fish for listed species has been much improved since listing decisions were made in the 1990s. The Council certainly deserves some credit for these improvements because of the leadership it has provided through the Program.

The second part of the materials describes the questions and concerns we have identified regarding the proposal to change direction and test higher levels of spill for the next ten years or so. We believe there are significant questions regarding the correlations underlying the proposal, the asserted biological benefits of the proposal, and the nature of the test.

We would be glad to meet with you or to answer and questions you may have regarding this information. We look forward to the completion of the latest updates to the Columbia Basin Fish and Wildlife Program and our continued partnership in implementing the Program.

Implementation of the 2008-2018 All-H Strategy: Recent Hydro Improvements and Benefits of Smart Spill

February 3, 2014

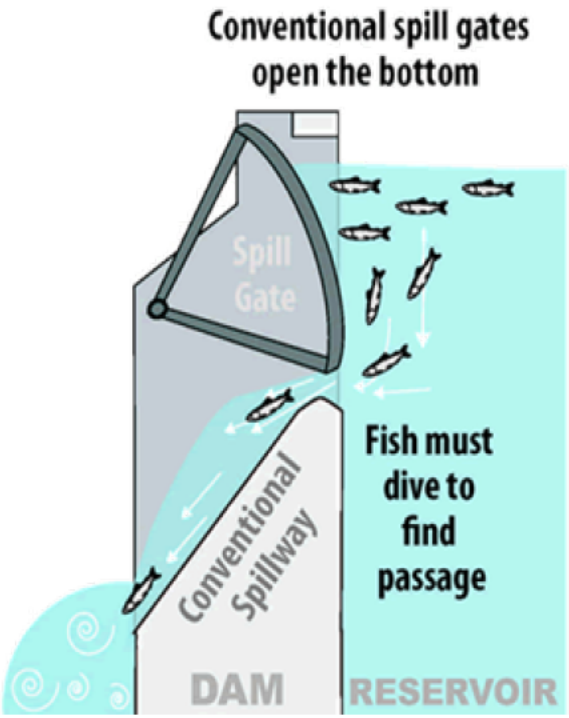
The 2008 Hydro Plan is Underway and Deserves a Chance to Show Results

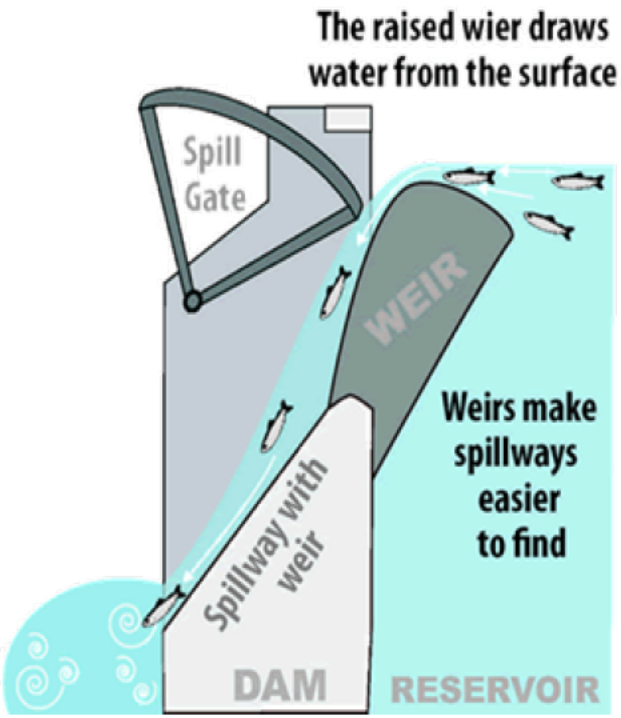
- Congress and BPA ratepayers, in collaboration with the region, have invested heavily in recent years to achieve ambitious performance standards and in-river survival targets.
  - Research guides passage improvements at each dam.
  - Rigorous testing measures progress toward dam passage performance standards and in-river survival targets.
  - Physical hydraulic models inform best spill patterns at each dam to avoid adverse effects.
- Current action plan (2008-2018) includes major dam modifications (e.g. The Dalles Spill Wall), surface passage, Smart Spill, turbine screens and relocation of bypass outfalls.
- Actions and testing are on track but still underway; it is too early to change course.

"Smart Spill" is a Key Component of the Federal Strategy to Improve Fish Survival

- Spill ***effectiveness*** is more important to safe fish passage than spill ***volume.*** *(And increasing spill does not increase flow or speed of river.)*
- With smart spill, fish survival is on track to meet juvenile dam passage performance standards of 96 percent survival for spring migrating fish and 93 percent for summer migrants.
- Spill levels and patterns are tailored for each dam, balancing adult and juvenile fish passage and the unique characteristics of each dam.
- Combines scientifically designed spill operations with surface passage and other structural changes (such as bypass outfall improvements) to increase juvenile fish survival beyond conventional spill.

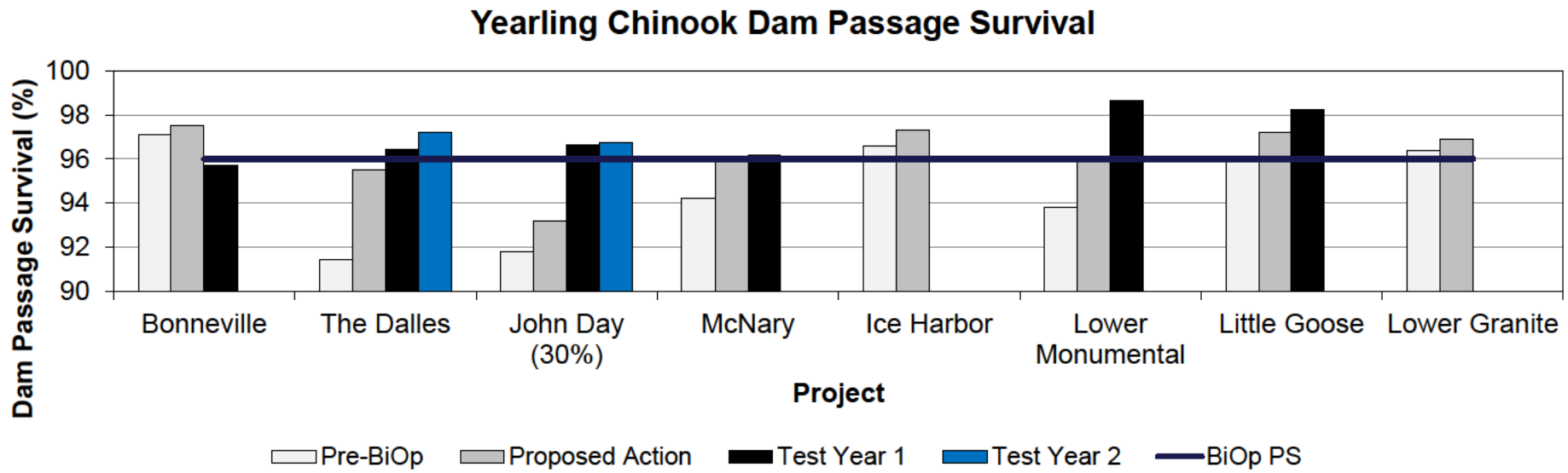
Surface Passage Characteristics

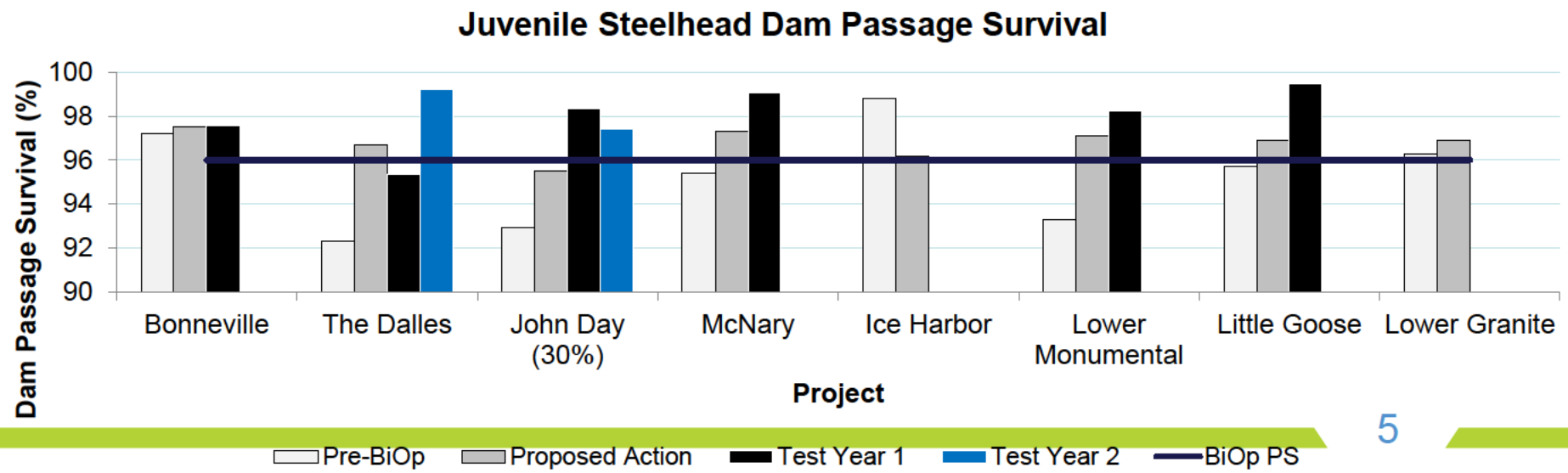




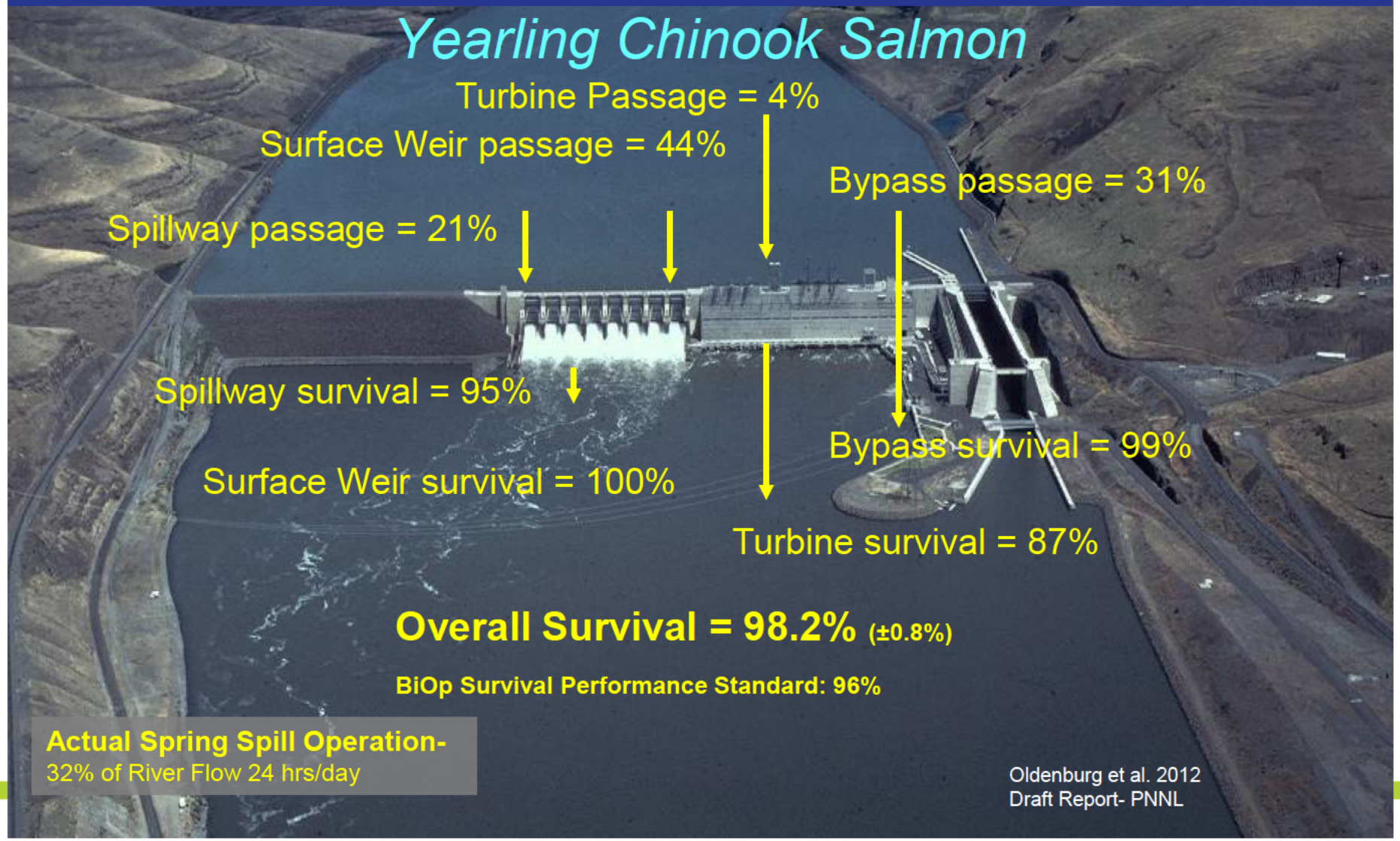
- Spillway weirs and other surface passage structures provide a surface route of passage and allow fish to pass dams at depths where they naturally migrate
  - Easier for fish to find; reduce migration delay and minimize exposure to predation near dams
  - Generally provide the highest survival of all passage routes at dams; consistently at or near 100 percent survival
  - Pass the most fish relative to the volume of water, making them the most effective passage route
  - Increase spill passage efficiency (% of fish that pass through spill); as many as 4-times the percent of fish pass the dam through spill bays equipped with spillway weirs
  - Reduces the number of fish that pass through turbines
- Surface passage routes currently exist at all 8 dams

Juvenile Dam Passage Survival Performance Standards



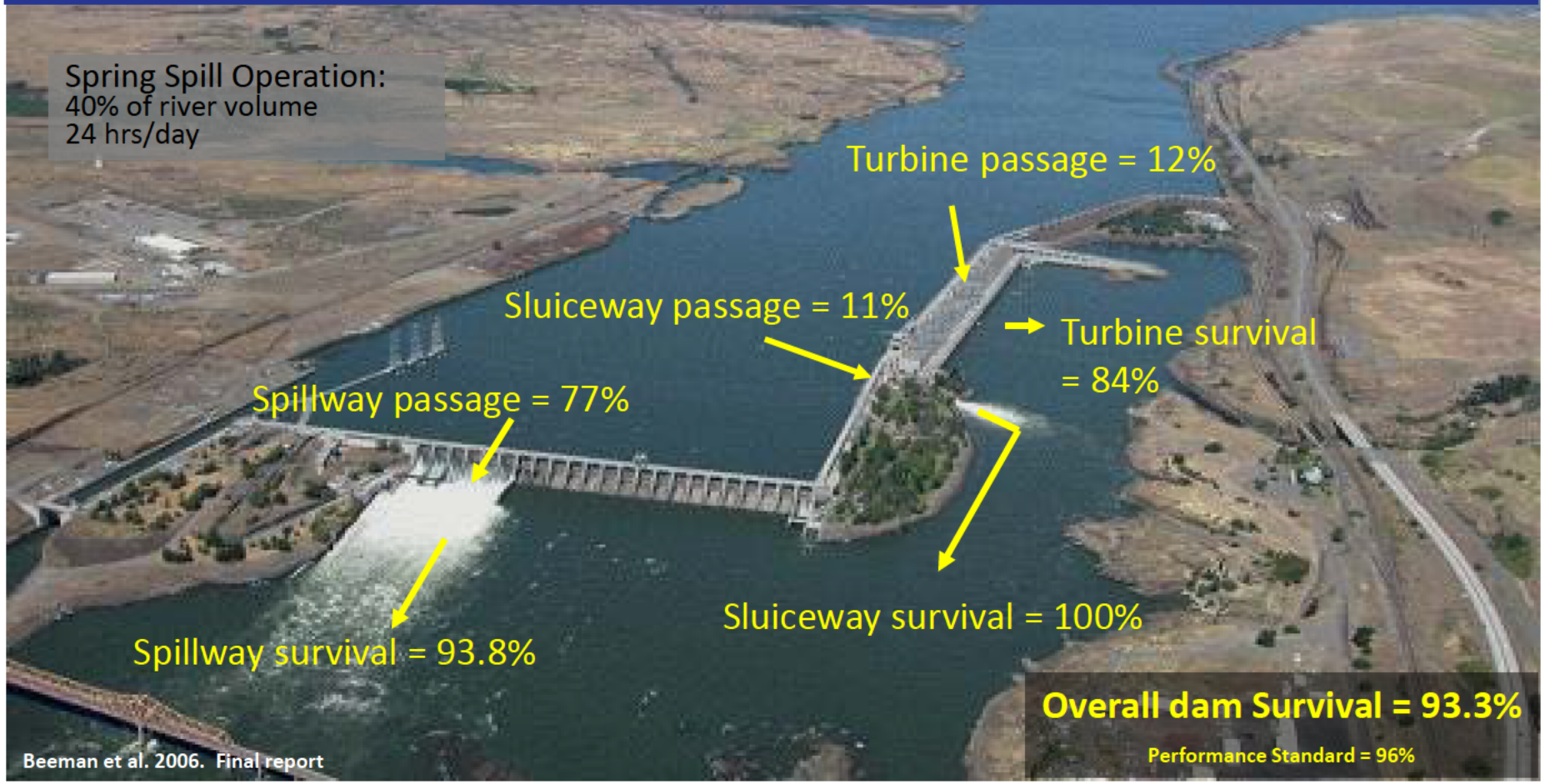


Little Goose Dam
2012Passage and Survival Metrics



Structural Changes at FCRPS Dams have Improved Survival

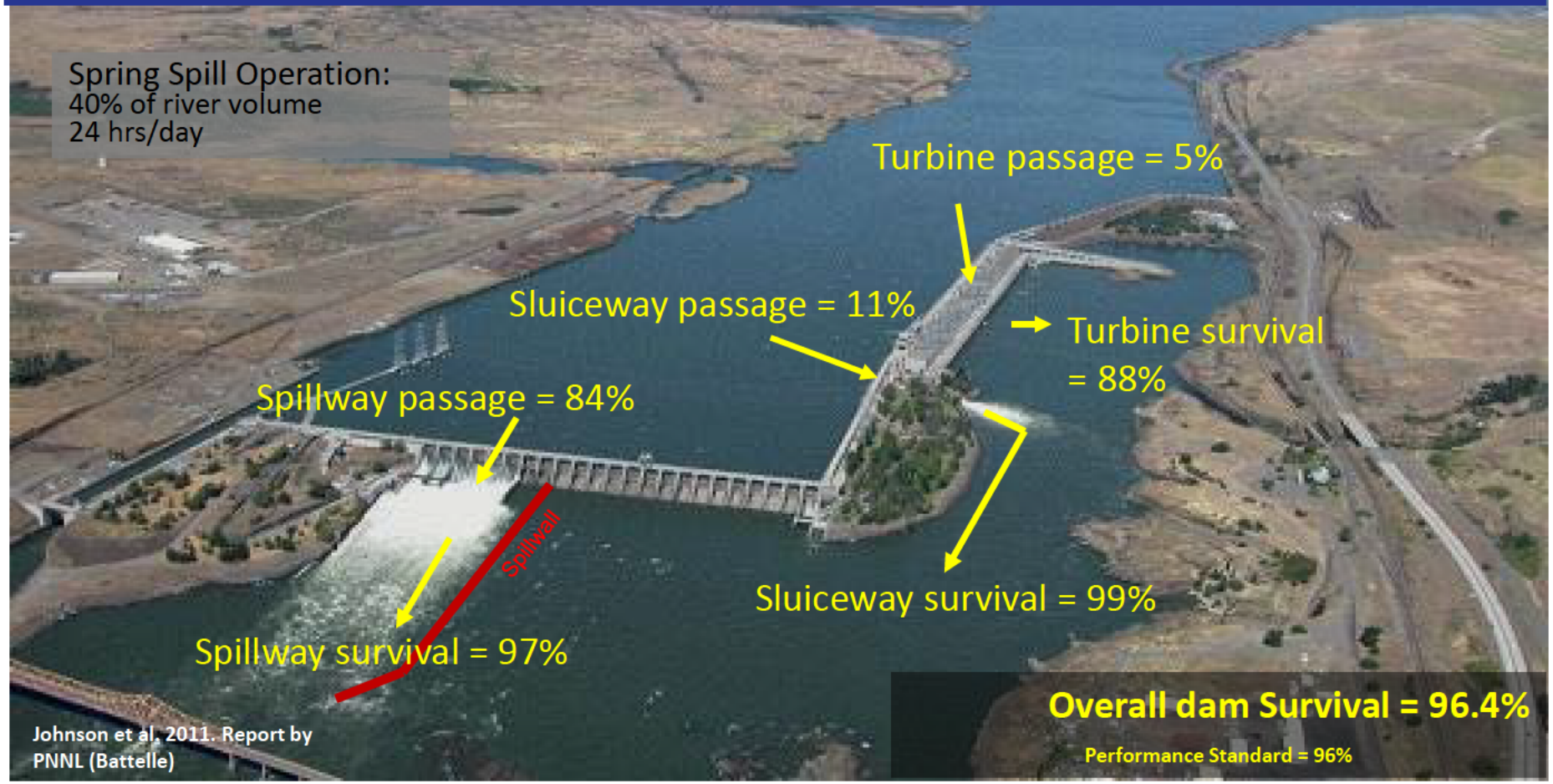
***2005** - The Dalles Dam: Spring Chinook*



Beeman et al. 2006. Final report

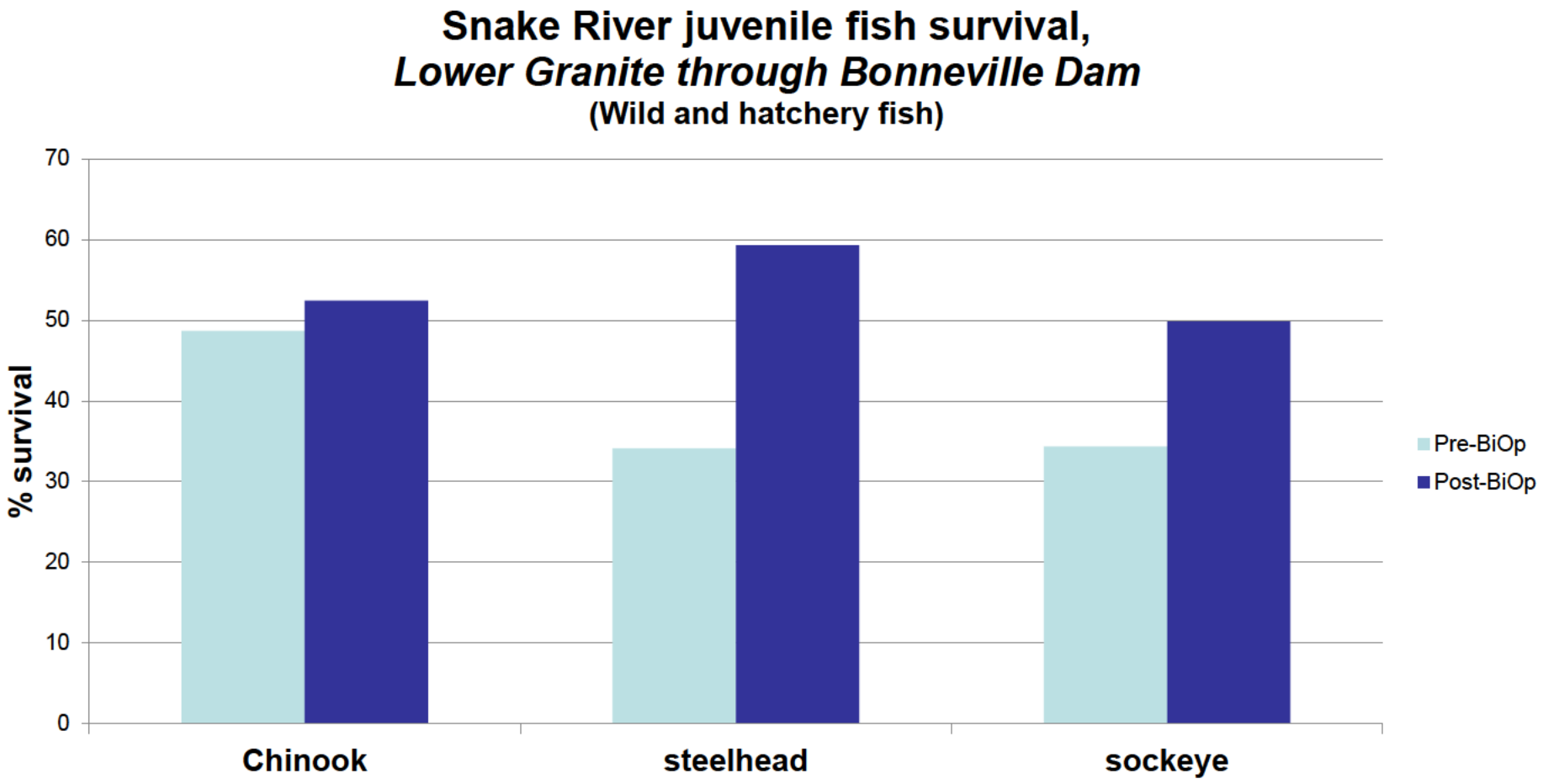
Structural Changes at FCRPS Dams have Improved Survival

***2010** - The Dalles Dam: Spring Chinook*



Johnson et al. 2011. Report by PNNL (Battelle)

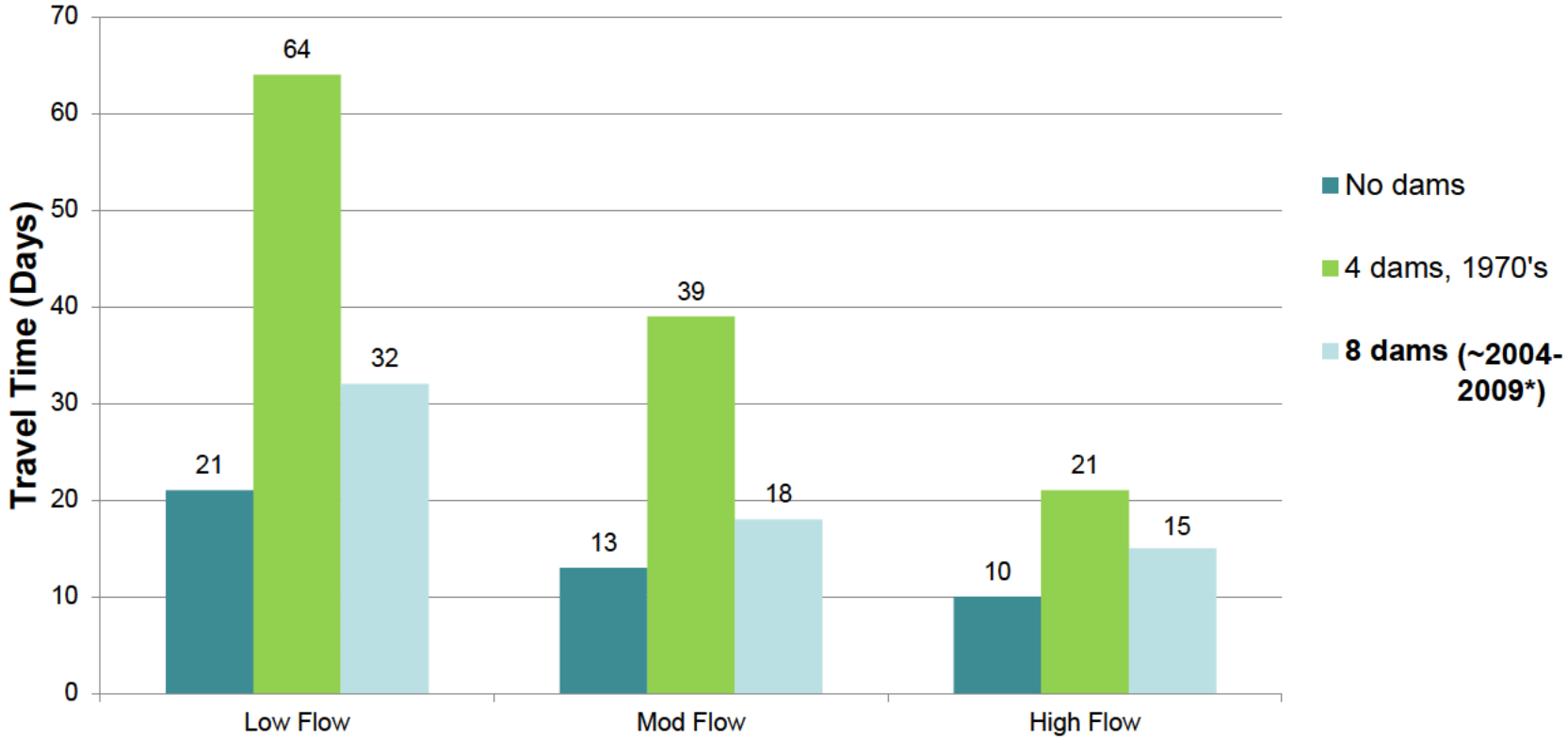
In-river Survival has Increased with Smart Spill



Pre-BiOp period: 1997 – 2007
Post-BiOp period: 2008 - 2012

Fish Travel Time is Decreasing

Lower Granite Dam to Bonneville Dam Fish Speed Migration in Travel Time per Day under 3 Flow Conditions (low, moderate, high)



Data currently being updated by NOAA.

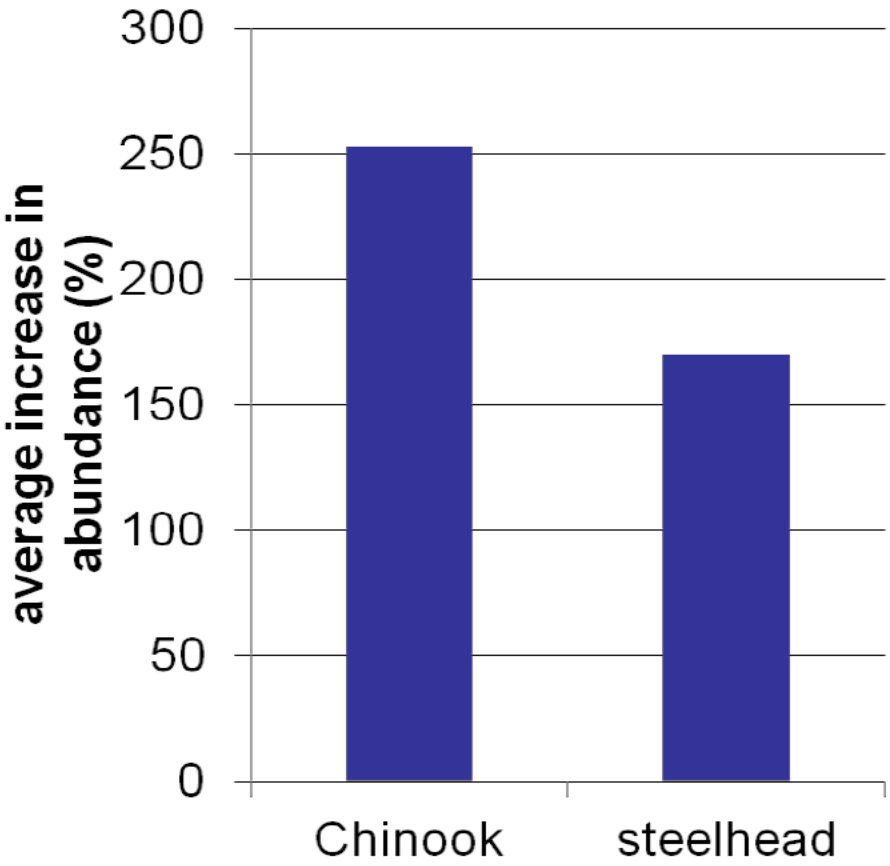
* Muir does not explicitly state the years he used to calculate the 8 dam travel time, but did state "last 5 years" since publishing his paper in 2010.

SOURCE: Muir, W.D., Williams, J.G. 2012. Improving connectivity between freshwater and marine environments for salmon migrating through the lower Snake and Columbia River hydropower system. Ecol. Eng. 48: 19-24

Wild Adult Fish Abundance is Increasing

Based on 10 years of data, 2002 – 2011:

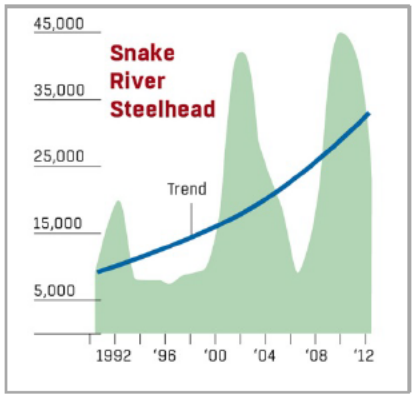
- On average, wild Chinook salmon populations have more than tripled in abundance.
- On average, wild steelhead populations have more than doubled in abundance.

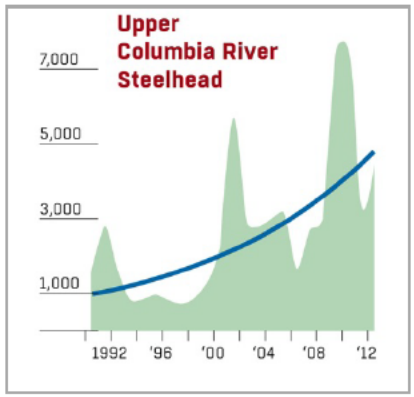


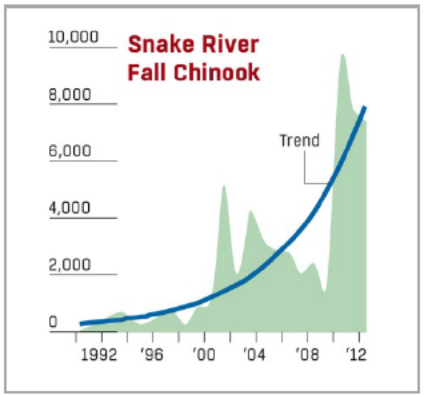
Note: Based on comparison of geometric mean of abundance from 1990-1999 to most recent 10 years, generally 2002-2011.

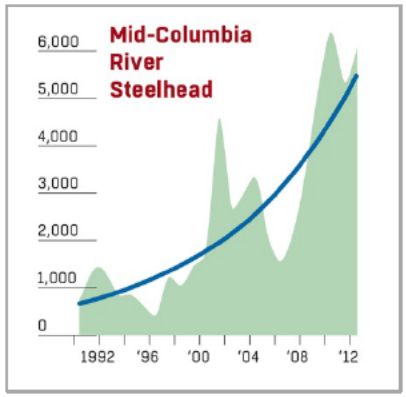
Status of Adult Fish

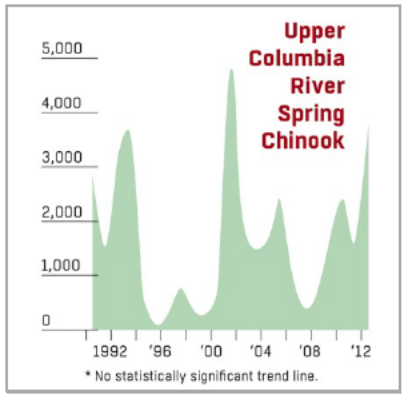
Of the 49 Interior Columbia Basin wild adult fish populations where data are available, 47 have increased in abundance since listings in the 1990s.

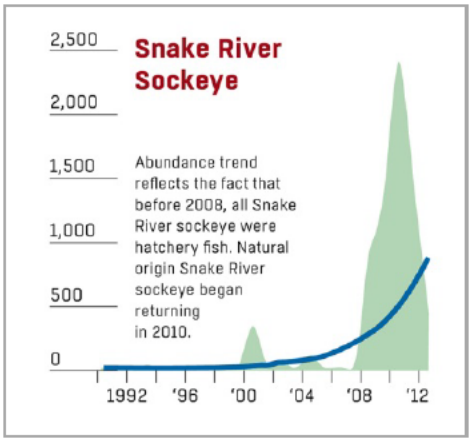


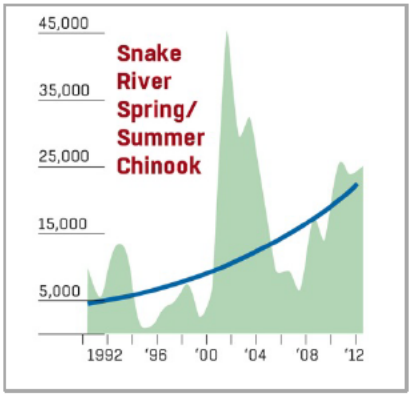












Note: Abundance monitoring and reporting started with the first ESA salmonid listing.

Summary: Hydro Results are Ongoing and Promising

- Research-based improvements are delivering improved passage, higher in-river survival and faster fish travel time.
- Smart Spill is tailored to conditions at each dam, enhancing both spill effectiveness and efficiency.
- As of 2010, all mainstem dams have been equipped with a surface passage route.
- Improvements and testing are ongoing and still proving their value to the region. We need to maintain the course for this current performance-based approach.

Spill Test Issues and Questions

Summary of Oregon's Spill Proposal

- Increases spill levels significantly.
- Spring "Experimental Spill Management Program":
  - Spill up to 125% TDG level
  - April 3 – June 20, 24 hours per day
  - Use CSS framework to monitor SARs, which Oregon expects to increase significantly
- Spill test exceeds Oregon and Washington water quality criteria and requires regulatory changes.
- Oregon's proposal indicated some constraints, but without specifics that can be evaluated.

There are Science-based Concerns About the Proposed Spill Test

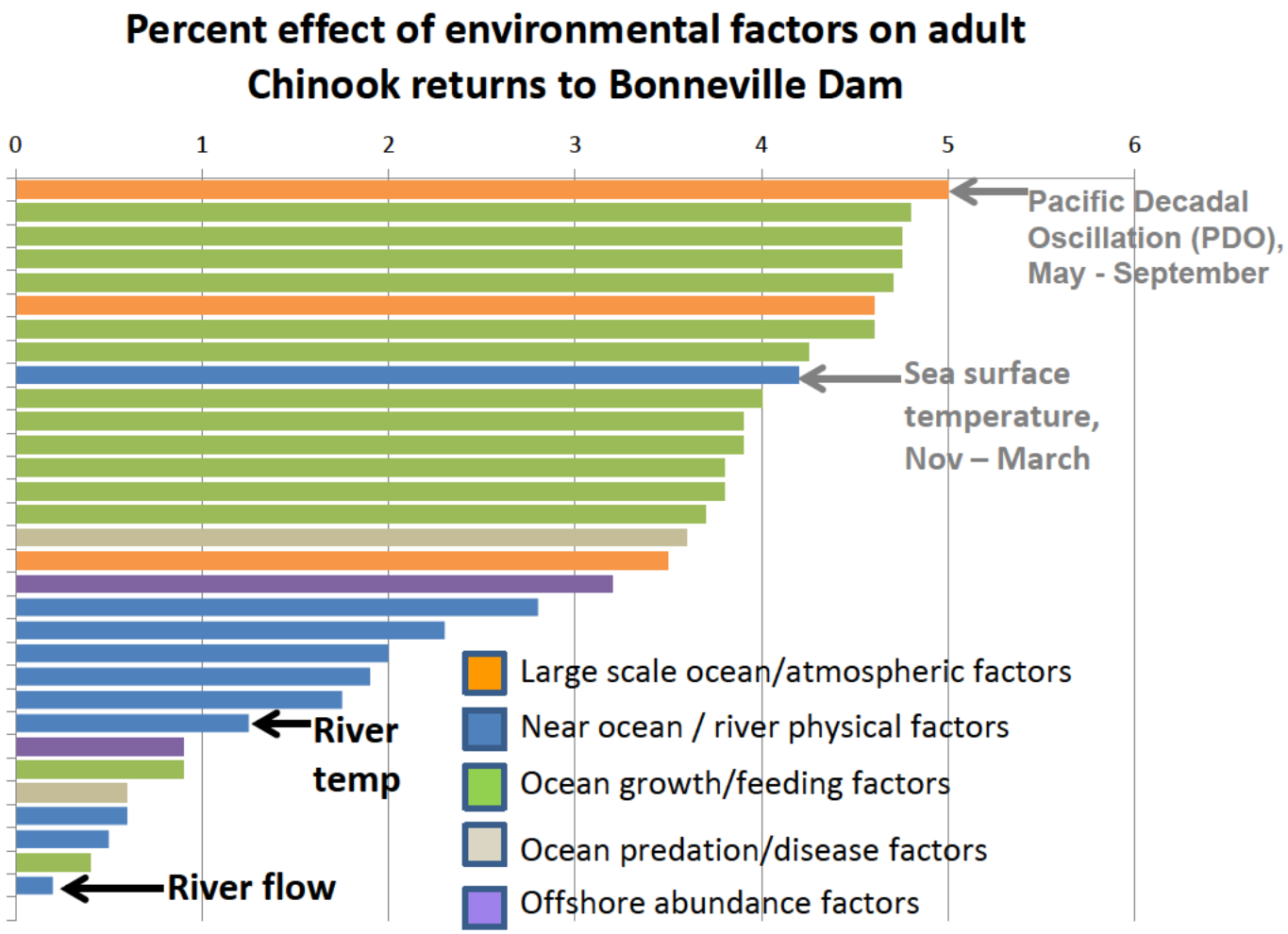
- Uses a 2-6% target for Smolt-to-Adult Returns (SARs) as a measure of the effect of spill, but SARs reflect more than hydro system.
- Relies on a Comparative Survival Study (CSS) model, and is based on simplified correlations that tie spill volume directly to adult returns. This correlation between spill and SARs requires oversimplified hydro system spill assumptions (e.g., average system-wide spill volumes rather than dam specific spill operations that balance juvenile and adult passage) that are taken beyond the available data.
- Assumes delayed mortality of juvenile migrants, but significant scientific debate remains over the magnitude and/or cause of delayed mortality.

SARs are not an Appropriate Measure of Hydrosystem Performance

- Hydro performance is more appropriately measured by:
  - Juvenile dam passage survival which directly measures changes to survival as a result of improvements made at the dams by the Action Agencies.
  - Total in-river and reach survival (e.g. Lower Granite to Bonneville) of juveniles and adults monitors survival through the reservoirs of the FCRPS*, not just the dams.
- Dam operators cannot control or influence the vast majority of the factors that affect adult fish returns and SARs.
  - Approximately 60% of the environmental factors influencing Chinook returns to Bonneville Dam are related to large scale ocean/atmospheric conditions, and ocean growth/feeding. (Burke et al. 2013)
- So many factors affect SARs that tests that attempt to isolate the effects of different spill conditions may require several decades to show a statistically reliable effect on SARs.

*Federal Columbia River Power System

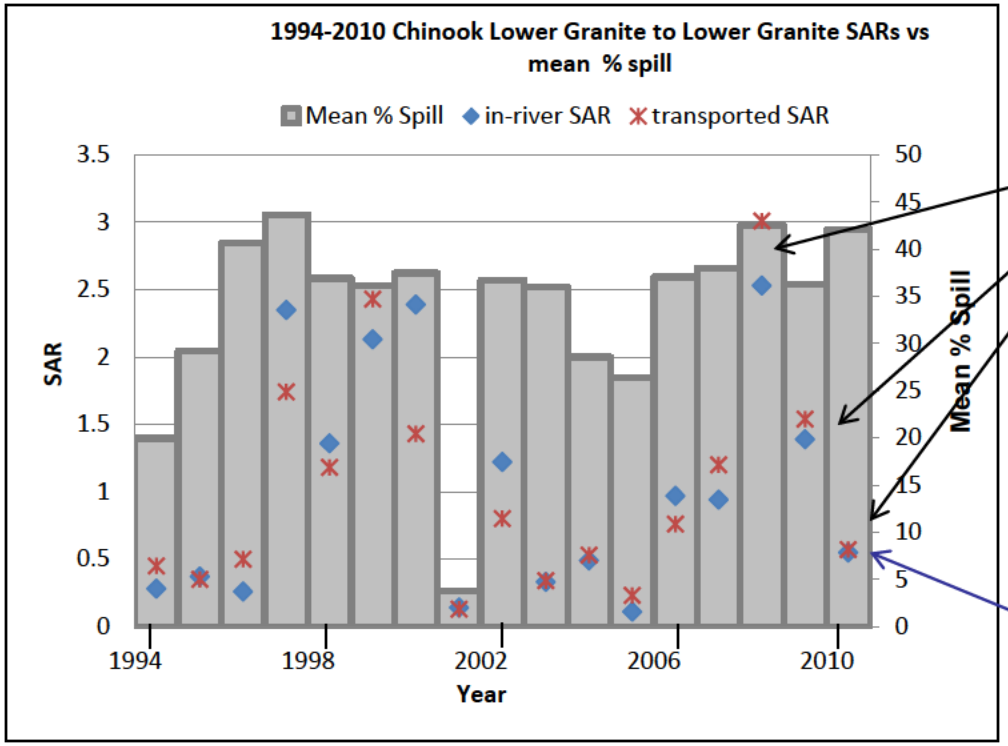
Ocean Conditions, not Spill Levels, have the Greatest Influence on Adult Returns



Source: Burke et al. (2013)

Similar Trends for Transported and In-river Fish Suggest Factors Other than Spill are Driving SARs

- The SARs of transported fish that did not experience spill have a similar correlation to spill as the SARs of in-river migrants that did experience spill. This demonstrates that other factors, besides spill, are affecting SARs of both groups.



In 2008, 2009, and 2010 Chinook SARs were similar for transported and in-river fish.

Even though the mean % spill was high in 2010, Chinook SARs were low for both transported and in-river fish.

Source: 2012 CSS Annual Report

Delayed Mortality Hypotheses Remain Questionable

- There are substantial questions about the magnitude and cause of delayed mortality and whether it is attributable to the hydro system.
- In 2007, the ISAB strongly advised against continuing to try to measure delayed (latent) mortality (since it cannot be measured against a dam-less reference) and instead called for <u>focusing on in-river versus transport mortality that can be measured directly.</u>
- BiOp action plan takes this focused approach.
- Studies conflict over evidence of delayed (latent) mortality. ISAB stated in 2007 that, "Any signal we can detect will be subtle at best and confusing at worst, contributing to the confusion over latent mortality", and in 2012 they stated that "the factors responsible for latent mortality remain poorly understood and inadequately evaluated."

Spill Benefits Fish, But Too Much Spill Can Cause Harm

Too much spill, without being carefully calibrated to each dam, can impact:

- Adults
  - Delay adults migrating upstream, confusing adult fish trying to find fish ladders.
  - Sweep adult fish that have successfully climbed fish ladders back downstream through the spillway, known as “fallback” (tiring the fish, causing migration delay, and increasing their vulnerability to predation in the case of Bonneville Dam).
- Juveniles
  - Create eddies below dams that trap juvenile fish and expose them to predators by delaying downstream juvenile egress.
  - Draw fish away from surface passage routes, which are generally safer and faster.

High Spill can Conflict with Known Project Constraints to Delay Passage and Reduce Survival

Examples:

	Biological Impacts	Structural Constraints*
Bonneville	Adult fallback increases over 100kcfs	Erosion of the spillway stilling basin
The Dalles	Dam survival has been demonstrated to decrease as spill increases	Spill levels above 40% can lead to spill outside of the spill wall or less safe gate openings
John Day	Spill above 40% can negatively affect conditions in the tailrace reducing overall dam survival.	Erosion of the spillway stilling basin
Little Goose	Adult passage can be blocked/delayed at spill levels greater than 30%	Erosion of north fishway entrance
Lower Granite	Higher spill levels can pull fish away from surface passage and into conventional spill which has lower survival	Erosion of the spillway stilling basin

* At this time, a project by project comprehensive evaluation has not yet been completed to determine what the actual structural constraints are, beyond erosion of the spillway stilling basin.

High Spill Creates Harmful Gas Conditions in the River

Total dissolved gas (TDG) is a pollutant that causes bubbles in the cardiovascular system of aquatic species, similar to when divers get the "bends."

The proposed spill test requests spill to 125% TDG in the tailrace. This would increase the occurrence of gas bubble trauma and impacts on both salmonids and other aquatic species.

- Environmental Protection Agency's national criterion for TDG is 110%.
- The states granted special exceptions (forebay limit of 115% in WA and tailrace limit of 120% in OR & WA) on the Snake and Columbia Rivers to allow increased spill for improved juvenile salmon and steelhead migration.
- Fish passage spill is managed to not exceed these limits because of the risk to salmon and other aquatic species.
- NOAA Fisheries has stated that to protect migrating salmon and steelhead tailrace TDG conditions should not exceed 120%.

CSS Provides a Long-Term Data Set that is Useful, but Lacks Technical Basis for the High Spill Test

- CSS confirms that spill is an important tool for improved fish survival which is consistent with the BiOp spill program.
- CSS documents this relationship at a very broad level using averaged spill volumes.
- Because spill effectiveness is more important for fish survival than averaged spill volumes, CSS results can not address more complex smart spill management issues at individual dams.
- In 2012, the ISAB reviewed the correlations used in CSS and stated that their finding of "indirect evidence for latent mortality as a consequence of bypass passage does not provide definitive evidence of causation. The positive correlation between in-river and ocean survival rates could be related to other factors such as fish size or climate variables not considered explicitly in the CSS analysis."

CSS Assumptions Underlying the Proposed High Spill Test are Oversimplified

- Dam passage survival and passage condition data are out of date and do not reflect recent Smart Spill advancements
  - CSS does not consider 10+ years of cumulative route-specific acoustic tag information from BiOp juvenile performance standard and survival testing for each dam
  - CSS assumes passage by volume rather than using actual route specific information based on smart spill
- Dam specific biological and structural constraints, including total dissolved gas constraints, are not included, making the results incomplete.
- Results are extrapolated beyond the range of empirical data thus assuming that if some spill improves survival then more spill will provide further increases proportionate to volume.

Best Available Science Supports Existing Path Forward

- The federal agencies just completed a 5-year comprehensive evaluation of our ten-year strategy, with very good results and measurable metrics for accomplishments. This program of research-based improvements and rigorous testing is demonstrating positive results and should be completed as planned, such as:
  - Juvenile Dam Passage Performance Standards
  - In-river passage and reach survival of juveniles and adults, including adult abundance
- Outstanding science questions remain about impacts of higher spill, the rationale for the proposed test and delayed mortality.
- The region could benefit from further discussion of the science behind these issues between now and 2018.

From:	McNary,Sarah R (BPA) - A-7
To:	Bodi,Lorri (BPA) - KE-4
Cc:	Milstein,Michael C (BPA) - KE-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; Ball,Crystal A (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5
Subject:	FW: spill presentations
Date:	Tuesday, February 04, 2014 12:40:27 PM
Attachments:	Characterizing Spill Jan 2014.pptx Spillway passage estimation results Jan 2014.pptx

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Lorri – For your awareness. You likely have received this already from your team and I know Jason is working directly with Ritchie, but I wanted to be sure you received this communication from Ritchie. For efficiency's sake I am cc'ing a few of our key folks internally as an FYI.
S.

From: Ritchie Graves - NOAA Federal [mailto:ritchie.graves@noaa.gov]
Sent: Tuesday, February 04, 2014 10:02 AM
To: Peters, Rock D NWD; Feil, Dan H NWD; Sweet,Jason C (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5; Mike Ford - NOAA Federal; Michael Tehan - NOAA Federal; Bruce Suzumoto; Puckett, Kathryn J; McNary,Sarah R (BPA) - A-7; Lori Thompson; Richard Zabel - NOAA Federal
Cc: Paul Wagner; Gary Fredricks; Bill Hevlin; Trevor Conder; Steven Smith - NOAA Affiliate; James Faulkner - NOAA Federal; Eitel, Michael (ENRD); Mark Eames - NOAA Federal
Subject: Fwd: spill presentations

All:

As most of you are aware, following the Jan 17 ISAB meeting, I agreed to meet with some of the Comparative Survival Study technical staff to better understand how, and to what extent, they have incorporated SPE etc. changes resulting from the installation of surface passage structures at the mainstem dams into their analysis. Paul and I met with them on January 24, and Steve Haeseker (FWS) kindly walked us through their analysis methodology (see the attached spreadsheets).

Part of the confusion (from NOAA's perspective) appears to have been caused by a miscommunication between myself and a CSS member at their April 2013 workshop. The 2013 CSS report's heavy reliance on references to earlier materials (workshop results, earlier reports, etc.) regarding methodologies also seems to have contributed to our misunderstanding of how this information has been incorporated into the report.

The attached PowerPoint presentations summarize the CSS methodology for estimating detection probabilities and derived SPE estimates for their models for both yearling Chinook and steelhead. I've not had the time to compare this to the SPE estimates used in COMPASS (which we'll be working to update again in the coming year or so) or get any review from our Science Center.

(I can say that we had shared versions of the COMPASS SPE curve estimates with Steve Haeseker in the past, and he considered this

information in building his relationships.)

Long story short... it is clear that the CSS group has done a substantial amount of work to try and incorporate and update spill relationships that have changed as a result of surface passage routes being added to many of the mainstem dams for the observed ranges of data.

Thus, their work should not be characterized to others as having ignoring the effect of these configurational improvements.

The CSS group has pointed this out in their latest comments to the ISAB (Theme 2: Criticism of the CSS Analysis - "The implementation and operation of surface passage structures and available acoustic tag data have all been incorporated into the CSS analyses spill metric").

I would strongly urge you to contact Steve Haeseker or Michele DeHart if you have additional questions about the analysis or would like to organize a meeting to discuss this information further with the CSS group.

Best Wishes,
Ritchie

Ritchie Graves
Columbia Hydropower Branch
Interior Columbia Basin Office
NOAA Fisheries, West Coast Region

phone: 503-231-6891
cell: 503-730-5148

---------- Forwarded message ----------
From: **Haeseker, Steve** <steve_haeseker@fws.gov>
Date: Mon, Jan 27, 2014 at 9:43 AM
Subject: spill presentations
To: Ritchie.Graves@noaa.gov
Cc: Howard Schaller <howard_schaller@fws.gov>, Michele Dehart <mdehart@fpc.org>

Ritchie,

Attached are the presentations from our meeting last week. Let me know if there are any other questions.

-Steve

--
Steve Haeseker

Columbia River Fisheries Program Office
U.S. Fish & Wildlife Service
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

Phone: 360 604-2517
www.fws.gov/columbiariver/

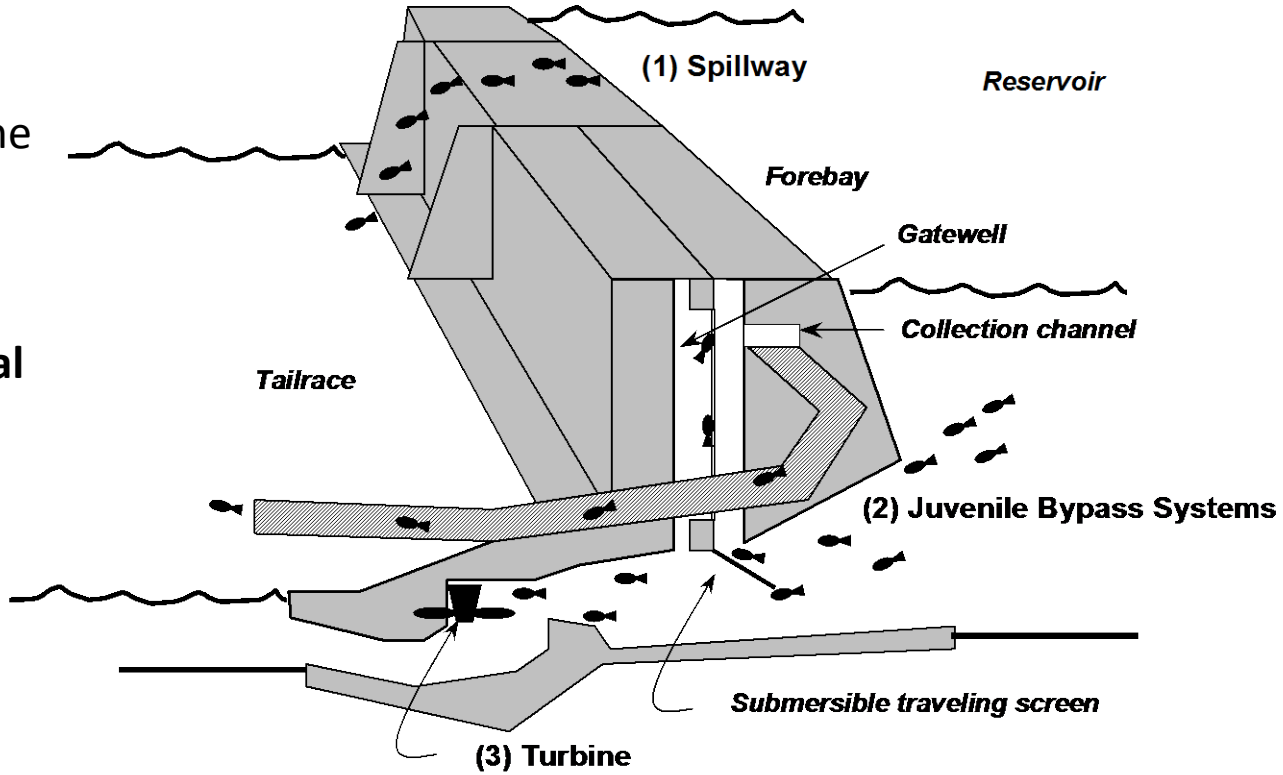
Characterizing Spill Metrics Relevant to Fish Survival

In-river Passage Routes

Non-powerhouse = Spill (traditional or surface spillway weirs)
Powerhouse = Turbine or juvenile collection/bypass

Direct survival:
spill ≥ bypass > turbine

Direct & indirect survival (delayed mortality):
spill > bypass
spill > turbine



Fish Guidance Efficiency (FGE)

- Proportion of powerhouse fish that are “guided” to bypass/collection systems via screens
- FGE = Bypass / Powerhouse
- ➡ Powerhouse = Bypass / FGE

- If you have bypass and FGE estimates, then you can estimate powerhouse passage
- Spillway passage = 1 – powerhouse passage

Spill metrics

- Average spill proportion (post-development)
- N_Powerhouse (direct proportion)
- N_PH_{PIT} or N_Spill_{PIT} (PIT-tag detection probability)

Spill metrics

- Average spill proportion
  - commonly used metric (FPC, CSS, NOAA analyses, Haeseker et al. 2012)
  - average spill proportion for defined time period across N-dams
  - simple, physical measurement
  - indirect measure of passage routing, fish passage assumed to be proportional
  - N_dams changed over historic period - Snake River fish faced 2 dams in 1956 to 8 dams by 1975
  - 20% average spill proportion has different meaning for 2 dams vs. 8 dams

Spill metrics

- N_Powerhouse
  - Expected number of powerhouse passages (turbine + collection/bypass) for defined time period across N-dams (Petrosky & Schaller 2010)
  - N_dams changed over historic period - Snake River fish faced 2 dams in 1956 to 8 dams by 1975

$$\text{N\_Power House}(i) = \text{Ndams}(i) - \sum_{j=1}^{\text{Ndams}(i)} \text{Prop\_spill}(i,j)$$

where i = year, j = dam

  - Example: 20% spill @ Bonneville = 80% powerhouse passage @ Bonneville
  - Indirect measure of passage routing, fish passage proportion assumed to be 1:1 with water volume
  - Retrospectively characterized spill proportion as N_dams increased
  - Can account for variation during development (2 through 8 dams) and post-development (8 dams)

Spill metrics

- N_Spill_{PIT} or N_PH_{PIT}
  - recommendation from 2011 CSS Workshop
  - expected number of spillway or powerhouse passages
  - accounts for spill passage efficiency
    - spillway passage proportion differs by dam, flow, spill proportion, surface collectors, and species
  - N_Spill_{PIT} and N_PH_{PIT} are mathematical compliments ($r = -1.0$)
    - Can account for variation post-development (8 dams) and during development (2 through 8 dams)

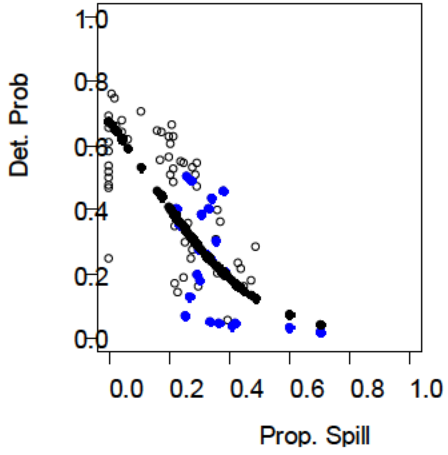
Spill metrics

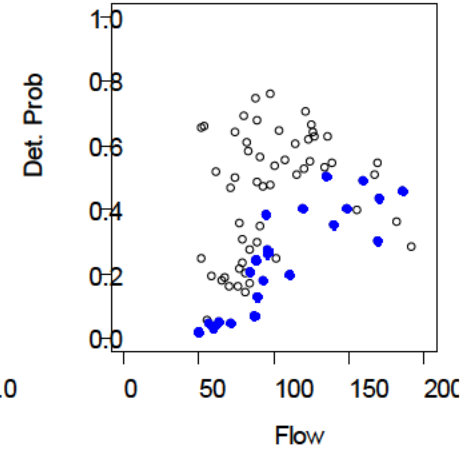
N_Spill_{PIT} approach:

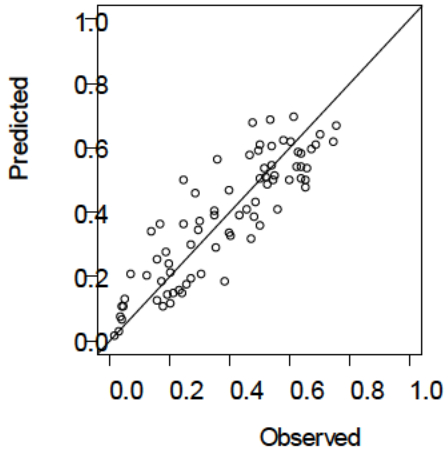
- Summarize CJS detection probabilities
- Summarize dam conditions (spill, flow, surface passage)
- Develop models for detection probabilities as function of spill, flow, surface passage
- Use intercept @ 0% spill as FGE estimate
- Apply best-fit model and FGE estimate to estimate spillway passage
- Estimates validated using telemetry data

Spill metrics

Lower Monumental Dam steelhead



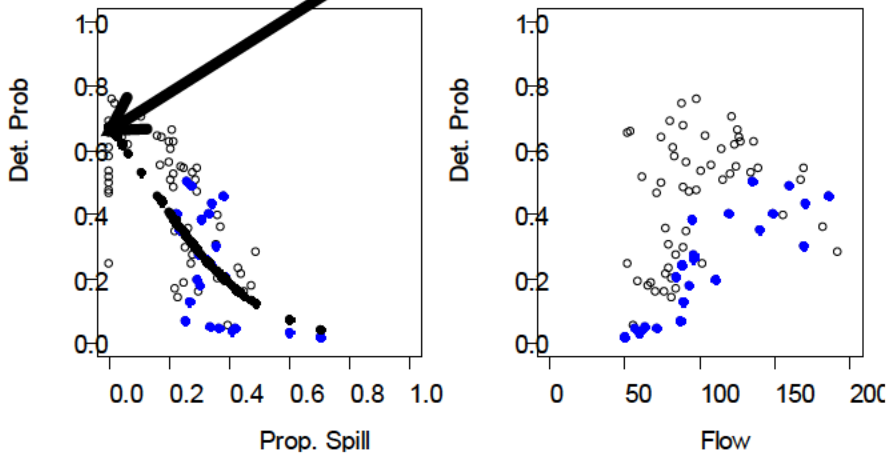


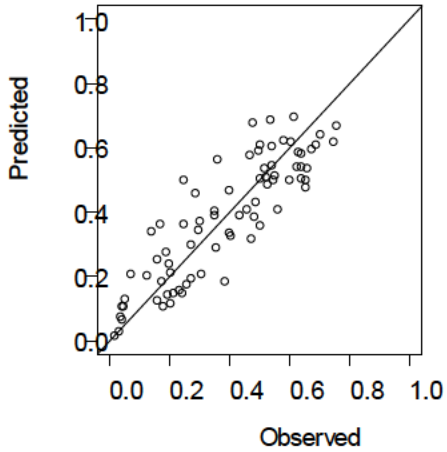


Spill metrics

Lower Monumental Dam steelhead

FGE = 0.62

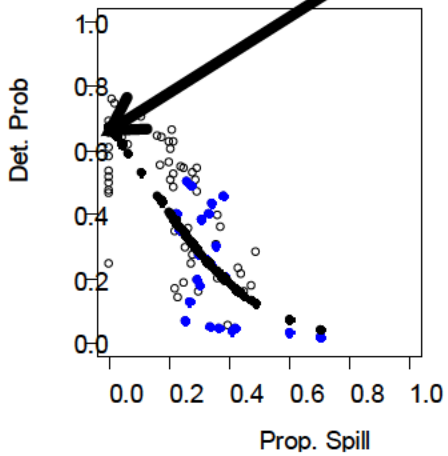


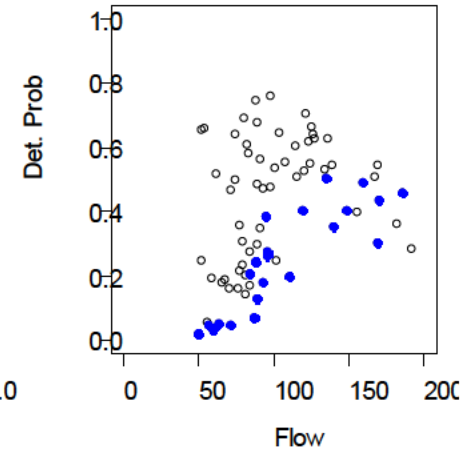


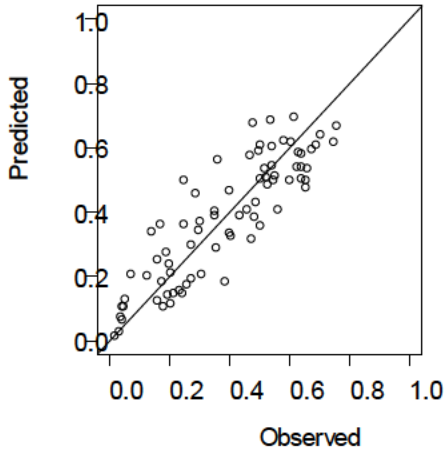
Spill metrics

Lower Monumental Dam steelhead

FGE = 0.62





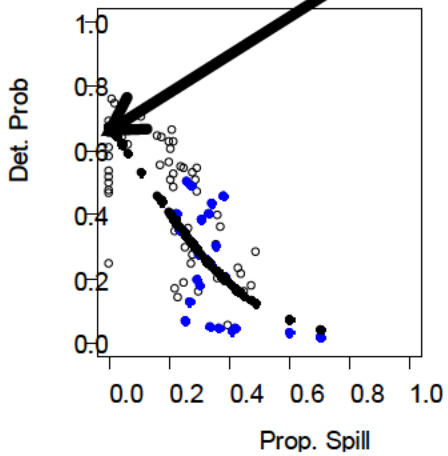


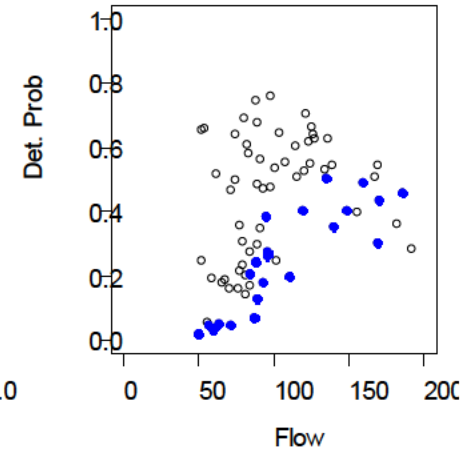
Detection prob. = f (spill, flow, spillway weir)

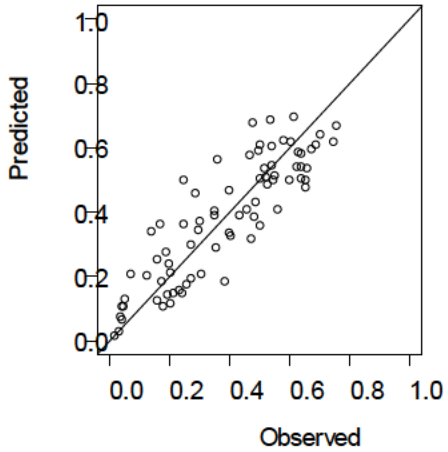
Spill metrics

Lower Monumental Dam steelhead

FGE = 0.62

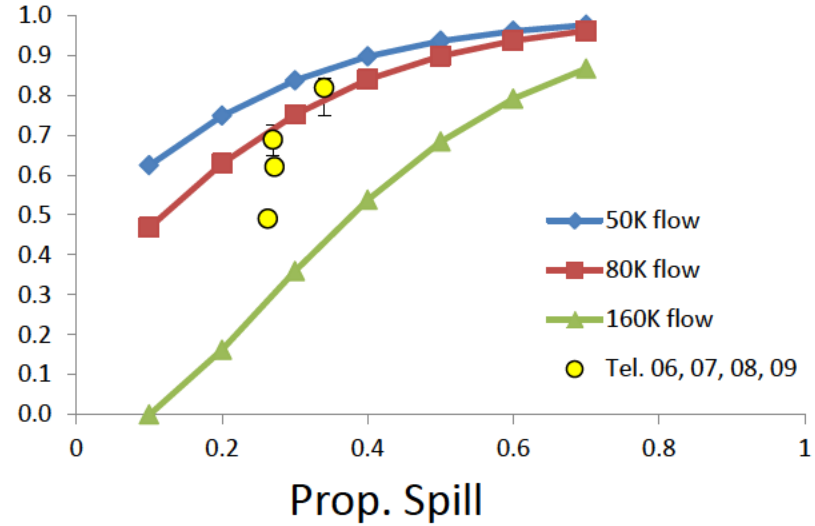






Detection prob. = f (spill, flow, spillway weir)

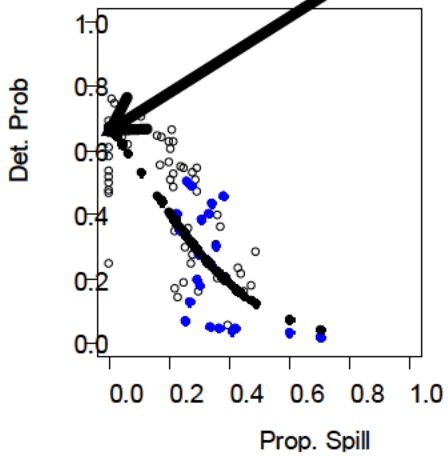
Spillway passage

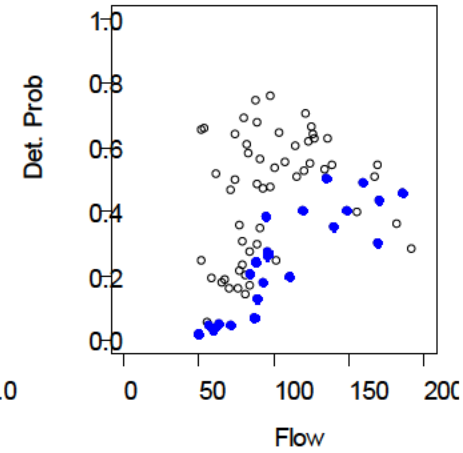


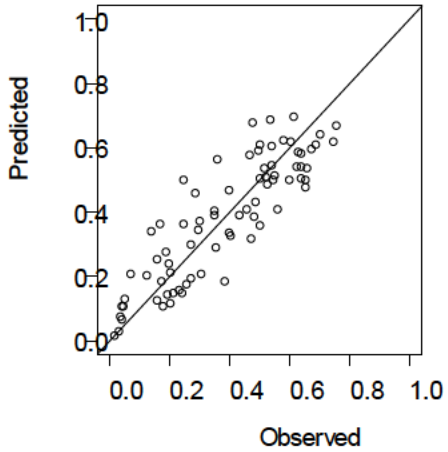
Spill metrics

Lower Monumental Dam steelhead

FGE = 0.62

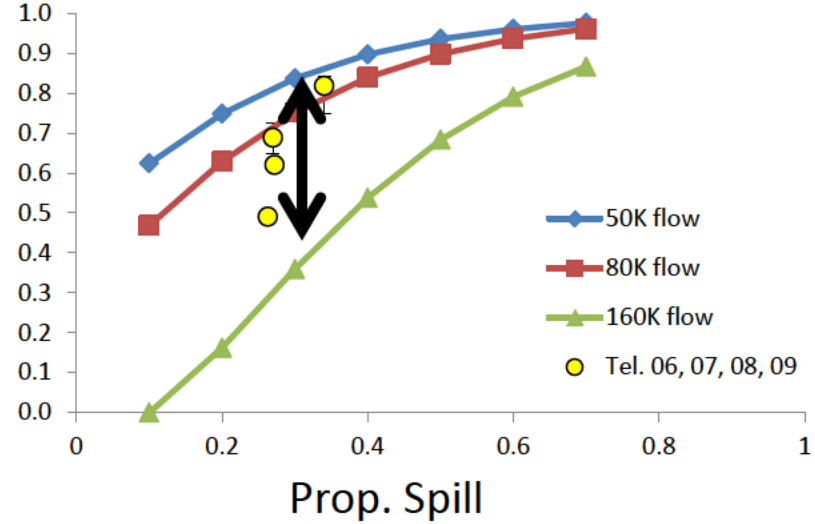






Detection prob. = f (spill, flow, spillway weir)

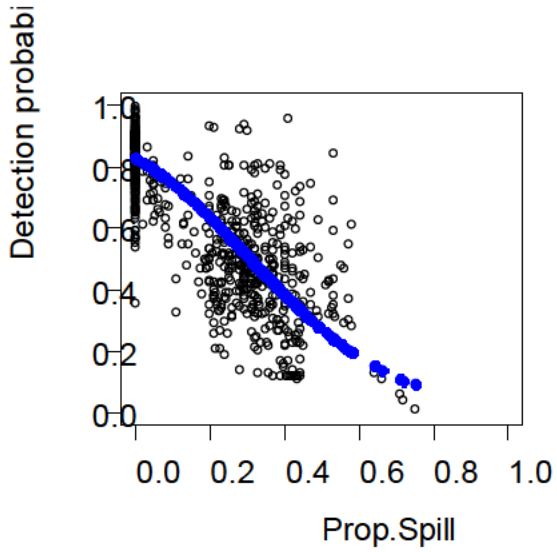
Spillway passage

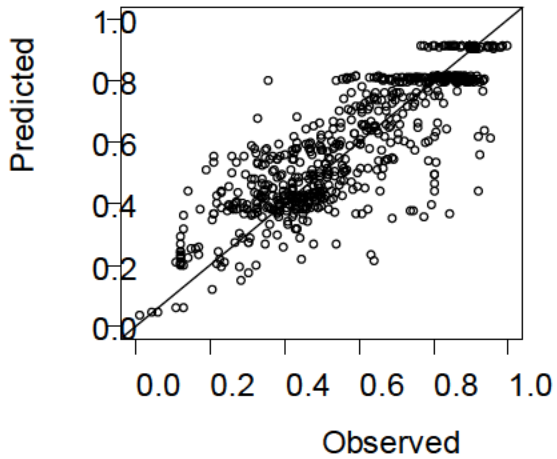


Factors influencing detection probabilities

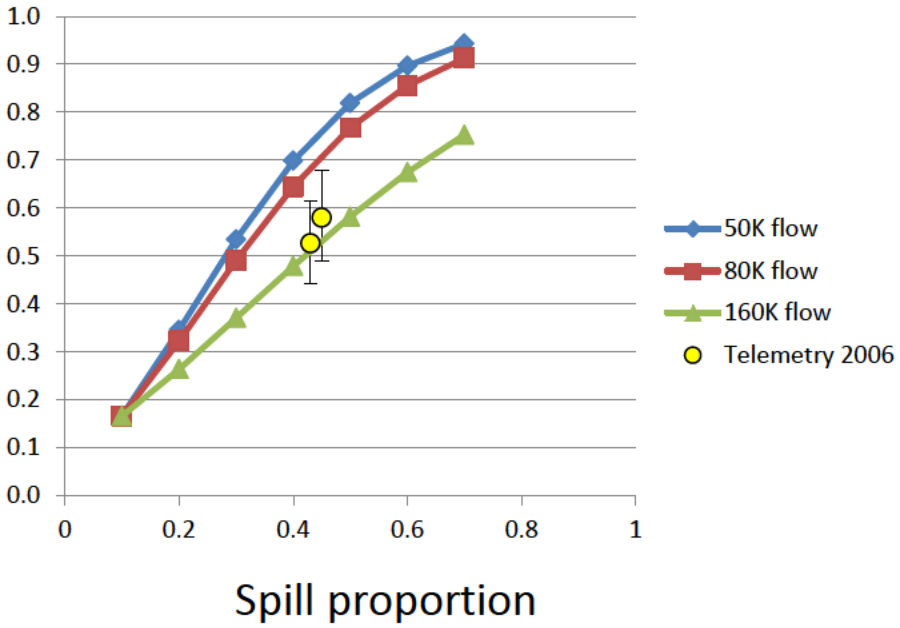
	Project	Flow	Spill %	Flow * Spill %	RSW/TSW
Chinook	LGR				
	LGS				
	LMN				
	IHR				
	MCN				
	JDA				
	TDA				NA
	BON				NA
Steelhead	LGR				
	LGS				
	LMN				
	IHR				
	MCN				
	JDA				
	TDA				NA
	BON				NA

LGR
STH+W

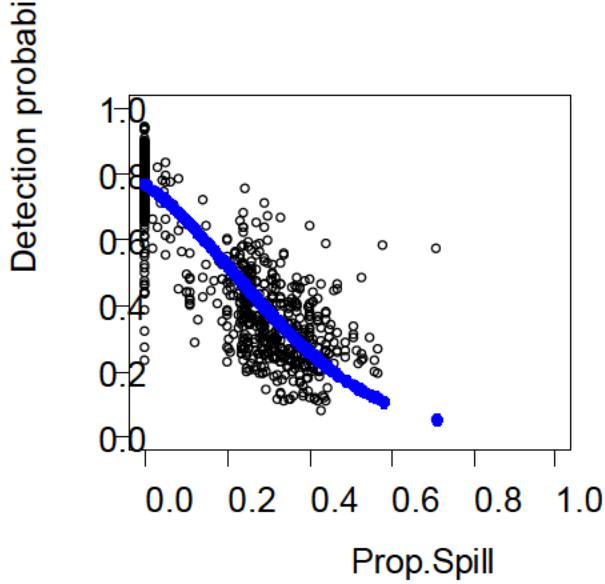


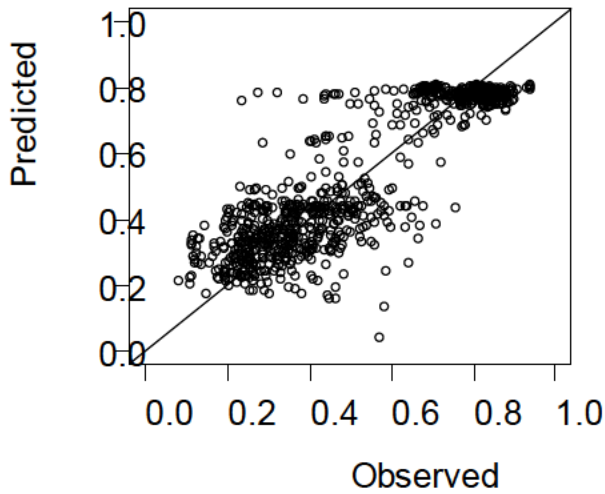


Spillway
passage

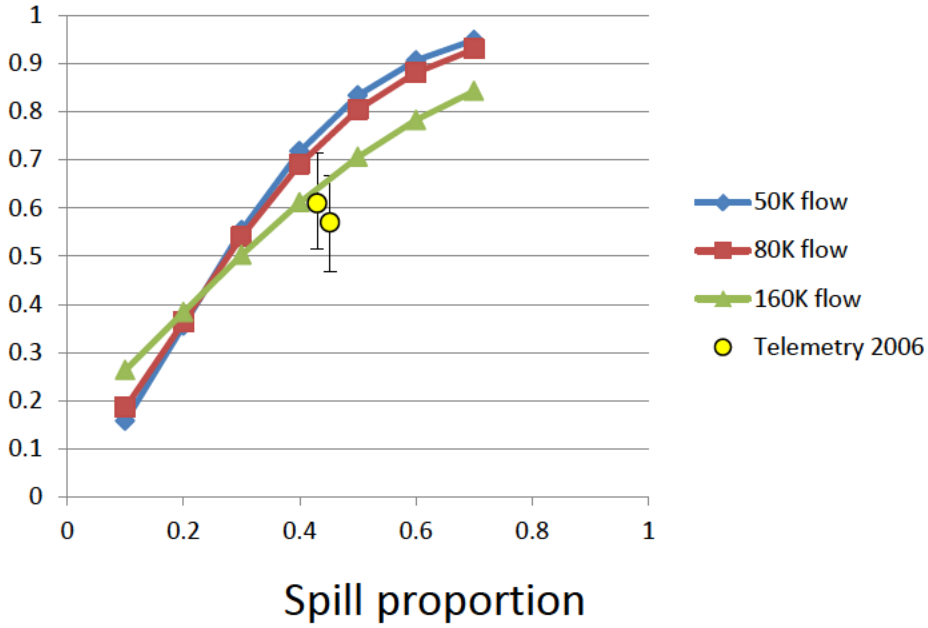


LGR
CH1H+W

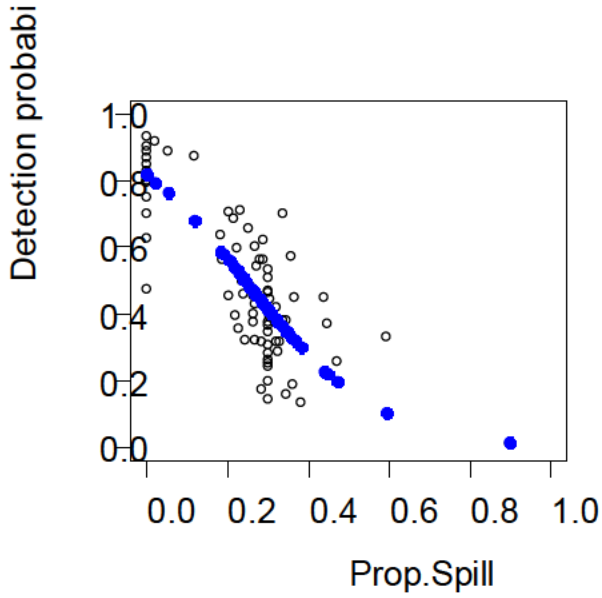


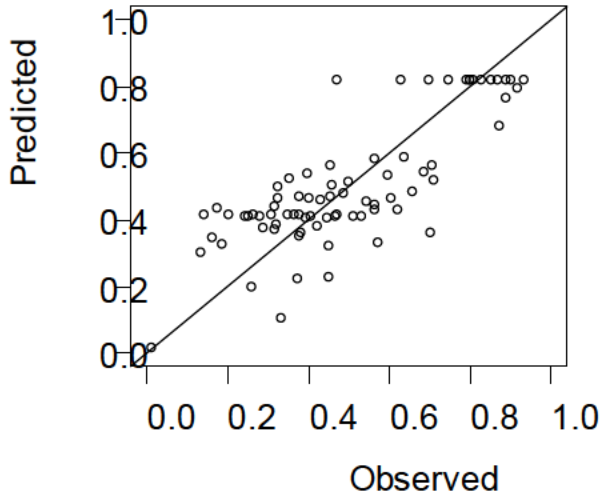


Spillway
passage

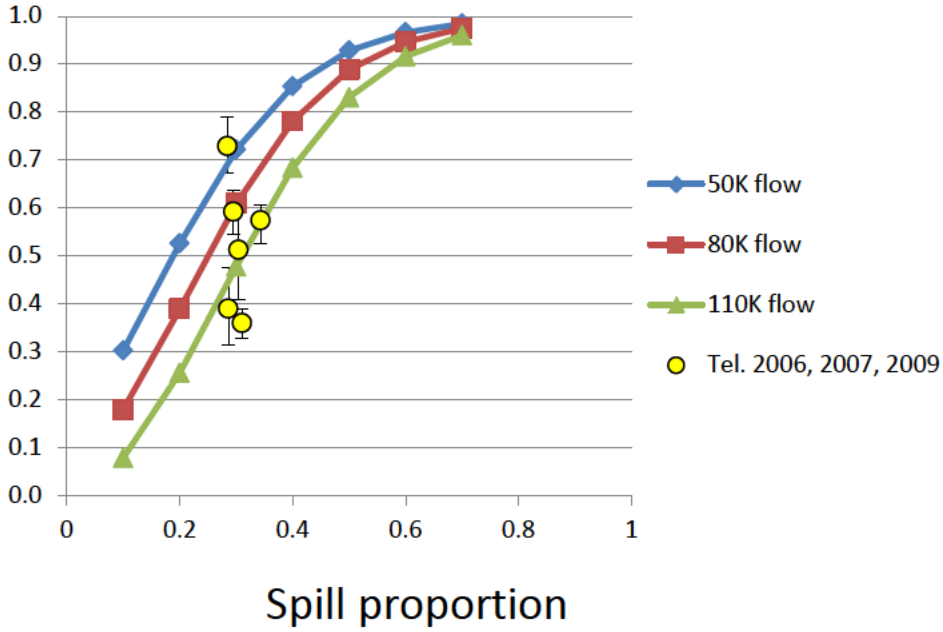


LGS
STH+W





Spillway
passage



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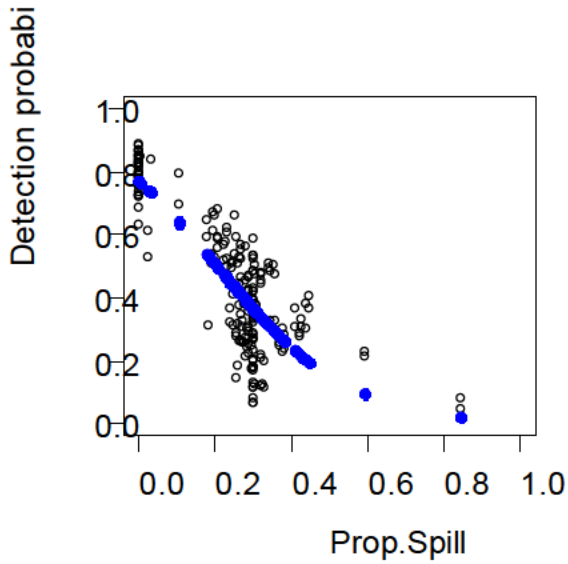
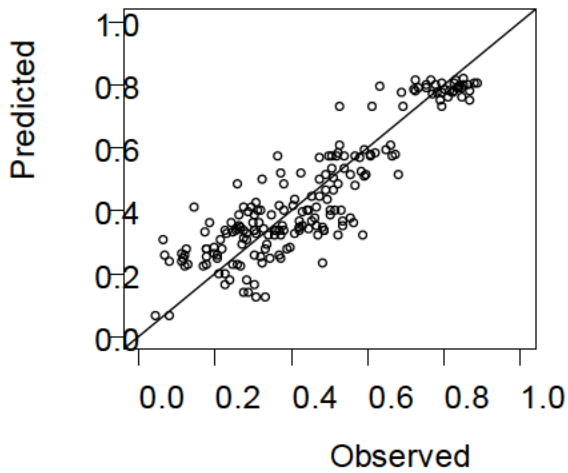
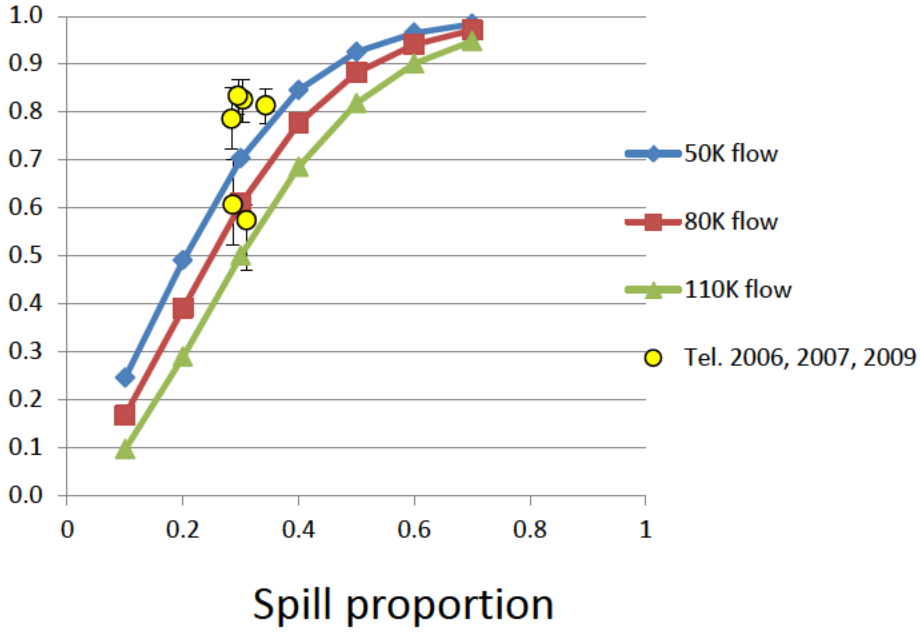
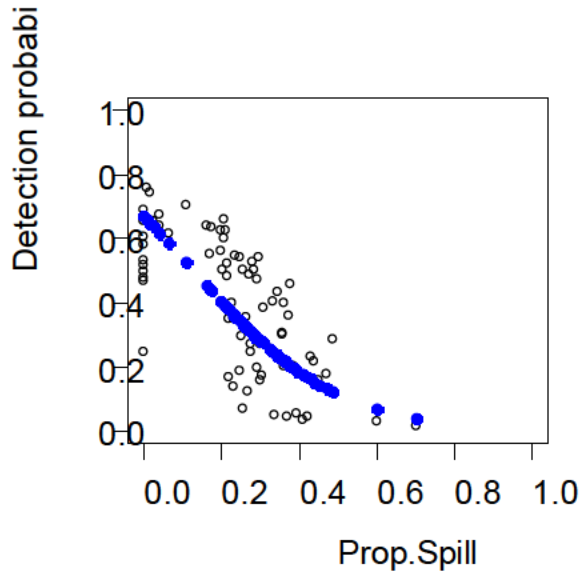


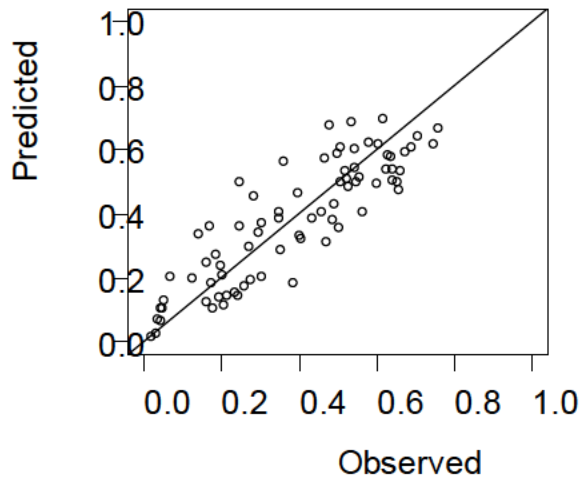


Spillway
passage

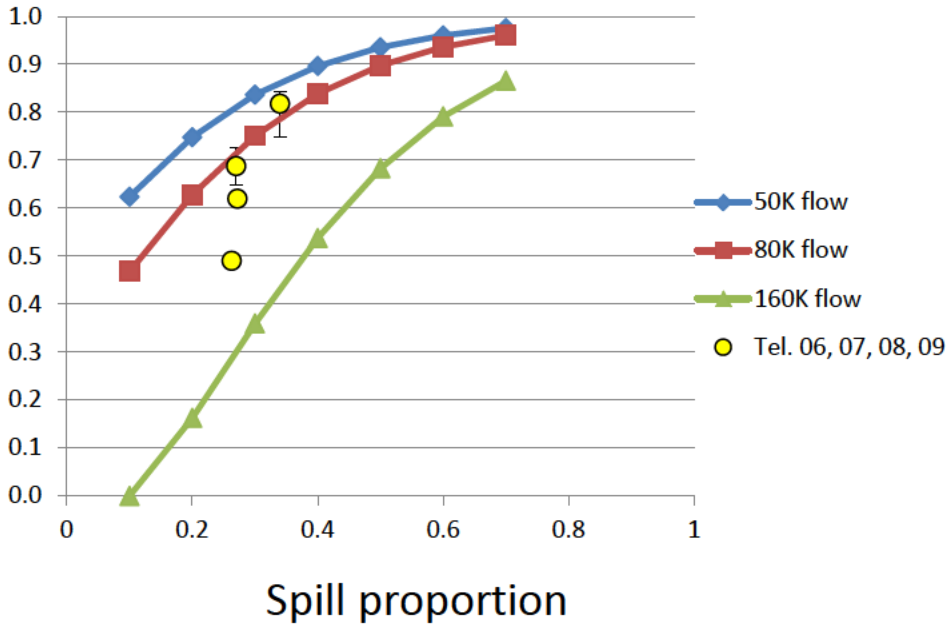


LMO
STH+W

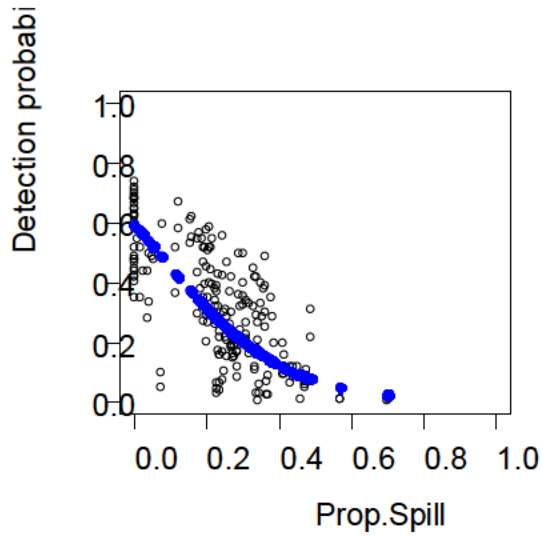


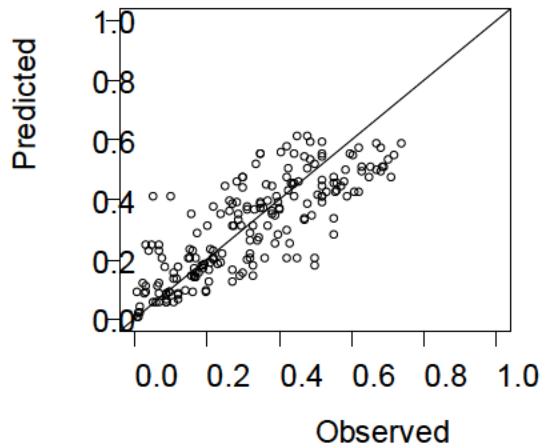


Spillway
passage

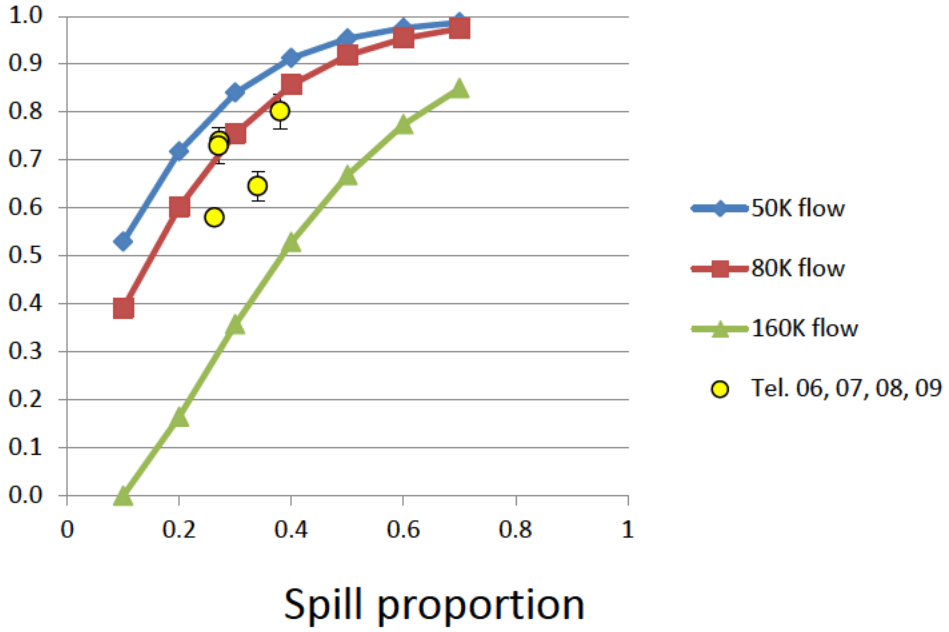


LMO
CH1H+W

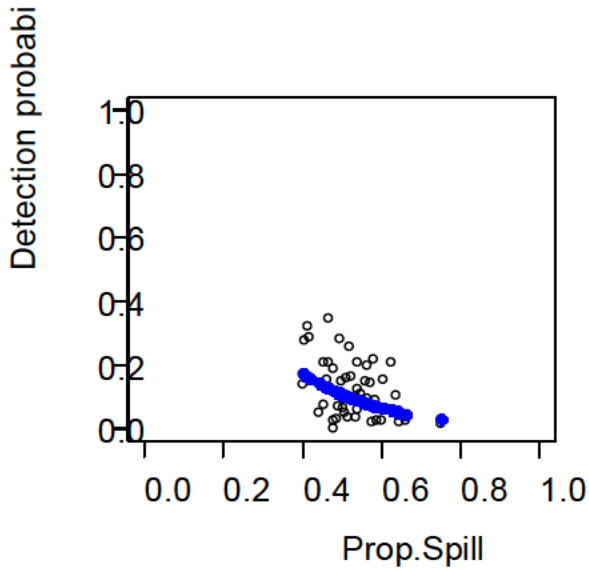


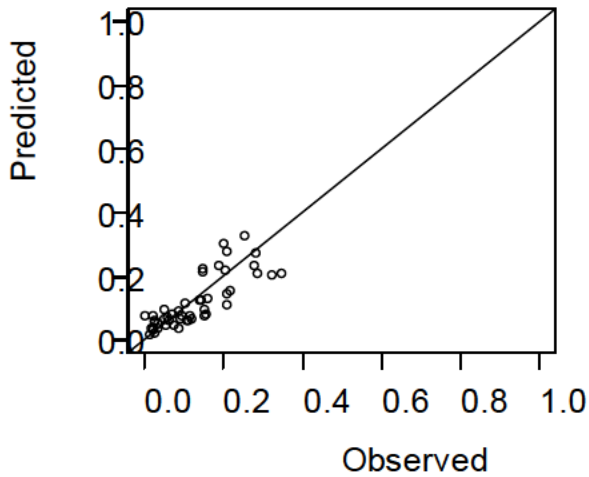


Spillway
passage

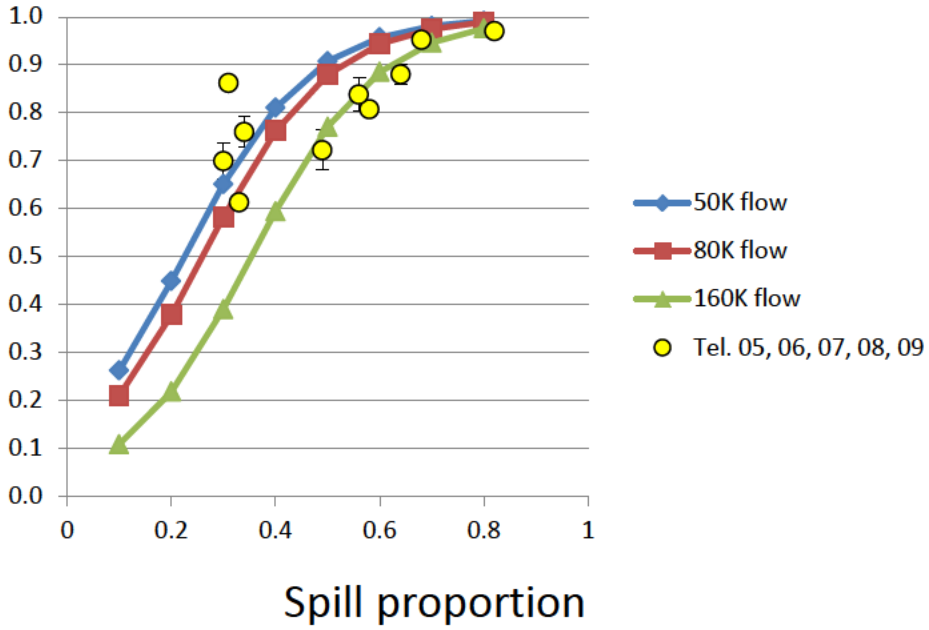


IHR
STH+W





Spillway
passage



IHR
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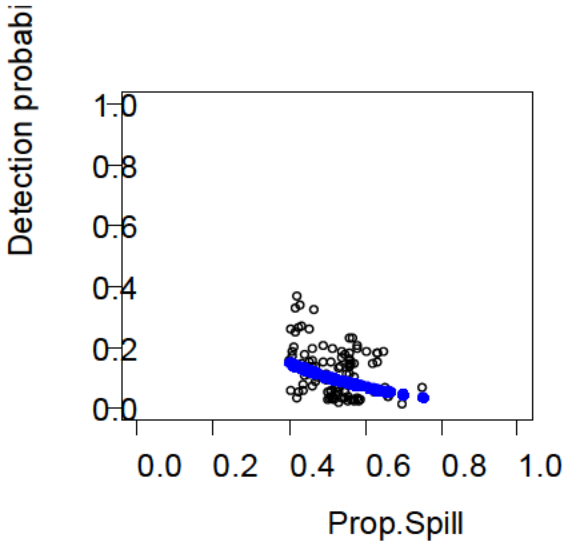
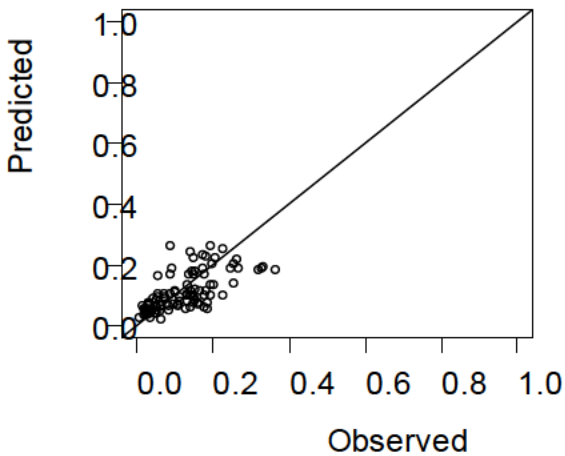
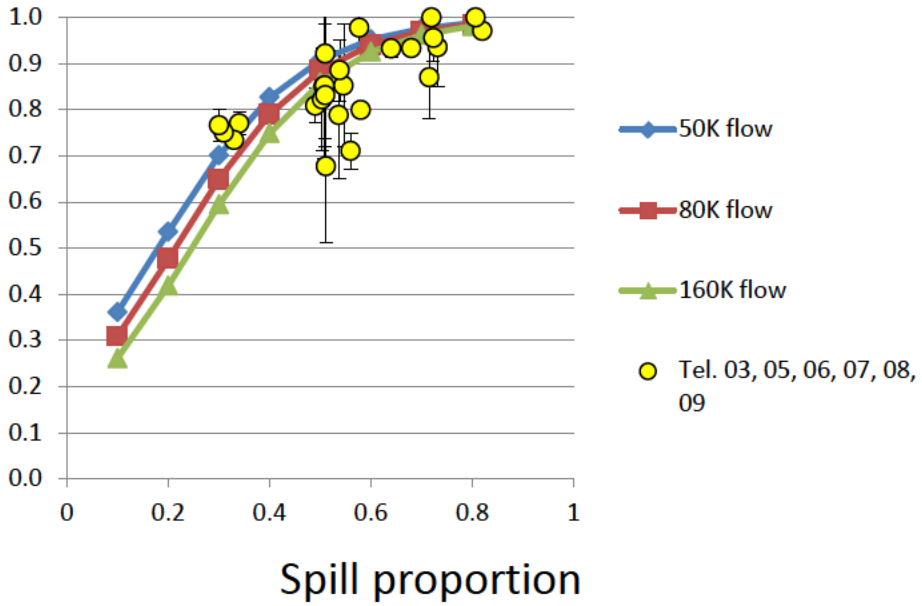




Spillway passage



MCN
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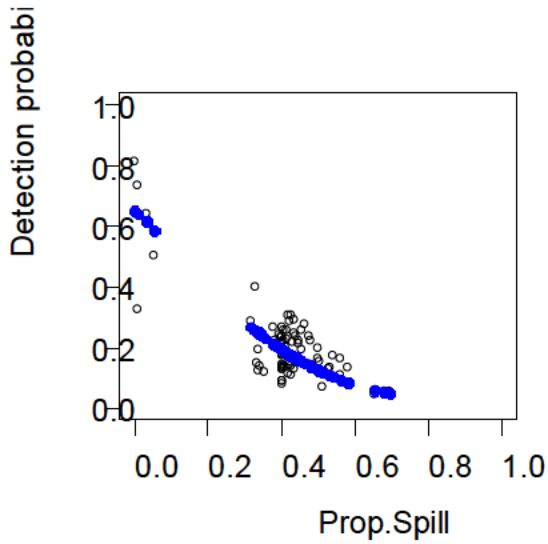

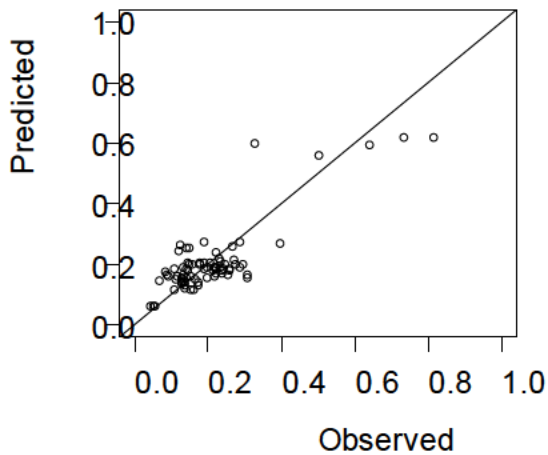

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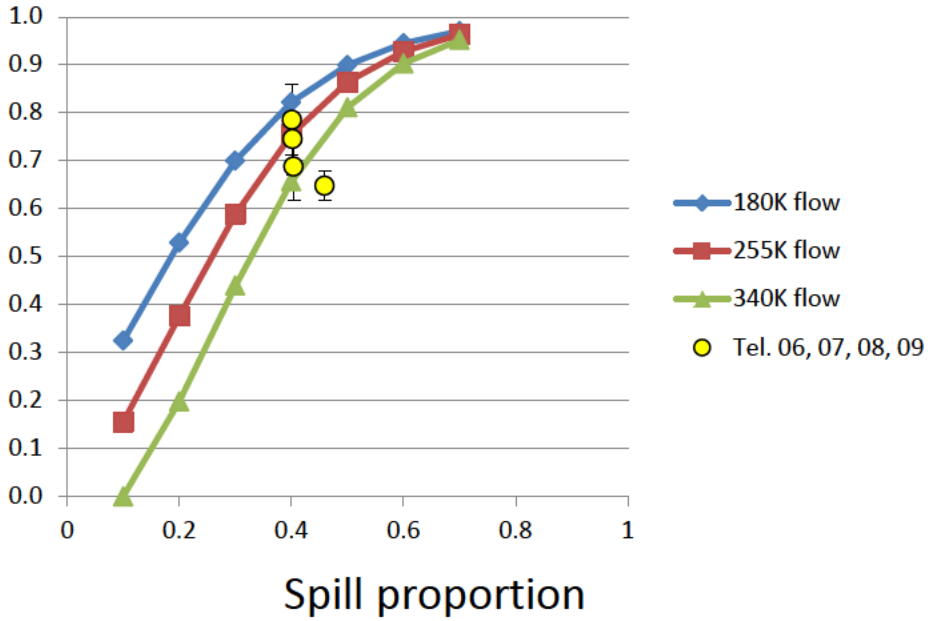

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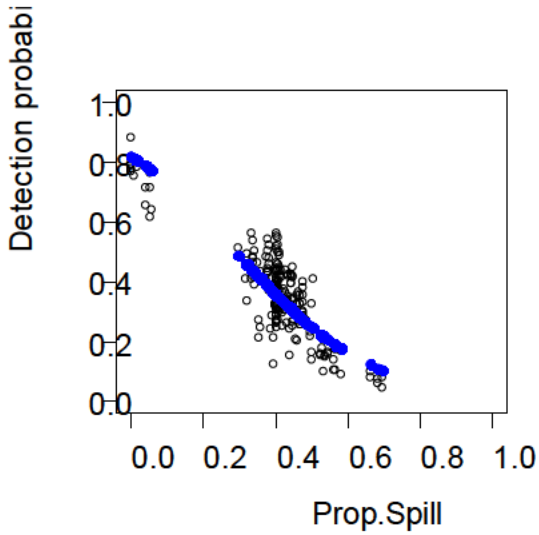
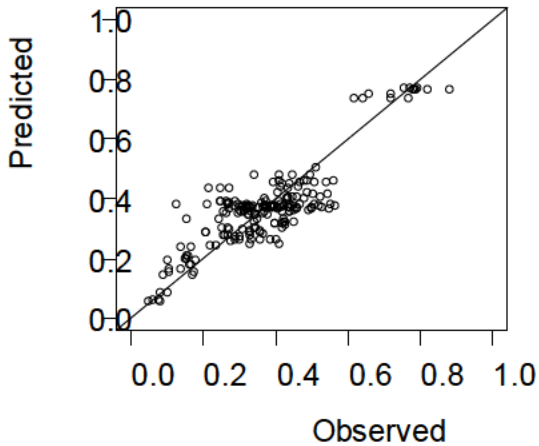
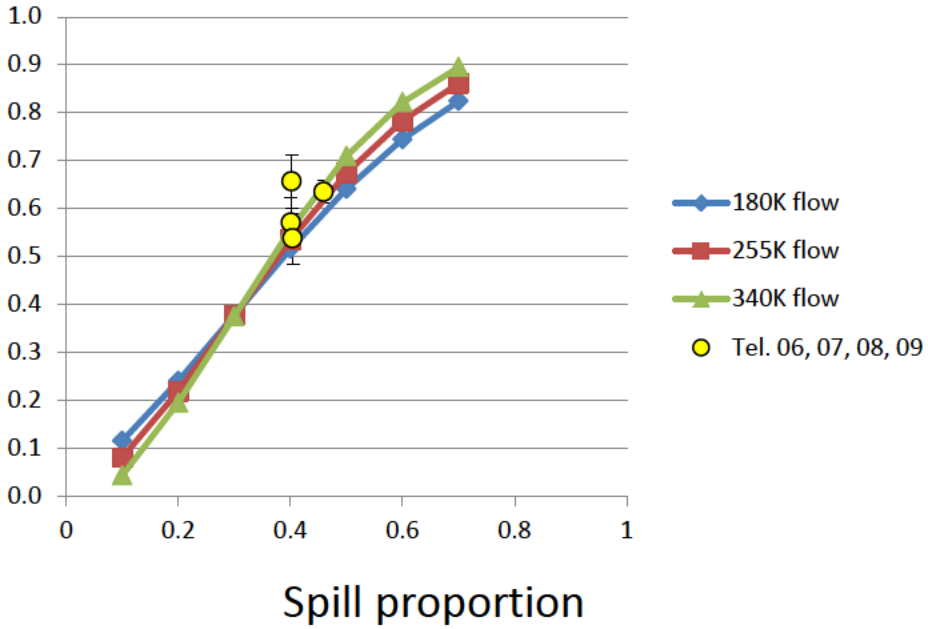




Spillway passage



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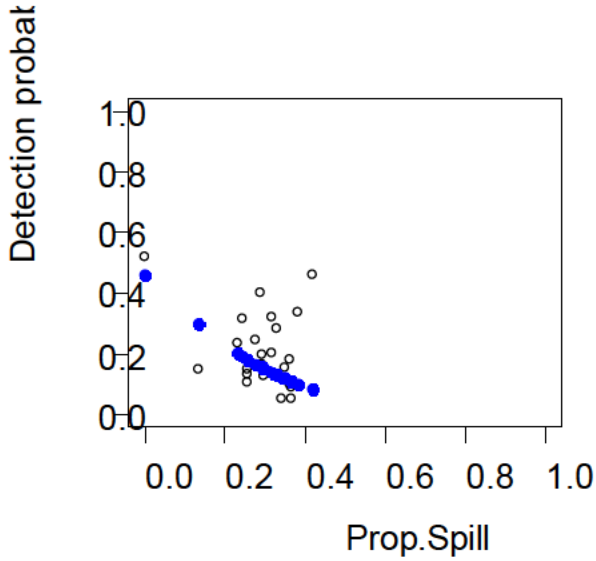
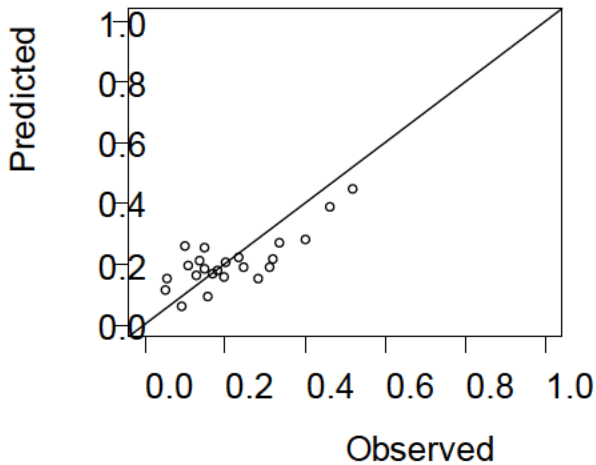
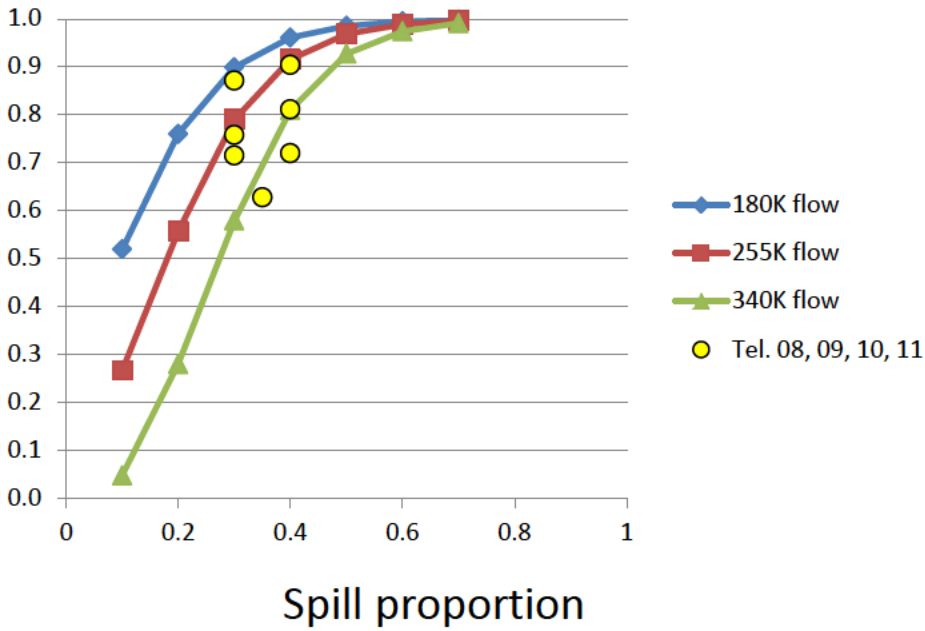




Spillway
passage



JDA
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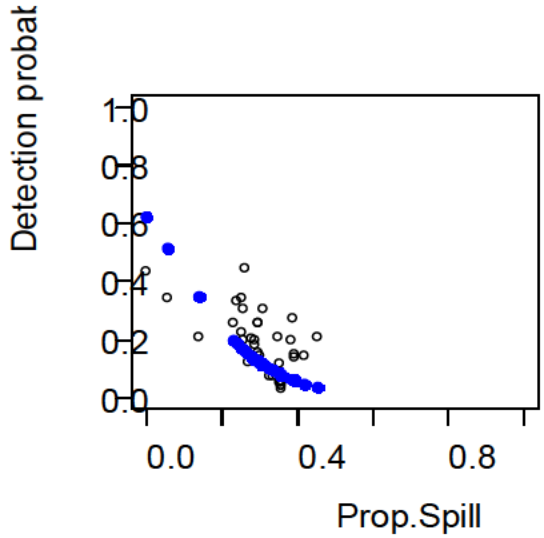
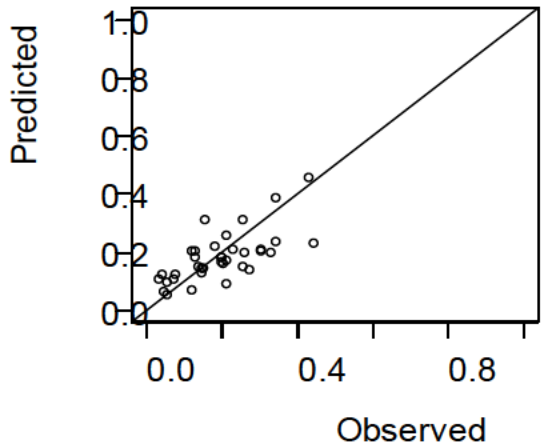
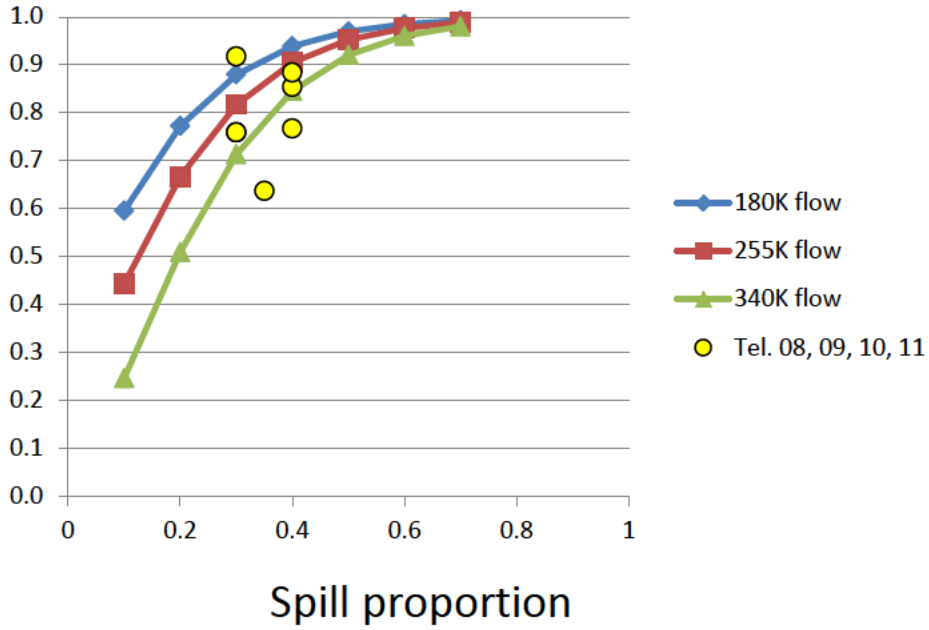




Spillway
passage



TDA
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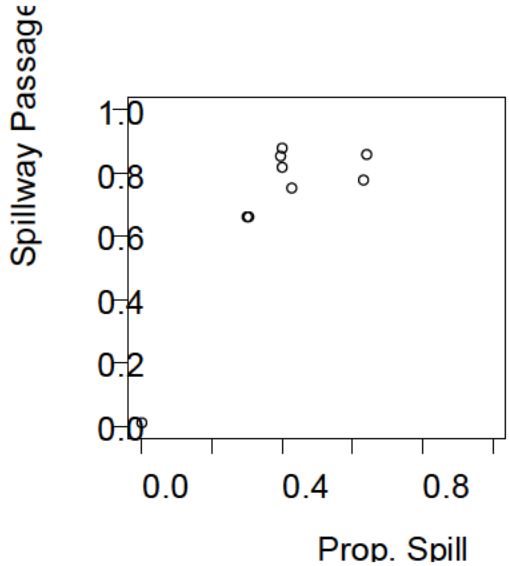

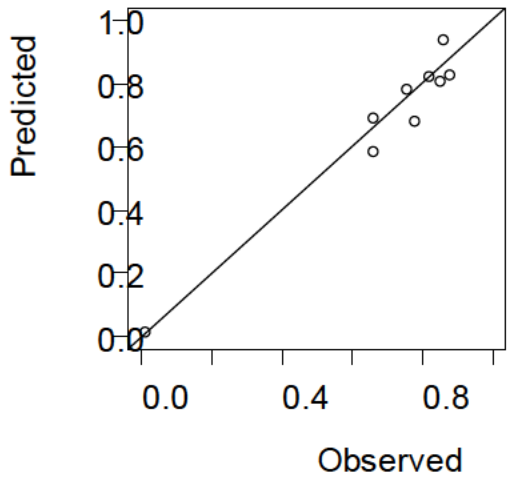

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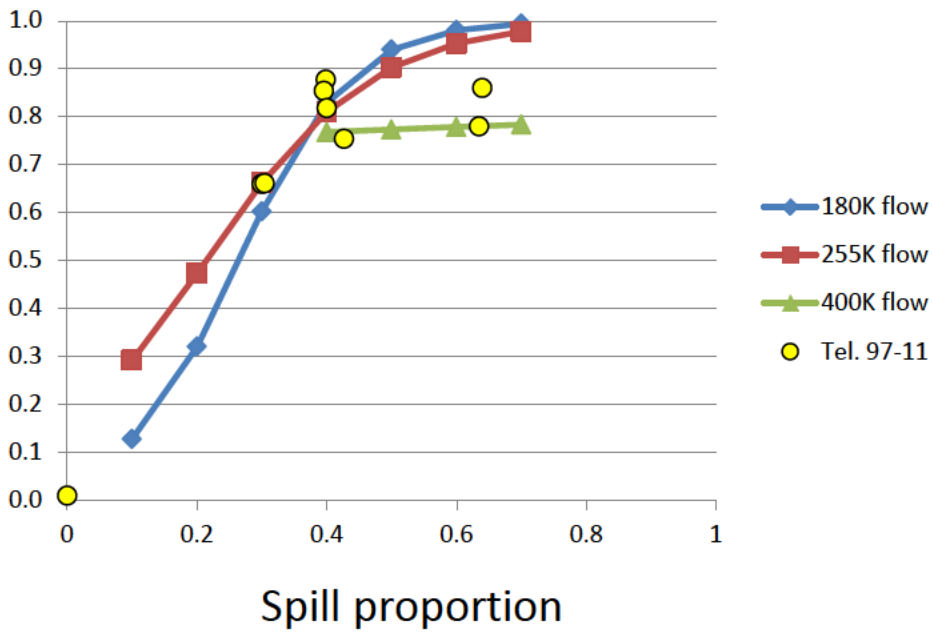

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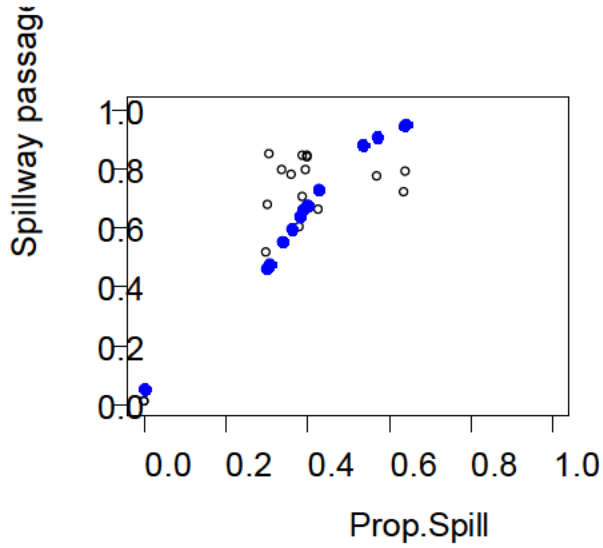
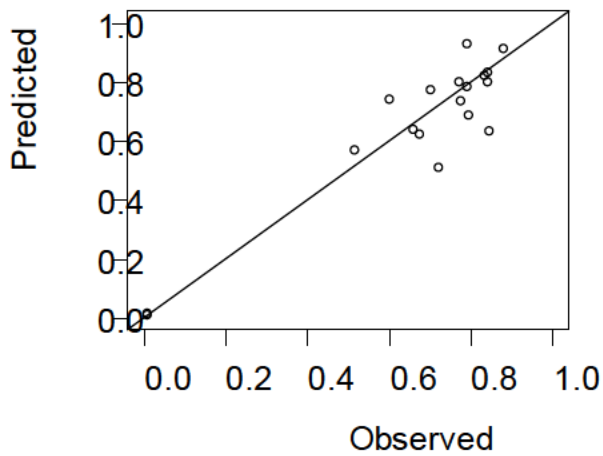
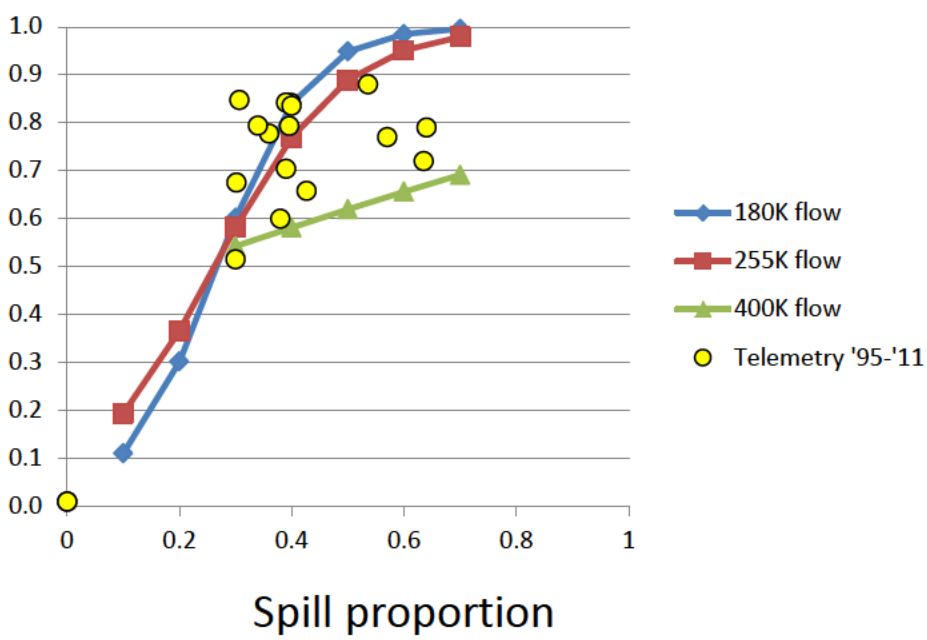




Spillway
passage



BON
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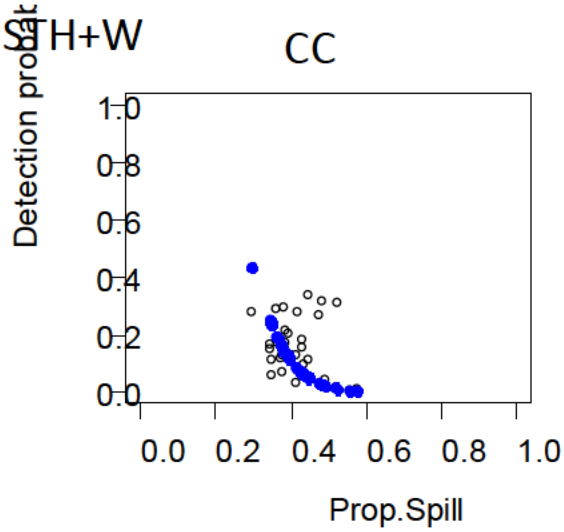
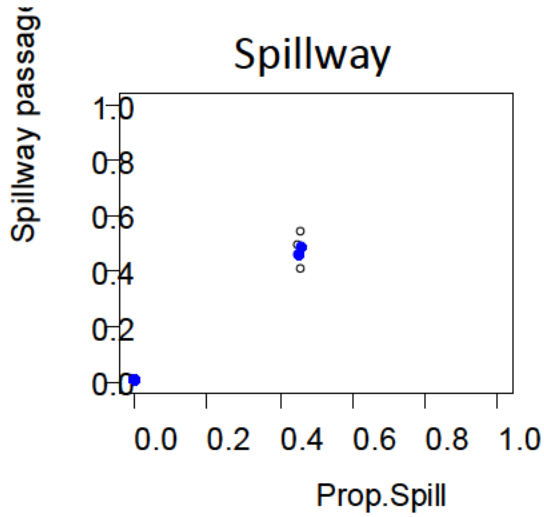
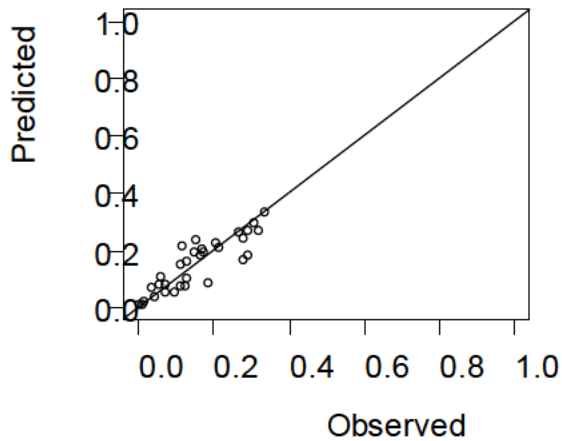
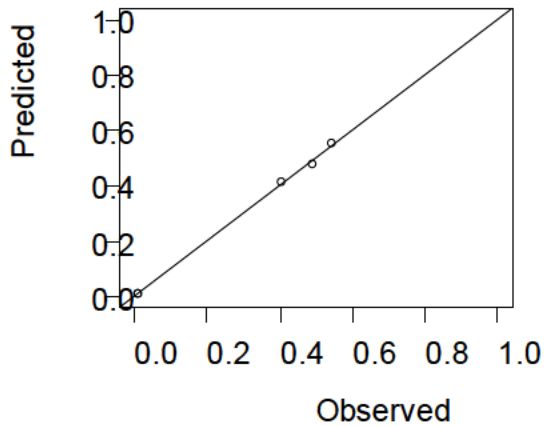
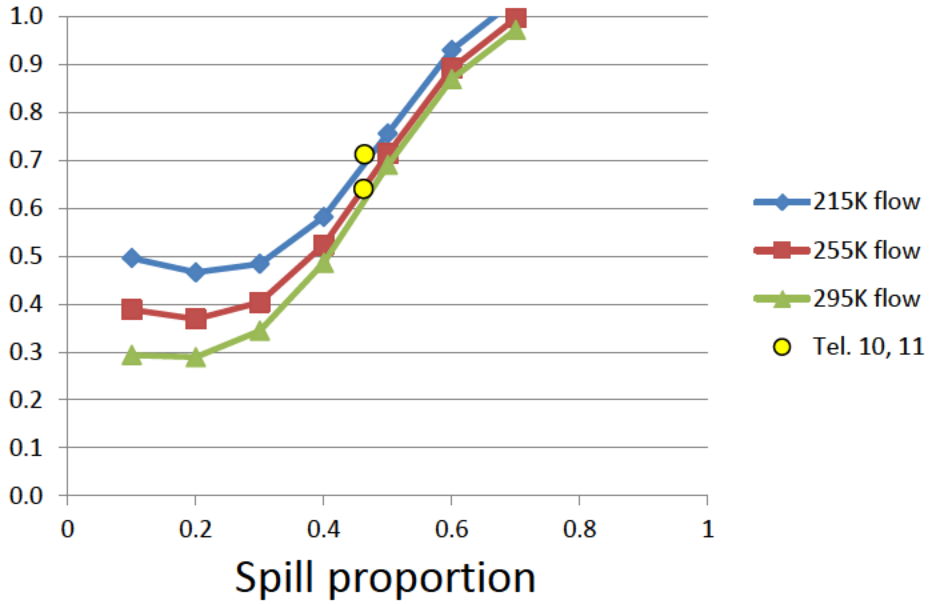








Spillway + CC passage



BON
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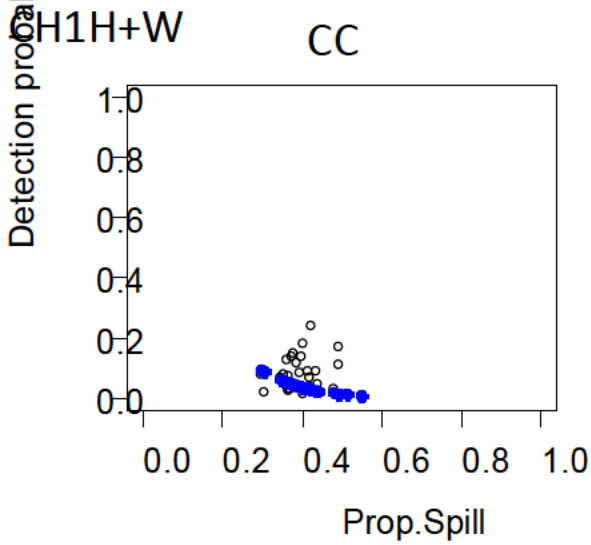
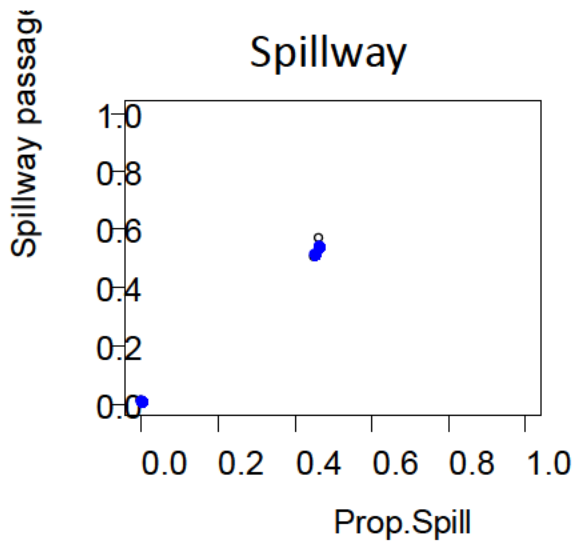
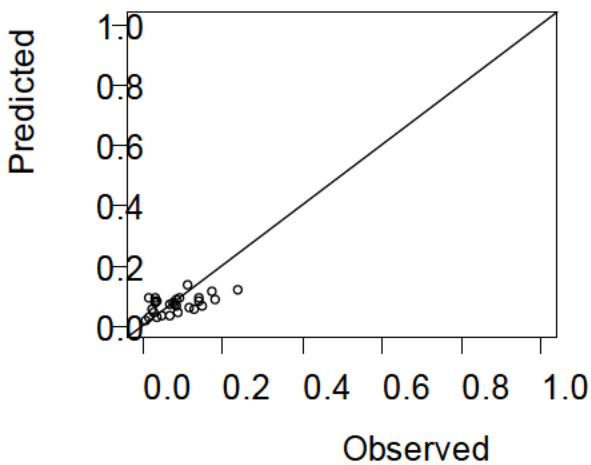
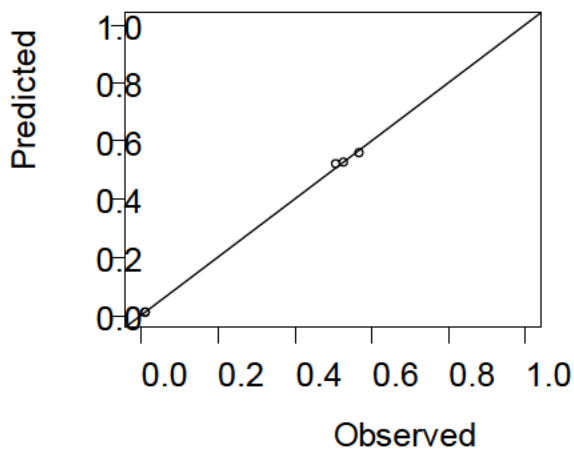
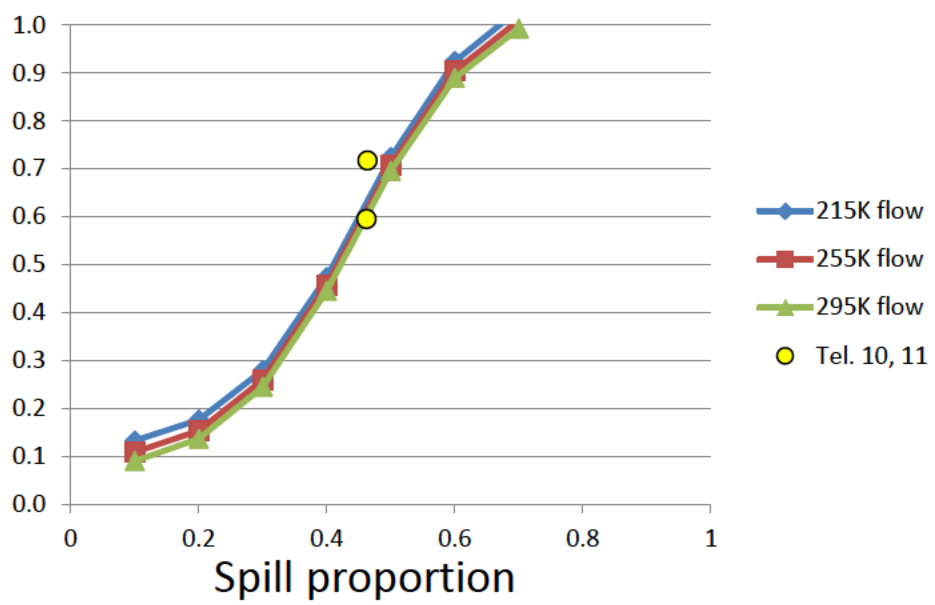








Spillway + CC passage



From:	Milstein,Michael C (BPA) - KE-4
To:	Lut,Agnes (BPA) - KEWR-4; Petersen,Christine H (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4
Subject:	RE: spill presentations
Date:	Wednesday, February 05, 2014 12:45:35 PM

I mentioned this to Jason yesterday and he agreed it's probably time to set up a meeting. He's out today but said we should discuss further when he's back.

From: Lut,Agnes (BPA) - KEWR-4
Sent: Wednesday, February 05, 2014 8:39 AM
To: Petersen,Christine H (BPA) - KEWR-4; Milstein,Michael C (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4
Subject: RE: spill presentations

Christine,
Please hold off on asking Tracy or Barbara to set up a meeting with FPC. This really needs to go through the official channels at the top.
Considering the sensitivity of this issue and this request, it would be best to have Jason work this issue.
a-

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Wednesday, February 05, 2014 8:35 AM
To: Milstein,Michael C (BPA) - KE-4; Lut,Agnes (BPA) - KEWR-4
Subject: RE: spill presentations

Thinking a little more – this might be a good idea to ask to have a phone call with CSS staff where you could go over a list of questions. It could throw them a bit for a loop but you could ask some direct questions. I'm not sure if you'd want to ask Tracy Hauser or Barbara Shields to set it up, and which staff member you would ask to have there (whether it would be Michelle Dehart as spokesperson or Steve Haeseker or Jack Tuomikoski as modelers.

Christine

From: Milstein,Michael C (BPA) - KE-4
Sent: Tuesday, February 04, 2014 4:23 PM
To: Bodi,Lorri (BPA) - KE-4; Lut,Agnes (BPA) - KEWR-4
Cc: Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7; Petersen,Christine H (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5
Subject: RE: spill presentations

Agnes and I have discussed this and gone back over the reports in detail and it's unclear to us whether the 1:1 relationship remains an issue. The CSS presentations and the annual report are not clear on where and when it is used and where and when they switched from that outdated metric to a new one involving models based on PIT tag data. We may need to meet with them and have them explain how they went about this because trying to interpret their calculations is like trying to decipher the Dead Sea Scrolls. Once we do understand their model we probably want to have someone review it. In the meantime we should hold off on bringing up the 1:1 issue.

Interestingly their model does seem to show a significant reduction in how often fish pass through powerhouses since the advent of spill and surface passage.

From: Bodi,Lorri (BPA) - KE-4
Sent: Tuesday, February 04, 2014 1:55 PM
To: Lut,Agnes (BPA) - KEWR-4
Cc: Milstein,Michael C (BPA) - KE-4; Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7; Petersen,Christine H (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5
Subject: Re: spill presentations

So the use of the 1:1 relationship rather than the use of the actual data remains a real issue.

On Feb 4, 2014, at 1:52 PM, "Lut,Agnes (BPA) - KEWR-4" <axlut@bpa.gov> wrote:

> Michael is correct, CSS accounts for surface passage at each of the dams however it still does not utilize the Performance Standard Test route / survival data in their model. They also account for Spill Passage Efficiency (SPE) as a function of the spill volume.
>
> CSS states specifically (and this is where we disagree):
>
> CSS 2013 Annual Report – ". This metric provides an indirect measure of passage routing based on the assumption
> that the spill passage efficiency (SPE) is a 1:1 relationship and thus fish passage is directly proportional to
> water volume (e.g., when 20% of the water is spilled, then 20% of the fish will pass through the
> spillway)."
>
> ---
>
> **From:** Milstein,Michael C (BPA) - KE-4
> **Sent:** Tuesday, February 04, 2014 1:39 PM
> **To:** Klumpp,Elizabeth C (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Bodi,Lorri (BPA) - KE-4
> **Cc:** Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7; Petersen,Christine H (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5
> **Subject:** RE: spill presentations
>
> We should not be saying that CSS overlooks the recent Smart Spill improvements. This was the point about how we believed CSS oversimplifies conditions in the hydro system (last slide in the ISAB package) because they do not use recent acoustic tag data and therefore they do not account for the benefits of surface passage, etc. Ritchie is saying that they have updated their model so that it does reflect the benefits of those improvements at individual dams.
>
> ---
>
> **From:** Klumpp,Elizabeth C (BPA) - DKR-7
> **Sent:** Tuesday, February 04, 2014 1:18 PM
> **To:** McNary,Sarah R (BPA) - A-7; Bodi,Lorri (BPA) - KE-4

Cc: Milstein,Michael C (BPA) - KE-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5
Subject: RE: spill presentations

So, to summarize, should those of us who communicate externally stop using any statements that the CSS model was not designed for the kind of analysis Haeseker conducted? If that's not the point, can a fish-person summarize the message below? Thank you!

From: McNary,Sarah R (BPA) - A-7
Sent: Tuesday, February 04, 2014 12:40 PM
To: Bodi,Lorri (BPA) - KE-4
Cc: Milstein,Michael C (BPA) - KE-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; Ball,Crystal A (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5
Subject: FW: spill presentations

Lorri – For your awareness. You likely have received this already from your team and I know Jason is working directly with Ritchie, but I wanted to be sure you received this communication from Ritchie. For efficiency's sake I am cc'ing a few of our key folks internally as an FYI.
S.

From: Ritchie Graves - NOAA Federal [mailto:ritchie.graves@noaa.gov]
Sent: Tuesday, February 04, 2014 10:02 AM
To: Peters, Rock D NWD; Feil, Dan H NWD; Sweet,Jason C (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5; Mike Ford - NOAA Federal; Michael Tehan - NOAA Federal; Bruce Suzumoto; Puckett, Kathryn J; McNary,Sarah R (BPA) - A-7; Lori Thompson; Richard Zabel - NOAA Federal
Cc: Paul Wagner; Gary Fredricks; Bill Hevlin; Trevor Conder; Steven Smith - NOAA Affiliate; James Faulkner - NOAA Federal; Eitel, Michael (ENRD); Mark Eames - NOAA Federal
Subject: Fwd: spill presentations

All:

As most of you are aware, following the Jan 17 ISAB meeting, I agreed to meet with some of the Comparative Survival Study technical staff to better understand how, and to what extent, they have incorporated SPE etc. changes resulting from the installation of surface passage structures at the mainstem dams into their analysis. Paul and I met with them on January 24, and Steve Haeseker (FWS) kindly walked us through their analysis methodology (see the attached spreadsheets).

Part of the confusion (from NOAA's perspective) appears to have been caused by a miscommunication between myself and a CSS member at their April 2013 workshop. The 2013 CSS report's heavy reliance on references to earlier materials (workshop results, earlier reports, etc.) regarding

methodologies also seems to have contributed to our misunderstanding of how this information has been incorporated into the report.

The attached PowerPoint presentations summarize the CSS methodology for estimating detection probabilities and derived SPE estimates for their models for both yearling Chinook and steelhead. I've not had the time to compare this to the SPE estimates used in COMPASS (which we'll be working to update again in the coming year or so) or get any review from our Science Center.

(I can say that we had shared versions of the COMPASS SPE curve estimates with Steve Haeseker in the past, and he considered this information in building his relationships.)

Long story short... it is clear that the CSS group has done a substantial amount of work to try and incorporate and update spill relationships that have changed as a result of surface passage routes being added to many of the mainstem dams for the observed ranges of data.

Thus, their work should not be characterized to others as having ignoring the effect of these configurational improvements.

The CSS group has pointed this out in their latest comments to the ISAB (Theme 2: Criticism of the CSS Analysis - "The implementation and operation of surface passage structures and available acoustic tag data have all been incorporated into the CSS analyses spill metric").

I would strongly urge you to contact Steve Haeseker or Michele DeHart if you have additional questions about the analysis or would like to organize a meeting to discuss this information further with the CSS group.

Best Wishes,
Ritchie

Ritchie Graves
Columbia Hydropower Branch
Interior Columbia Basin Office
NOAA Fisheries, West Coast Region

phone: 503-231-6891
cell: 503-730-5148

---------- Forwarded message ----------
From: **Haeseker, Steve** <steve_haeseker@fws.gov>
Date: Mon, Jan 27, 2014 at 9:43 AM
Subject: spill presentations
To: Ritchie.Graves@noaa.gov
Cc: Howard Schaller <howard_schaller@fws.gov>, Michele Dehart <mdehart@fpc.org>

Ritchie,

Attached are the presentations from our meeting last week. Let me know if there are any other questions.

-Steve

--
Steve Haeseker
Columbia River Fisheries Program Office
U.S. Fish & Wildlife Service
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

Phone: 360 604-2517
www.fws.gov/columbiariver/

From:	McNary,Sarah R (BPA) - A-7
To:	Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4
Cc:	Bodi,Lorri (BPA) - KE-4; Harwood,Holly C (BPA) - PGB-5; Barco III,John W (BPA) - A-7
Subject:	FW: Final Materials for Caucus Today - Question
Date:	Wednesday, February 19, 2014 3:55:02 PM
Attachments:	Fed_C_Experimental_Spill_02_18_14.pptx
Importance:	High

Jason and Bill – I just got back from leave this afternoon and John filled me in on the Caucus presentation on this topic yesterday. A question for you both – is this exactly the same presentation as was made to the ISAB? I am looking in particular at slides 29-31 which appear to be a direct critique of the FCRPS BiOp.
Thanks,
Sarah

From: Gina Schroeder - NOAA Affiliate [mailto:gina.schroeder@noaa.gov]
Sent: Tuesday, February 18, 2014 4:08 PM
To: Dan H NWD Feil; David Redhorse; Gregory J Fuhrer; Barco III,John W (BPA) - A-7; Kozakiewicz, Vincent J; Steve Waste; Tony Barber; bill.white@or.usda.gov; Bruce Suzumoto; Dach, Robert; Kathryn J Puckett; Kathy Ceballos; Lief R Horwitz; Linda Ulmer; Mark Bagdovitz; Mary Lou Soscia; Peters, Rock D NWD; Rick Mogren; McNary,Sarah R (BPA) - A-7; James Dixon - NOAA Federal; Howard Schaller; Carmack, Corey P; Gary Sims; Lynn Hatcher; Mark Eames; Michael Coffey; Allyson Purcell - NOAA Federal; Rob Jones - NOAA Federal; Sweet,Jason C (BPA) - KEWR-4
Subject: Re: Final Materials for Caucus Today

Howard and Steve's presentation from today.

On Tue, Feb 18, 2014 at 12:53 PM, Gina Schroeder - NOAA Affiliate <gina.schroeder@noaa.gov> wrote:
Attached.

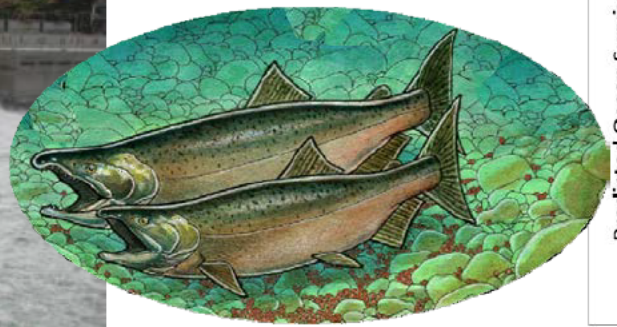
--
Gina K. Schroeder
Assistant Program Coordinator
Columbia Basin Federal Caucus
503.230.5426
gina.schroeder@noaa.gov
CRGT

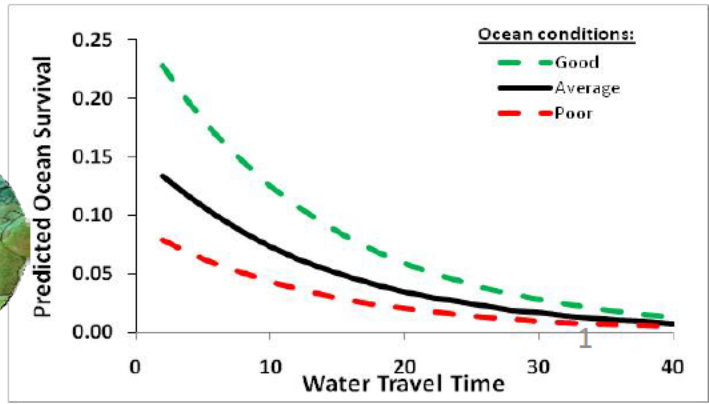
--
Gina K. Schroeder
Assistant Program Coordinator
Columbia Basin Federal Caucus
503.230.5426
gina.schroeder@noaa.gov
CRGT

Comparative Survival Study Outcomes – Experimental Spill Management

CSS Oversight Committee

February 18, 2014





Topics for today

- CSS study
- Long term survival studies
- Background on spill
- Experimental Spill Management Design
- Simulation results and next steps

Comparative Survival Study

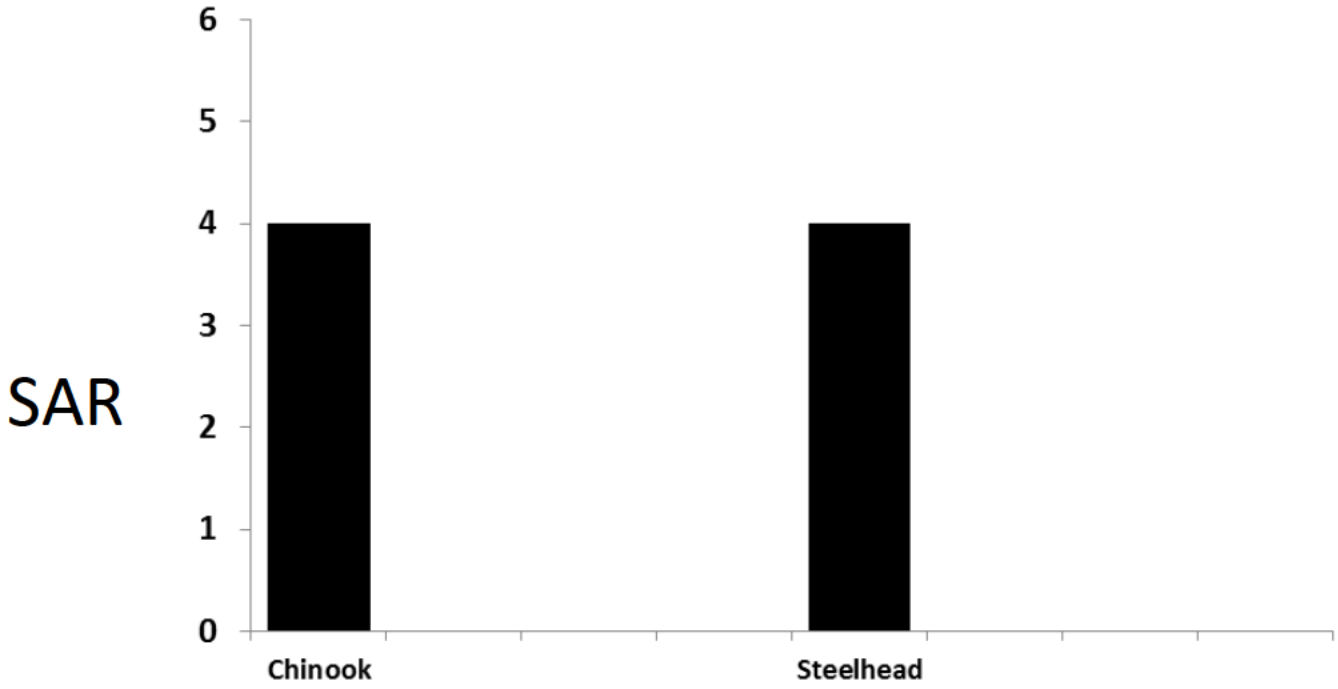
- A regional collaborative salmon and steelhead life cycle monitoring program
- Successfully implemented since 1998
- Annually reviewed by the NPCC Independent Scientific Advisory Board and the region
- Analyses published in peer reviewed scientific journals

History and Background

- Analyzed multiple lines of evidence
- 60- 40 years of historical run reconstruction data
- 15 years of Comparative Survival Study Data
- 15 years of spill and dissolved gas data and effects on juvenile migrants
- Developed spill scenarios on the basis COE data

NPCC Smolt-to-Adult Survival Goal-Recovery

- Achieve SARs averaging 4% for Snake River Chinook salmon and steelhead



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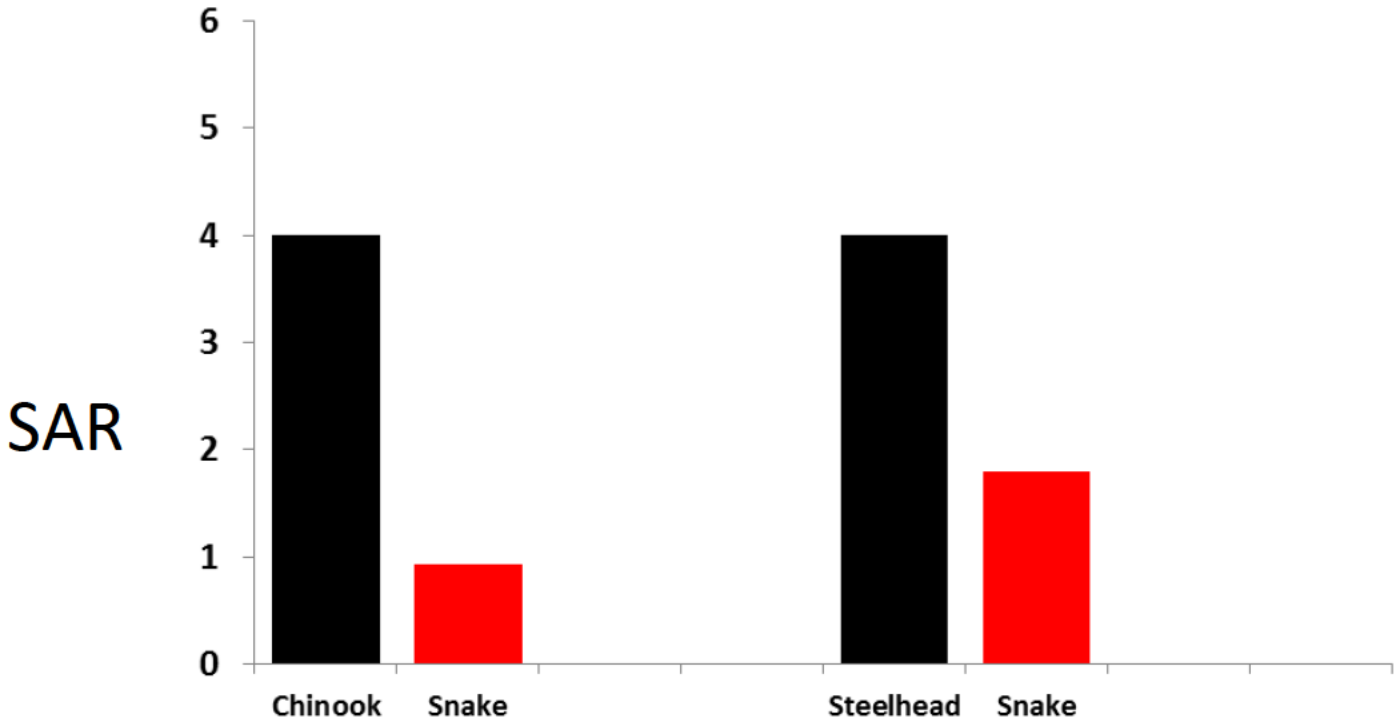

NPCC Smolt-to-Adult Survival Goal-Recovery

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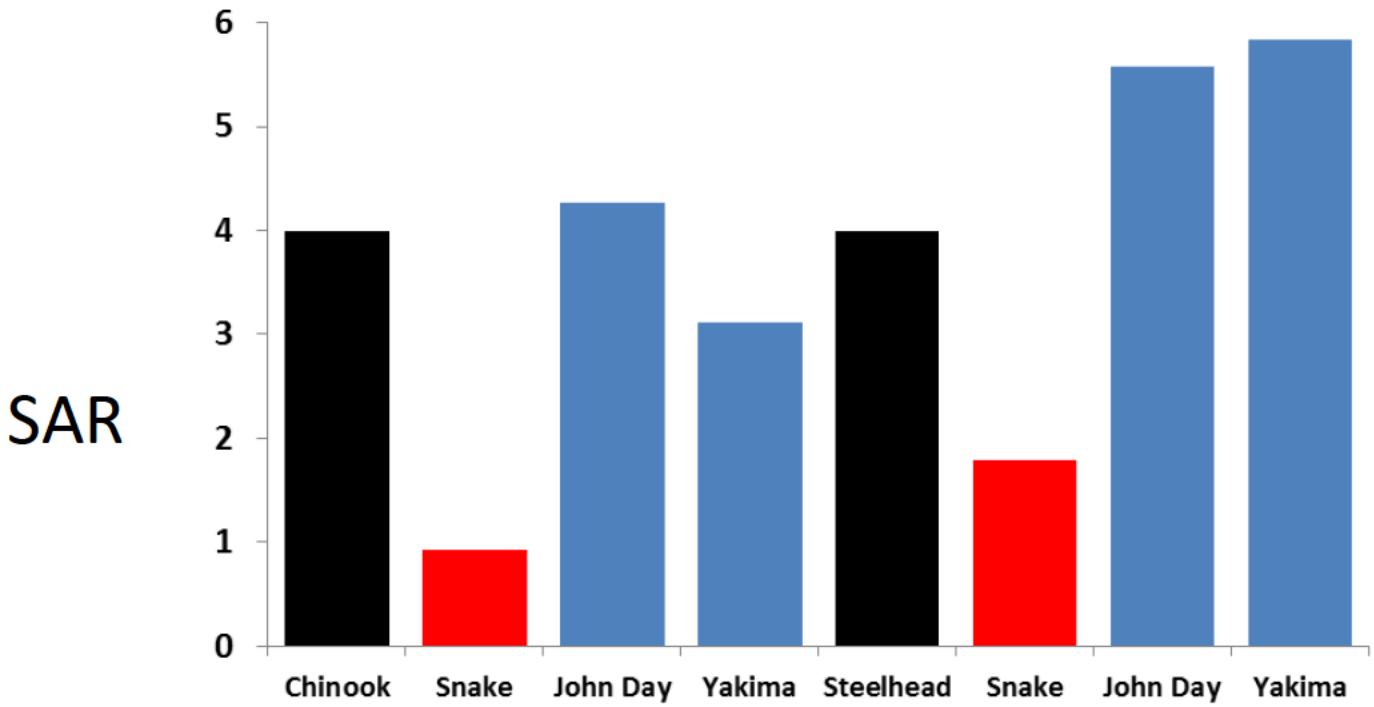
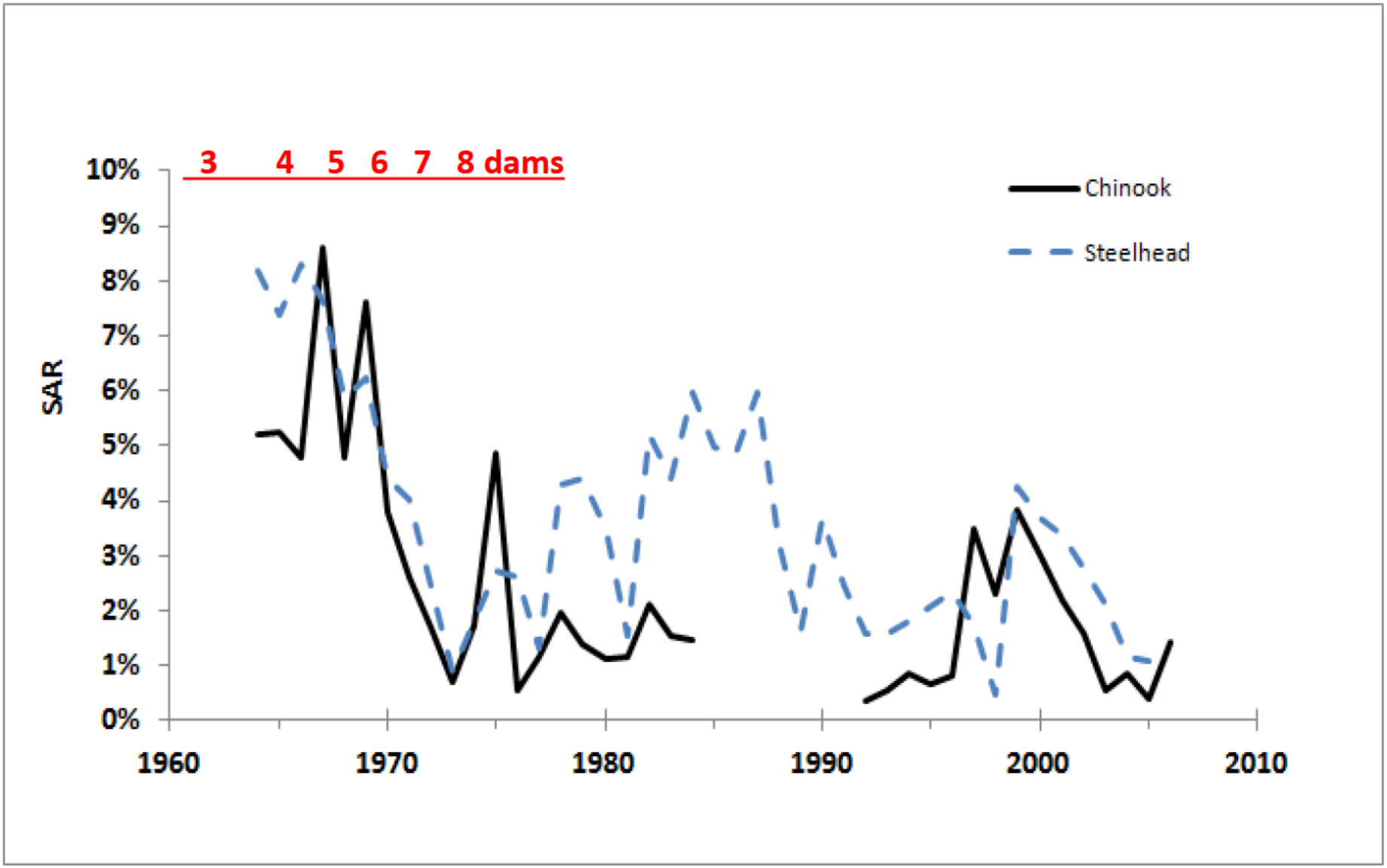


Decline in Snake R. Chinook & steelhead
associated with dams…

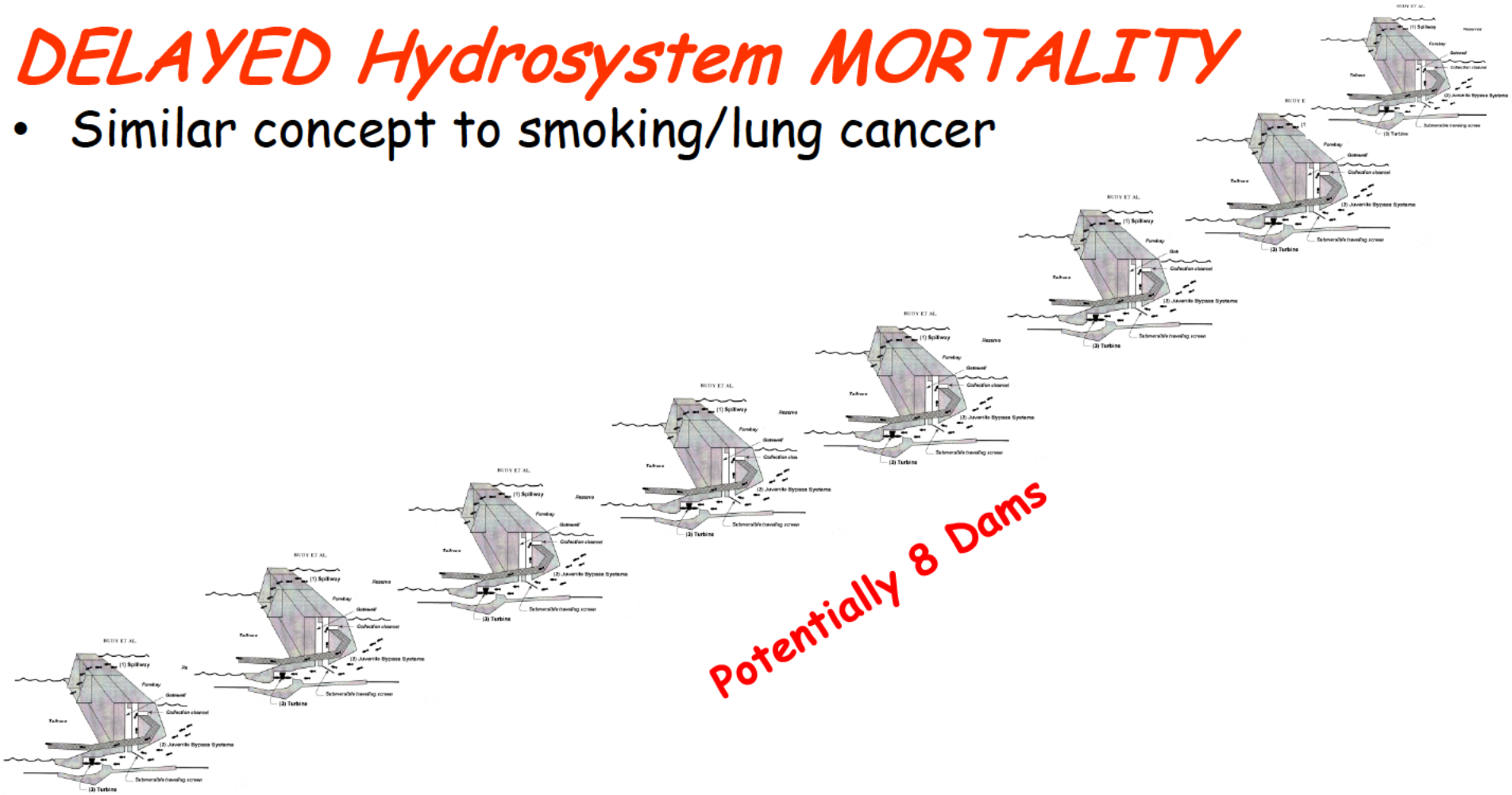


Key Concepts:

Is there evidence linking estuary and early-ocean mortality to the migration experience through the hydrosystem?

DELAYED Hydrosystem MORTALITY

- Similar concept to smoking/lung cancer



Delayed Hydrosystem Mortality

- Multiple lines of evidence-
  - 3 fold decline in marine survival rate for Chinook
  - 2 fold decline in marine survival rate for Steelhead

- **CSS Workshop 2011**
  - *"The evidence presented for … delayed mortality arising from earlier experience in the hydrosystem is strong and convincing."*
  - *" It is difficult to imagine how [other factors] would align so well both in time and space with the establishment of the hydro system."*

Summary of 2011 Workshop

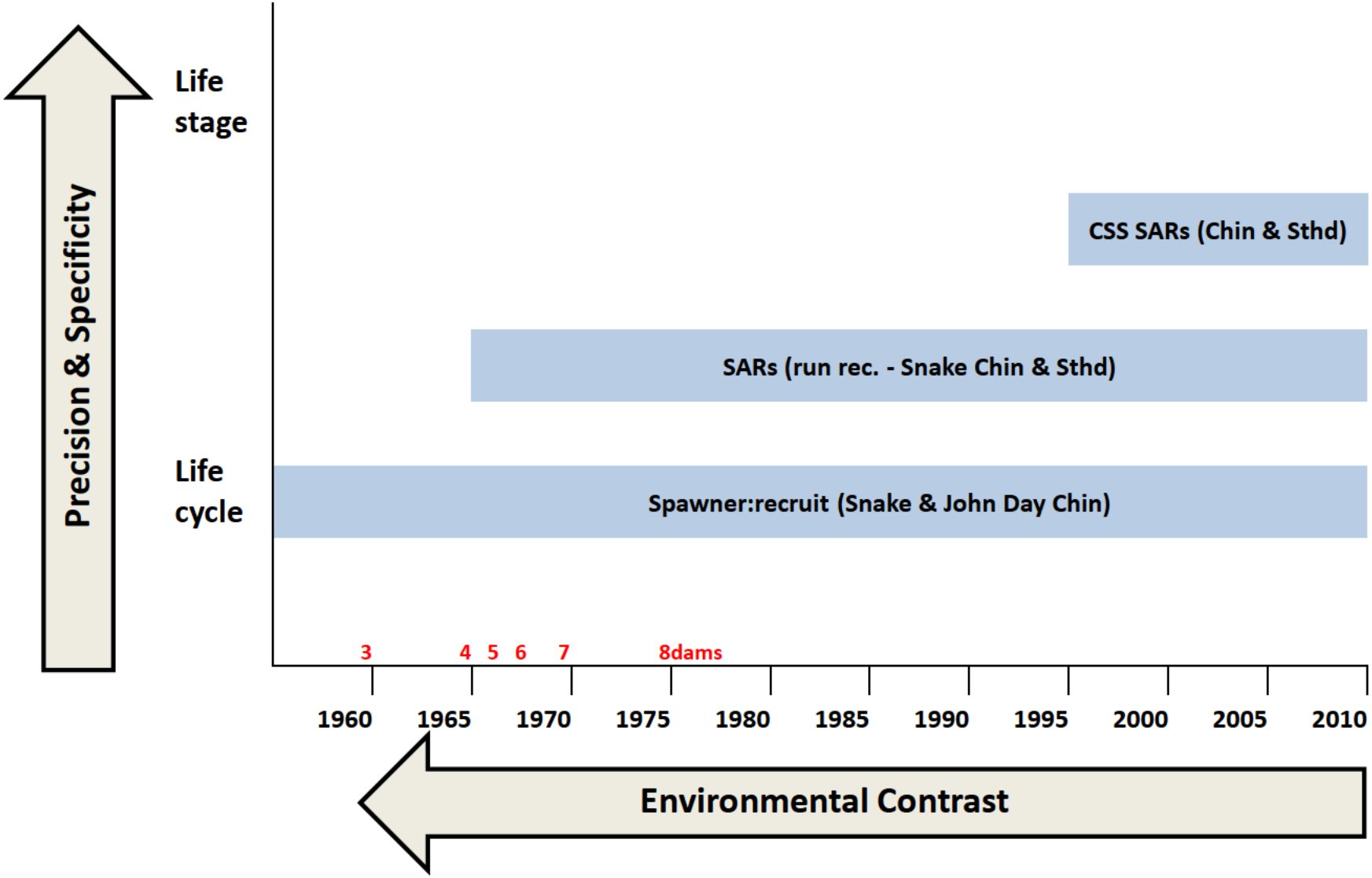
- Survival (in freshwater and marine) increases:
  - faster water velocity
  - increased spill
  - lower % transported

- Current FCRPS configuration:
  - Little ability to speed water velocity
  - Opportunity to further manage spill combined with surface passage to reduce powerhouse passages

- Promising approach - management experiment to evaluate improvements to SARs by increasing voluntary spill- Adaptive Management approach

Approach

Weight of evidence Multiple lines of evidence for relative importance of major factors influencing survival rates

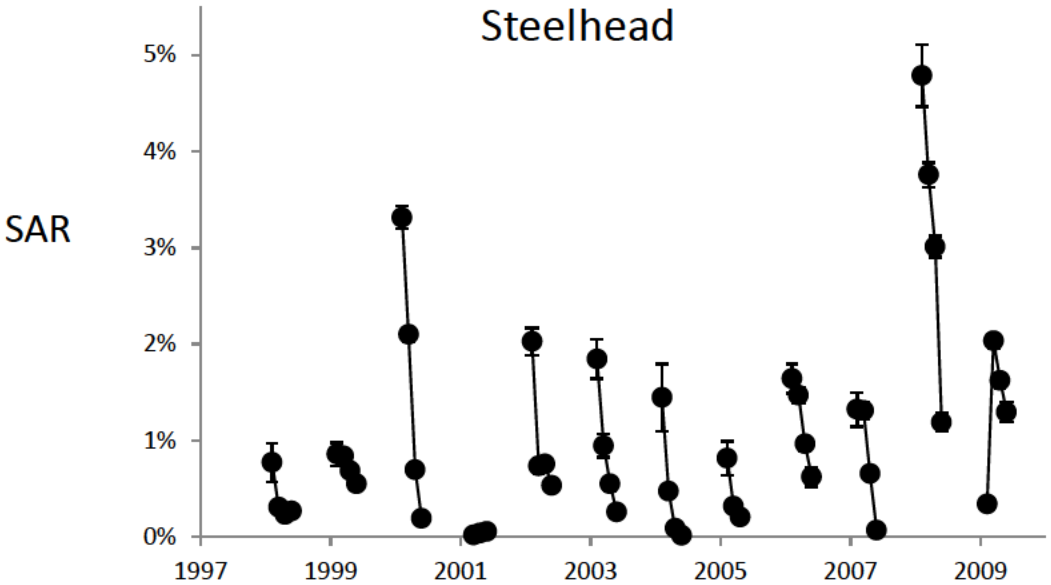


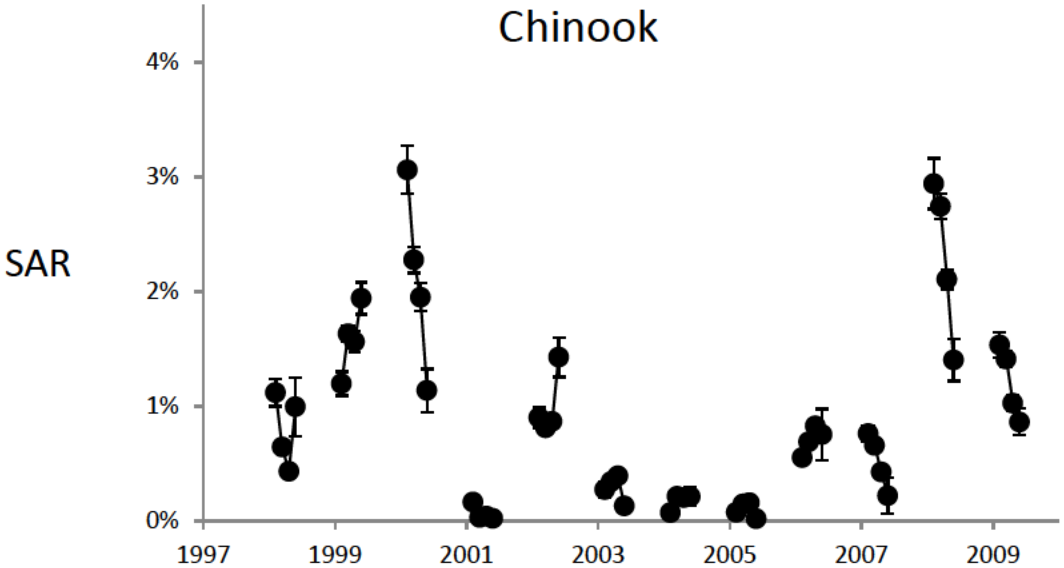
Key Studies

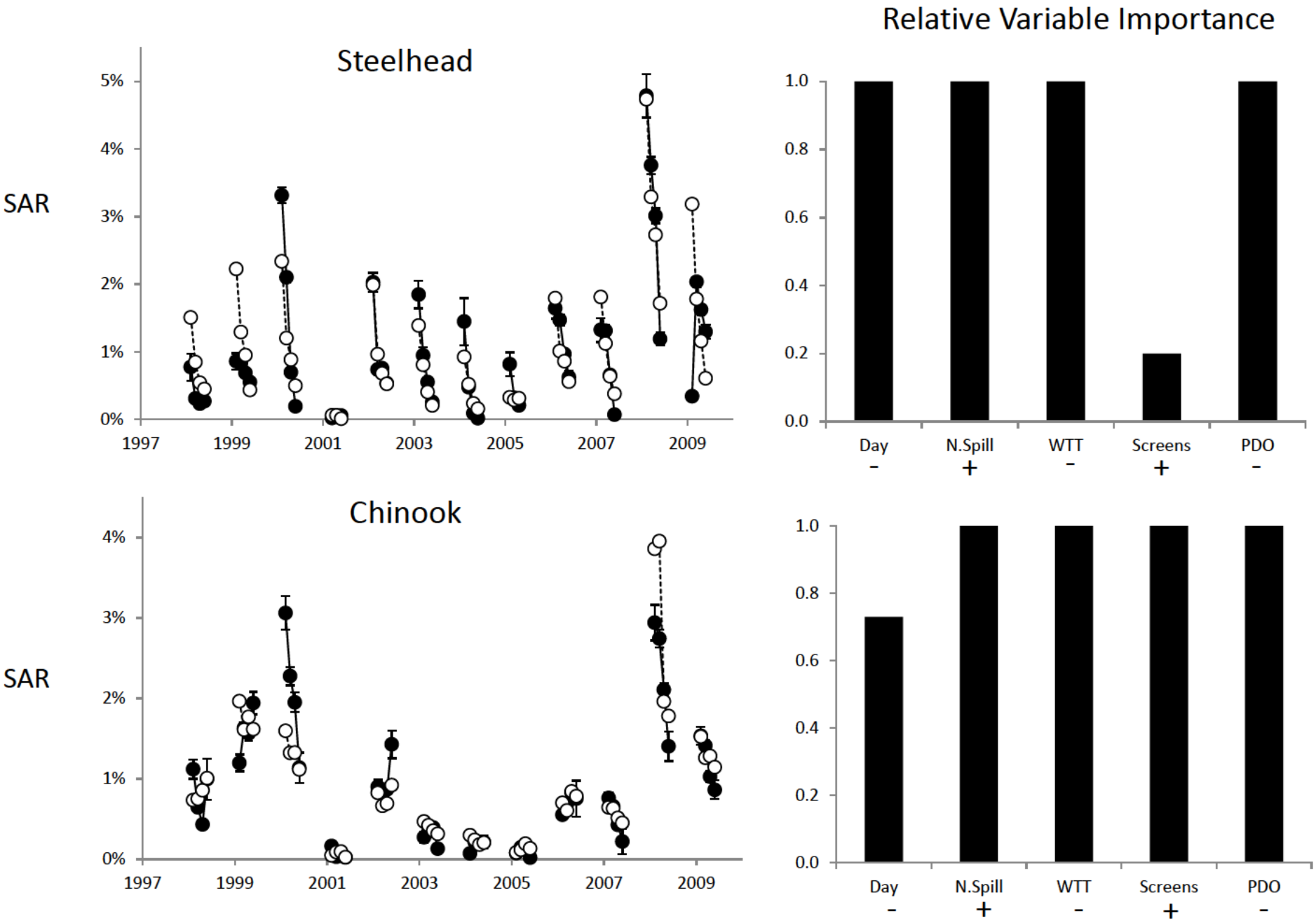
- Petrosky and Schaller 2010
  - Spill, water velocity and ocean conditions influence SARs
- Haeseker et al. 2012
  - Spill, water velocity and ocean conditions influence SARs
- Schaller et al. in 2014
  - Spill, water velocity and ocean conditions influence SARs

- Over a dozen peer reviewed publications

Relative Variable Importance






Relative Variable Importance
Steelhead
SAR
5%
4%
3%
2%
1%
0%
1997
1999
2001
2003
2005
2007
2009
1.0
0.8
0.6
0.4
0.2
0.0
Day
N.Spill
WTT
Screens
PDO
-
+
-
+
-
Chinook
SAR
4%
3%
2%
1%
0%
1997
1999
2001
2003
2005
2007
2009
1.0
0.8
0.6
0.4
0.2
0.0
Day
N.Spill
WTT
Screens
PDO
-
+
-
+
-

In-river Passage Routes

Non-powerhouse = Spill (traditional or surface spillway weirs)

Powerhouse = Turbine or juvenile collection/bypass

Direct survival:

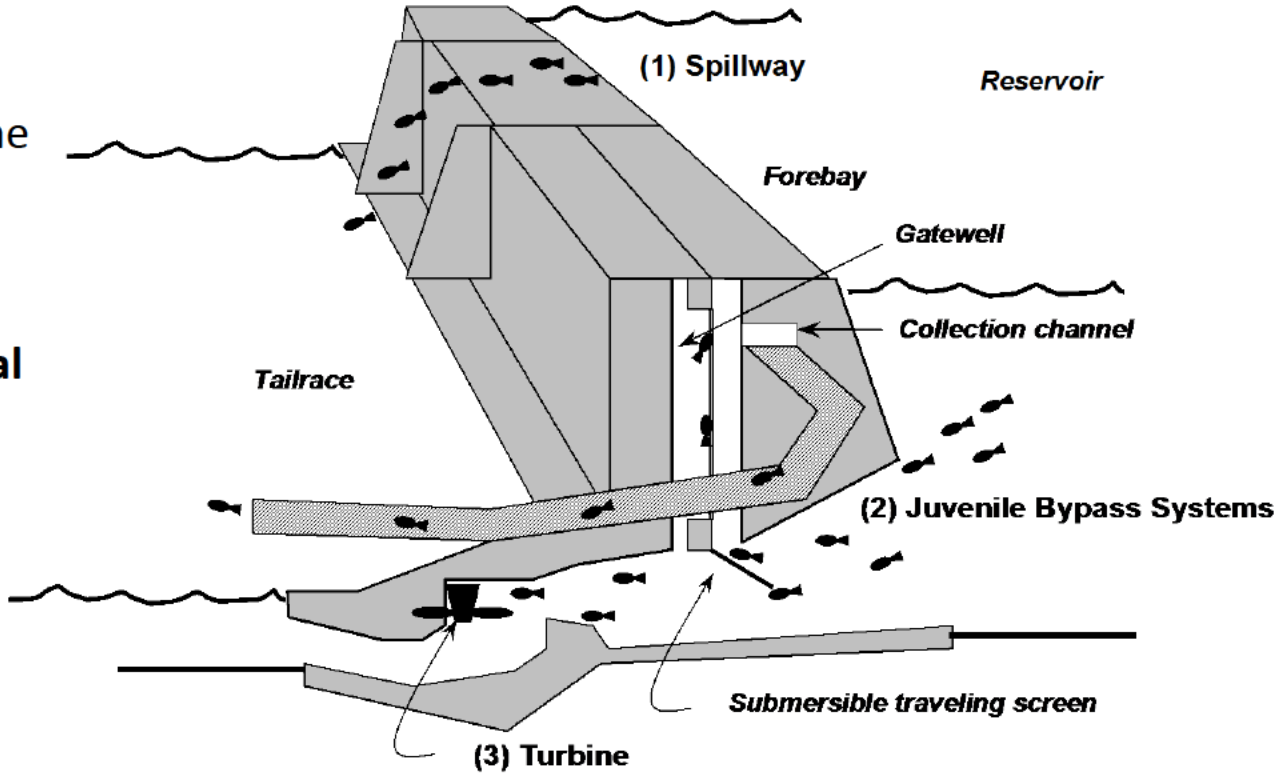
spill ≥ bypass > turbine

Direct & indirect survival (delayed mortality):

spill > bypass

spill > turbine

Forebay & Tailrace TDG monitoring



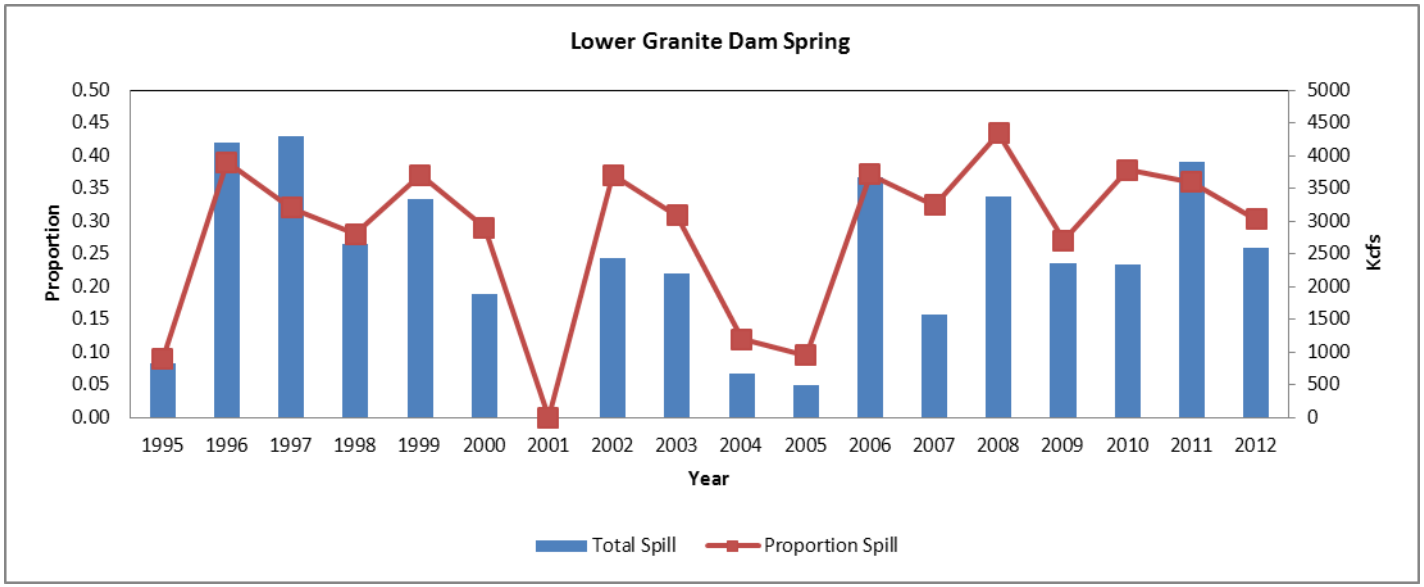
Spill Benefits

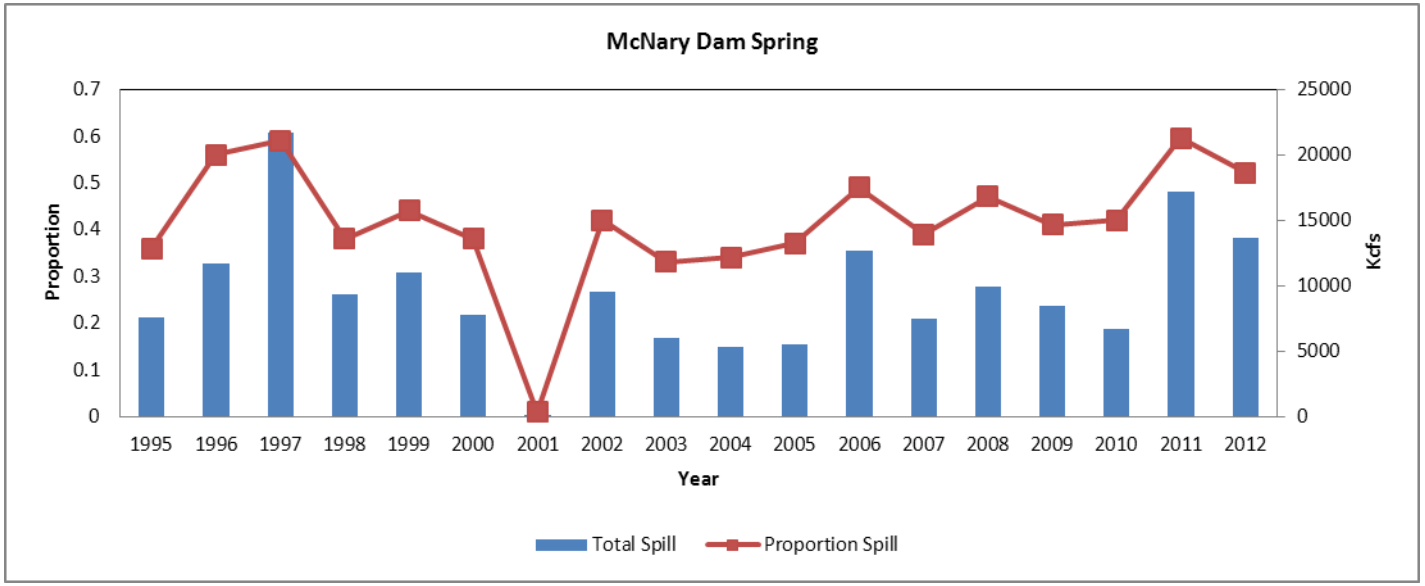
- Historic data has consistently shown a juvenile survival advantage.
- Spill is a mitigation measure that can be provided in every flow year.
- Spill can be provided without impact to reservoir elevations.

Risk Based Spill Program

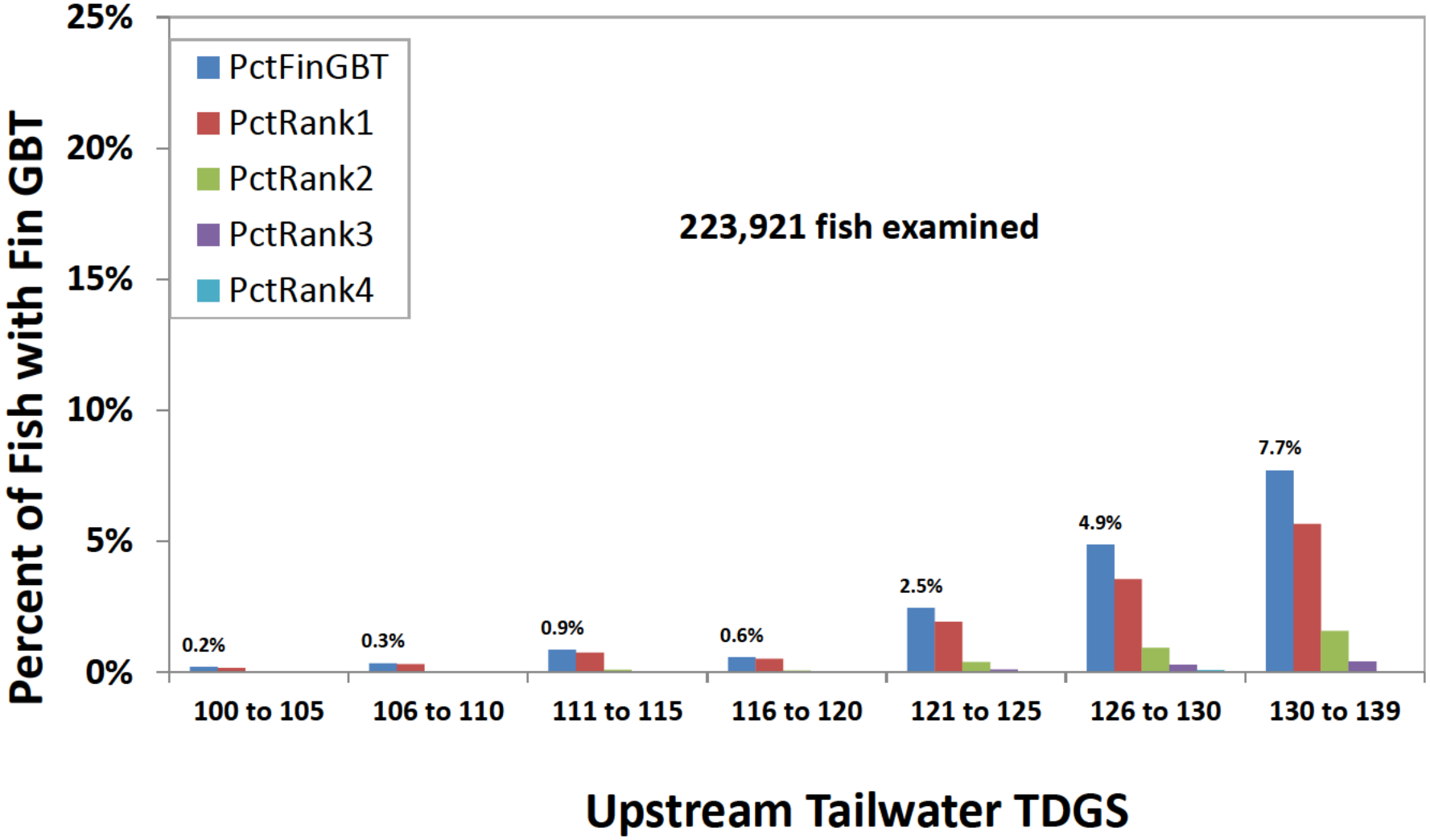
- Survival benefits of spill > potential TDG related mortality
- Adaptive Management approach- supported by empirical observations:
  - Juvenile survival
  - SARs
  - TDG effects

Variability of Spill 1995-2012





Summary of GBT Samples (1995-2012) as a function of TDG



In Preparation for 2013 Workshop

- Develop estimates of the amount of water that could be spilled (spill caps) at each of the hydroprojects on the Lower Snake and Columbia rivers for the various scenarios modeled for the 2013 workshop.

- Choose representative flow years for prospective modeling.

Summary of 2013 Workshop

- Reviewed historical dissolved gas effects.

- Presented and reviewed draft Experimental Spill Management Design.

- Evaluated four spill levels:
  - Biological Opinion-current
  - 115/120% - lowest increase
  - 120% Tailrace -moderate increase
  - 125% Tailrace - greatest increase

RSWs and TSWs Included in all experimental spill study evaluations

What is experimental design?

Plan **for measuring** ***response*** **to a** ***treatment***

- ***Treatment*** **= increase in voluntary spill**
- ***Response*** **= change in survival & travel time**
- ***Plan*** **= implement CSS monitoring methods**

Elements of "good" experimental design

- **Large contrast (perturbation)**
- **High precision of measured response variable**
- **High degree of replication**
- **Minimize and account for confounding factors**

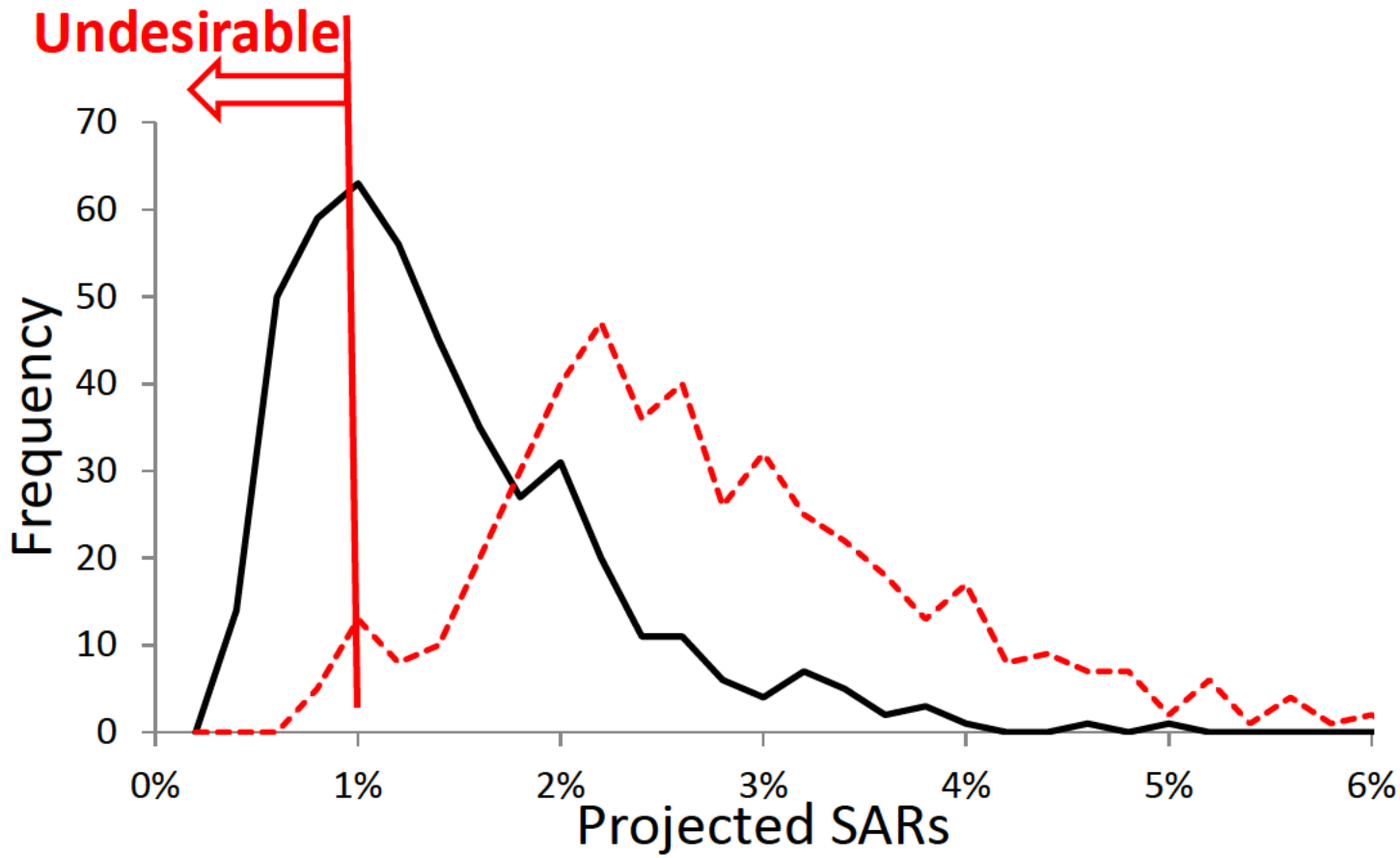
Summary of 2013Workshop

- Modeled the responses to the four spill levels considering variation in:
    - Flow
    - Migration timing
    - Ocean conditions

Prospective tools –

integrating across river and ocean conditions

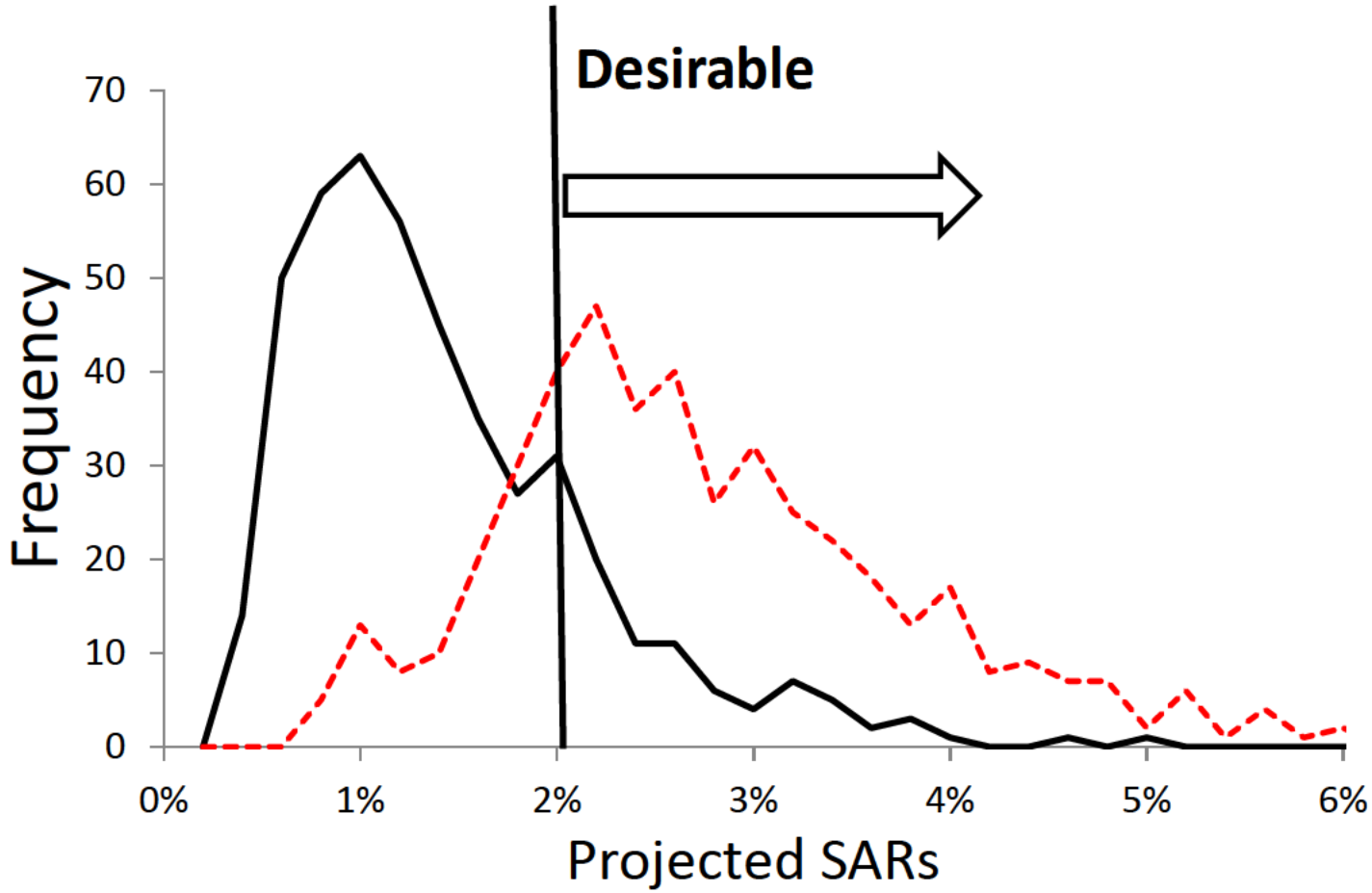
- Summarize distributions relative to desired goals (e.g., population viability)



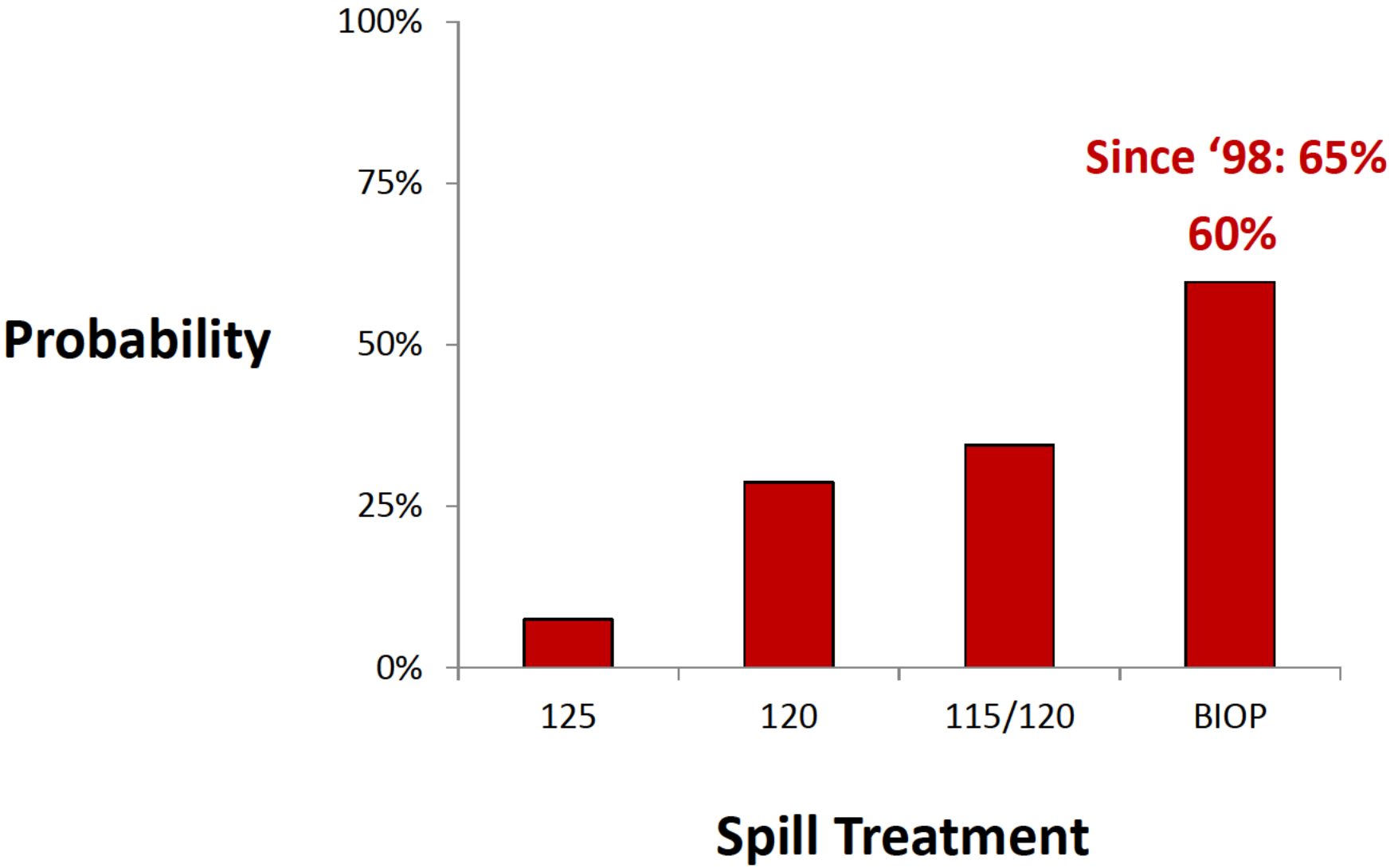
Prospective tools –

integrating across river and ocean conditions

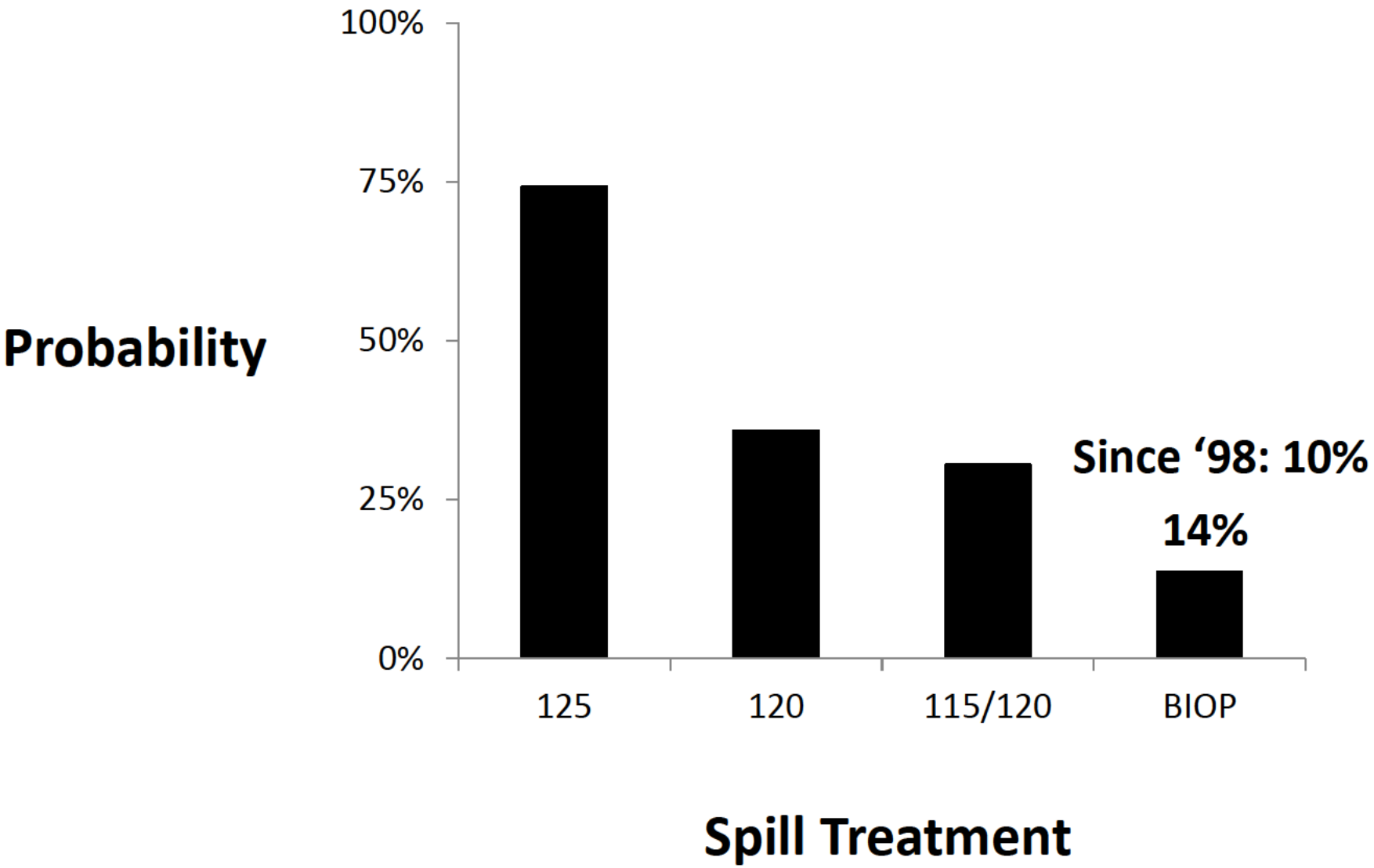
- Summarize distributions relative to desired goals (e.g., NPCC SAR goals, Recovery)



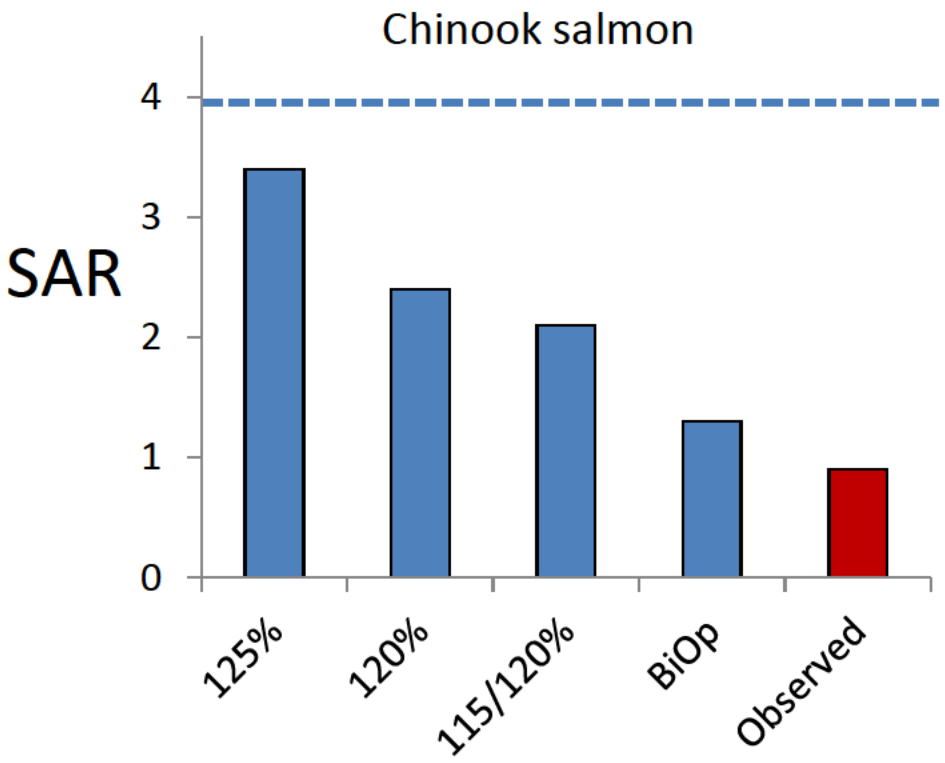
Chinook- Undesirable (< 1% SARS)

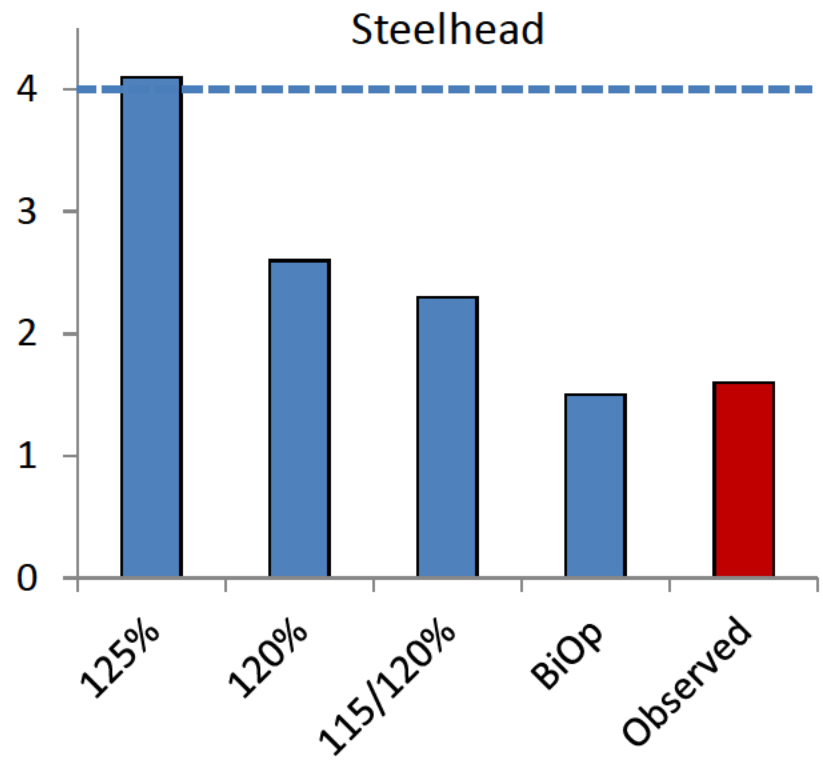


Chinook- Desirable (> 2% SARS)

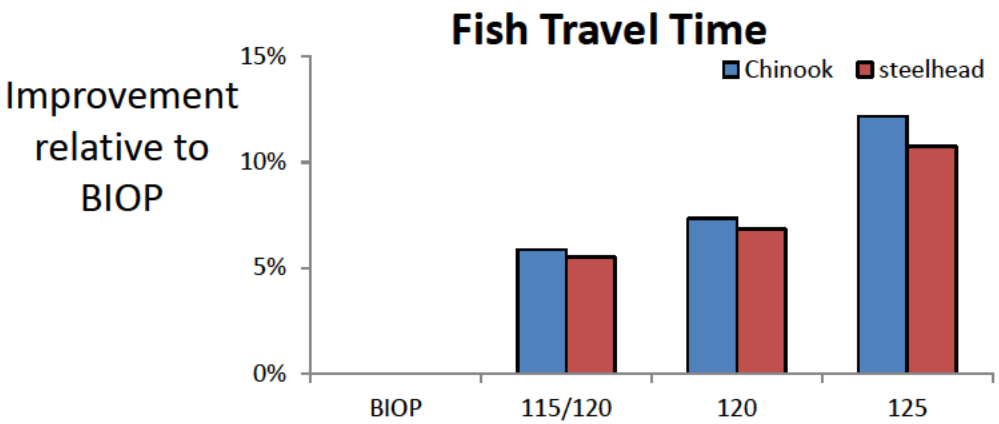


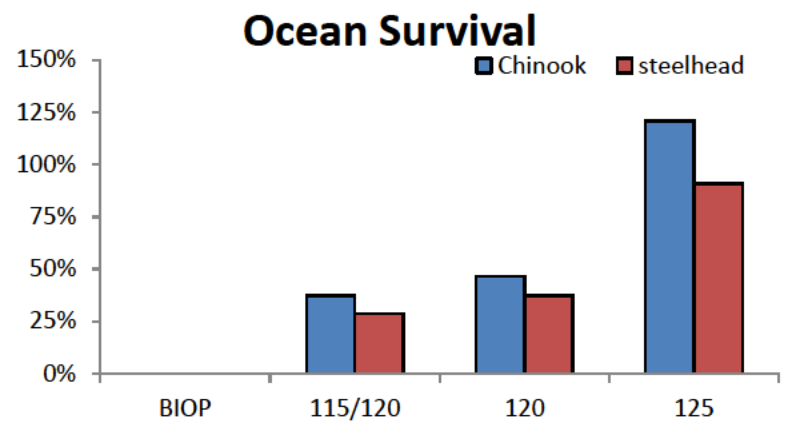
Summary of 2013Workshop

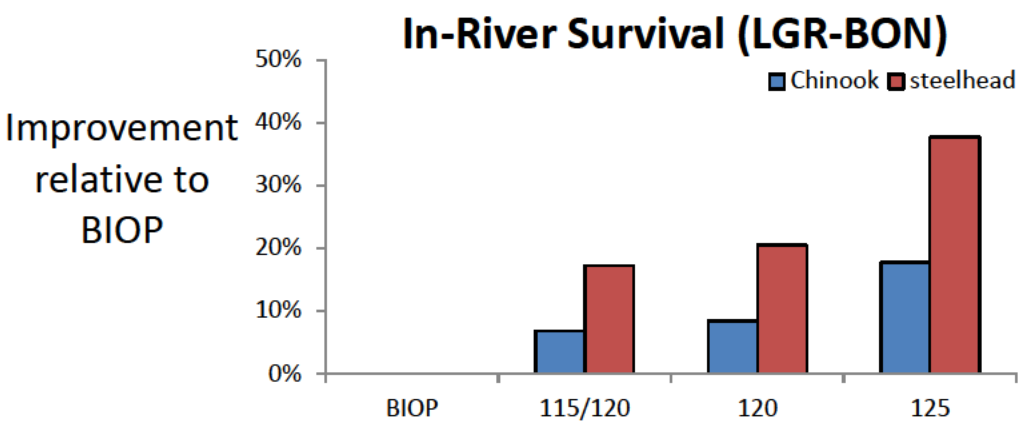


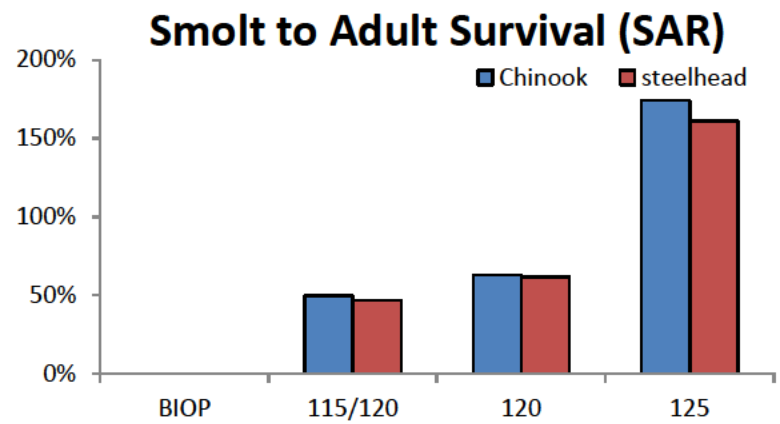


Multiple measures for detecting changes:









Summary:

- Definition of spill scenarios for simulations based on what appears technically possible with current FCRPS configuration
- Biological Planning tool indicates 125% spill level most likely to achieve SAR objectives
- Ongoing CSS analyses provide rigorous monitoring framework
- Expected benefits to Upper- & Mid-Columbia stocks
  - These stocks provide for additional monitoring/learning
- Simulations are encouraging in terms of:
  - expected response (conservation benefit)
  - likelihood of detecting response (learning)

Questions?

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

ISAB Members

J. Richard Alldredge, Ph.D., Emeritus Professor of Statistics at Washington State University

Kurt Fausch, Ph.D., Professor of Fisheries and Aquatic Sciences, Department of Fish, Wildlife, and Conservation Biology at Colorado State University

Colin Levings, Ph.D., Scientist Emeritus at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, West Vancouver, British Columbia, Canada

Alec Maule, Ph.D., Fisheries Consultant and former head of the Ecology and Environmental Physiology Section, United States Geological Survey, Columbia River Research Laboratory

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Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants

Laurel Saito, Ph.D., P.E., Director of the Graduate Program of Hydrologic Sciences at the University of Nevada Reno

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Steve Schroder, Ph.D., Fisheries Consultant and former Fisheries Research Scientist at the Washington Department of Fish and Wildlife

Carl Schwarz, Ph.D., Professor of Statistics and Actuarial Science at Simon Fraser University, Canada

Chris C. Wood, Ph.D., Scientist Emeritus at the Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada

Staff

Erik Merrill, J.D., Independent Science Program Manager, Northwest Power and Conservation Council

Cover photo: McNary Dam spillway by Tony Grover.

ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

    (a) Does the experiment include an adequately researched hypothesis?
    (b) Is the experiment appropriately designed to test the hypothesis?
    (c) Is the proposed duration of the experiment sufficient?
    (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:

    - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

    - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

    - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.

3. Monitoring Smolt-to-Adult survival rates.

4. Comparing survival rates against both past survival rates and prospective model predictions.

5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.

6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) **Does the experiment include an adequately researched hypothesis?**

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models

that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project's spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

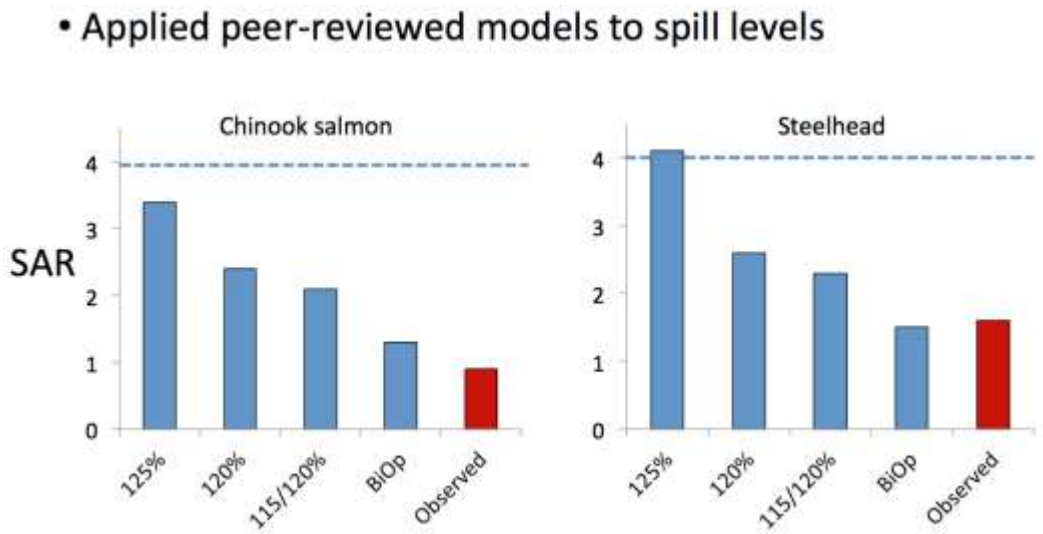

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have

increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead

should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE

funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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Independent Scientific Advisory Board

Review of the Proposed Spill Experiment, February 20, 2014

"The justification for the proposed test is based on correlative models that do not establish causality."

"There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan."

"It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect."

"There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors."

"The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life."

"Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern."

"There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation."

Non-Responsive

[redacted]

Non-Responsive

Non-Responsive

From: McNary,Sarah R (BPA) - A-7
To: Milstein,Michael C (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5; Pendergrass,Richard M (BPA) - PG-5; Francis,Rose (BPA) - LC-7; Majkut,Paul S (BPA) - L-7
Subject: RE: ISAB spill review
Date: Friday, February 21, 2014 8:10:26 AM
Attachments: ISAB2014-2.pdf

Thanks so much to Jason and Michael for their speedy review and analysis of this report. I am attaching a copy to ensure that the power and legal team also are aware.
S.

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, February 20, 2014 11:06 PM
To: Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: RE: ISAB spill review

And perhaps a benefit of all this may be that as they refine their proposal as the ISAB suggests they will be forced to learn about the true complexities of the system, which could be a constructive step toward real collaboration.

One interesting detail I noticed on closer reading: The ISAB cites unpublished research that they say is in press suggesting that delayed mortality is caused by high TDG levels above 125%. It does not show up until the fish get out into the plume.

From: Sweet,Jason C (BPA) - KEWR-4
Sent: Thursday, February 20, 2014 8:41 PM
To: Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: Re: ISAB spill review

I think there is plenty of fodder for both the proponents of the spill test and the AA's in this review, but the ISAB definitely recognized and appreciated the issues we brought forward. This ISAB analysis is actually very strongly worded in many sections and serves to confirm our view that the proposed spill test was not ready for review. The ISAB noted that many significant scientific issues need to be addressed and many broad policy issues to be considered before a study of this nature is ever implemented.

The ISAB also recognized that a study of this nature may never return definitive results but would instead only serve to advance our knowledge (which they tacitly support).

On the whole, I think this was a very positive review for us that highlighted the significant uncertainties surrounding this proposal, but it also gave the supporters of the spill test a lot of material to consider as they refine their proposal. This review seems to support our current approach of keeping the lines of communication open with the spill test supporters, but it certainly doesn't provide any short-term support for a high spill test to 125% TDG limits.

From: Maslen,Bill (BPA) - KEW-4
Sent: Thursday, February 20, 2014 06:30 PM
To: Cogswell,Peter (BPA) - DK-7; Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: Re: ISAB spill review

I think Erik Merrill's summary bullets to Council are pretty definitive and to the point...lots of uncertainty, lots of risk, not sufficiently developed.

From: Cogswell,Peter (BPA) - DK-7
Sent: Thursday, February 20, 2014 06:12 PM
To: Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Maslen,Bill (BPA) - KEW-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: RE: ISAB spill review

I think it is better than mixed bag, – bottom line interpretation as I see it: this thing needs a lot of work.

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, February 20, 2014 6:01 PM
To: Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Maslen,Bill (BPA) - KEW-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7; Cogswell,Peter (BPA) - DK-7
Subject: ISAB spill review

Just posted.

Have only skimmed, but appears to be a mixed bag. They say study design is incomplete and not fully researched, relies on correlations that do not establish causation, with potential confounding factors and could cause unintended negative consequences. Also they say it's unlikely spill could be isolated as a causative factor. However they say the proponents should be encouraged to develop a more complete proposal that responds to Action Agency concerns. Also they say a properly designed experiment could produce useful information about spill and juvenile passage survival.

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

ISAB Members

J. Richard Alldredge, Ph.D., Emeritus Professor of Statistics at Washington State University

Kurt Fausch, Ph.D., Professor of Fisheries and Aquatic Sciences, Department of Fish, Wildlife, and Conservation Biology at Colorado State University

Colin Levings, Ph.D., Scientist Emeritus at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, West Vancouver, British Columbia, Canada

Alec Maule, Ph.D., Fisheries Consultant and former head of the Ecology and Environmental Physiology Section, United States Geological Survey, Columbia River Research Laboratory

Bonnie McCay, Ph.D., Board of Governors Distinguished Service Professor at Rutgers University, New Brunswick, New Jersey in the Department of Human Ecology of the School of Environmental and Biological Sciences

Kate Myers, Ph.D., Research Scientist, Aquatic and Fishery Sciences, University of Washington (Retired)

Robert J. Naiman, Ph.D., Professor of Aquatic and Fishery Sciences at University of Washington

Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants

Laurel Saito, Ph.D., P.E., Director of the Graduate Program of Hydrologic Sciences at the University of Nevada Reno

Dennis Scarnecchia, Ph.D., Professor of Fish and Wildlife Resources at University of Idaho

Steve Schroder, Ph.D., Fisheries Consultant and former Fisheries Research Scientist at the Washington Department of Fish and Wildlife

Carl Schwarz, Ph.D., Professor of Statistics and Actuarial Science at Simon Fraser University, Canada

Chris C. Wood, Ph.D., Scientist Emeritus at the Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada

Staff

Erik Merrill, J.D., Independent Science Program Manager, Northwest Power and Conservation Council

Cover photo: McNary Dam spillway by Tony Grover.

ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

    (a) Does the experiment include an adequately researched hypothesis?
    (b) Is the experiment appropriately designed to test the hypothesis?
    (c) Is the proposed duration of the experiment sufficient?
    (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:

    - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

    - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

    - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.

3. Monitoring Smolt-to-Adult survival rates.

4. Comparing survival rates against both past survival rates and prospective model predictions.

5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.

6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) **Does the experiment include an adequately researched hypothesis?**

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models

that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project's spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

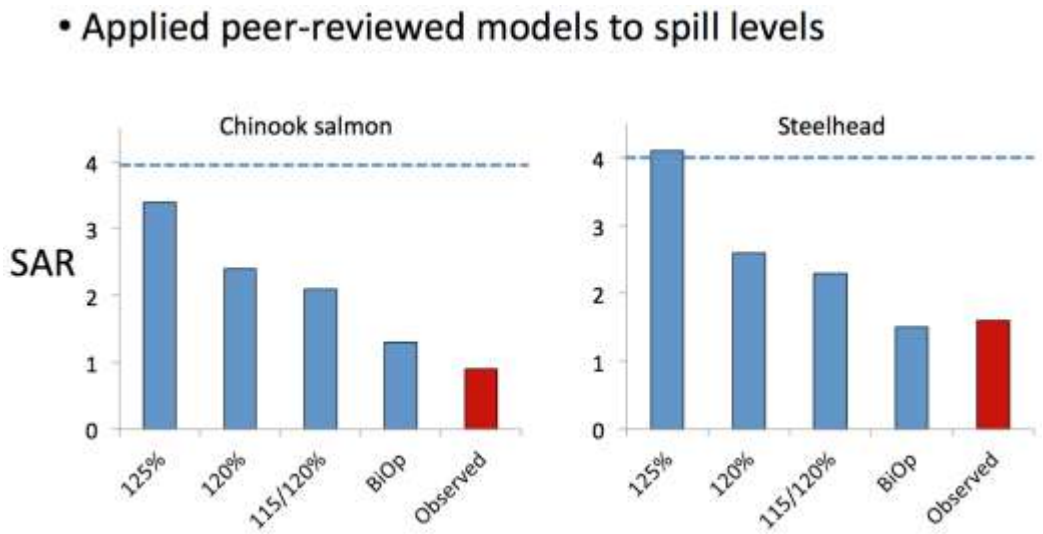

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have

increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead

should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE

funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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From: Merrill, Erik
To: Merrill, Erik; Ruff, Jim; "Scott, Teresa L (DFW)"; "Michele Dehart"; Sweet,Jason C (BPA) - KEWR-4; Grover, Tony; "Bill Tweit"; "Tom Rien"; "Robert Naiman"; "Greg Ruggerone"; "Rich Alldredge (b)(6) [redacted]"; "Rock.D.Peters@nwd01.usace.army.mil"; "Graves, Ritchie"; Ruff, Jim; "Mike.Ford@noaa.gov"; "ROGP@critfc.org"; "Al Giorgi"; Foster,Marchelle M (BPA) - KEWR-4
Subject: ISAB Review of the Proposed Spill Experiment
Date: Friday, February 21, 2014 9:14:09 AM
Attachments: ISAB 2014-2 SpillStudyReview 20feb.docx

All,

The ISAB's Review of the Proposed Spill Experiment is attached. The ISAB greatly appreciates the analyses, briefings, and literature that you provided to assist in their review.

Thank you,

Erik

From: Merrill, Erik
Sent: Thursday, February 20, 2014 5:39 PM
To: Council Members; F&W Plus; F&W State Staff; Public Affairs Division; 'John Stein - NOAA Federal'; 'Mike.Ford@noaa.gov'; 'Paul Lumley'; 'Phil Roger'; ''Robert Naiman' (naiman@uw.edu)'; 'Greg Ruggerone'; 'Rich Alldredge (b)(6) [redacted]
Subject: ISAB Review of the Proposed Spill Experiment

ISAB Administrative Oversight Panel:

Bill Bradbury, Chair, Northwest Power and Conservation Council
Paul Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission
John Stein, Science Director, NOAA-Fisheries Northwest Fisheries Science Center

In response to the Northwest Power and Conservation Council request, the ISAB reviewed the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program.

The ISAB summarizes its findings in the report's overview:

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to

inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

The Council asked that the ISAB consider a number of questions. Detailed answers to those questions are provided in the ISAB's full report, attached and available at www.nwcouncil.org/fw/isab/isab2014-2.

Sincerely,

Erik

Erik Merrill
Manager, Independent Scientific Review Program
Northwest Power and Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
503-222-5161
800-452-5161 (toll-free)

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

ISAB Members

J. Richard Alldredge, Ph.D., Emeritus Professor of Statistics at Washington State University

Kurt Fausch, Ph.D., Professor of Fisheries and Aquatic Sciences, Department of Fish, Wildlife, and Conservation Biology at Colorado State University

Colin Levings, Ph.D., Scientist Emeritus at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, West Vancouver, British Columbia, Canada

Alec Maule, Ph.D., Fisheries Consultant and former head of the Ecology and Environmental Physiology Section, United States Geological Survey, Columbia River Research Laboratory

Bonnie McCay, Ph.D., Board of Governors Distinguished Service Professor at Rutgers University, New Brunswick, New Jersey in the Department of Human Ecology of the School of Environmental and Biological Sciences

Kate Myers, Ph.D., Research Scientist, Aquatic and Fishery Sciences, University of Washington (Retired)

Robert J. Naiman, Ph.D., Professor of Aquatic and Fishery Sciences at University of Washington

Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants

Laurel Saito, Ph.D., P.E., Director of the Graduate Program of Hydrologic Sciences at the University of Nevada Reno

Dennis Scarnecchia, Ph.D., Professor of Fish and Wildlife Resources at University of Idaho

Steve Schroder, Ph.D., Fisheries Consultant and former Fisheries Research Scientist at the Washington Department of Fish and Wildlife

Carl Schwarz, Ph.D., Professor of Statistics and Actuarial Science at Simon Fraser University, Canada

Chris C. Wood, Ph.D., Scientist Emeritus at the Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada

Staff

Erik Merrill, J.D., Independent Science Program Manager, Northwest Power and Conservation Council

Cover photo: McNary Dam spillway by Tony Grover.

ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

    (a) Does the experiment include an adequately researched hypothesis?
    (b) Is the experiment appropriately designed to test the hypothesis?
    (c) Is the proposed duration of the experiment sufficient?
    (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:

    - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

    - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

    - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.

3. Monitoring Smolt-to-Adult survival rates.

4. Comparing survival rates against both past survival rates and prospective model predictions.

5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.

6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) **Does the experiment include an adequately researched hypothesis?**

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models

that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project's spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

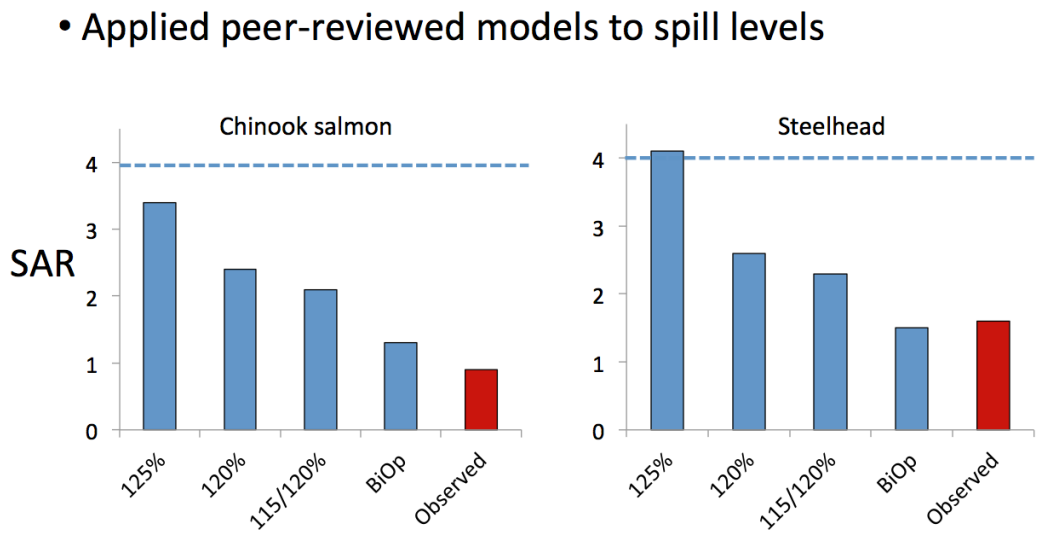

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have

increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead

should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE

funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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From: Bodi,Lorri (BPA) - KE-4
To: Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Dondlinger,Gregory J (BPA) - KEW-4
Subject: RE: STATE"s first blush response to: ISAB Review of the Proposed Spill Experiment
Date: Friday, February 21, 2014 10:46:18 AM

Really good observations.

From: Sweet,Jason C (BPA) - KEWR-4
Sent: Friday, February 21, 2014 10:23 AM
To: Maslen,Bill (BPA) - KEW-4; Bodi,Lorri (BPA) - KE-4; Dondlinger,Gregory J (BPA) - KEW-4
Subject: Fw: STATE's first blush response to: ISAB Review of the Proposed Spill Experiment

FYI

From: Reller,Mark D (BPA) - DKR-MSGL
Sent: Friday, February 21, 2014 10:20 AM
To: Klumpp,Elizabeth C (BPA) - DKR-7; Cogswell,Peter (BPA) - DK-7; Sweet,Jason C (BPA) - KEWR-4; Marker,Douglas R (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5
Subject: STATE's first blush response to: ISAB Review of the Proposed Spill Experiment

FYI State's biologist responds to Power Council – his first blush observations on the report.
M

From: Marotz, Brian [mailto:bmarotz@mt.gov]
Sent: Friday, February 21, 2014 11:13 AM
To: Berg, Kerry
Cc: Reller,Mark D (BPA) - DKR-MSGL; James Litchfield
Subject: RE: ISAB Review of the Proposed Spill Experiment

Kerry
I just finished reading the ISAB's report. After reading the earlier publications and reports, there were no big surprises. However, it was curious that ISAB did not focus more on the incremental improvements in fish guidance efficiency that have been implemented since 2006. While they did recommend improved monitoring to correlate fish passage with differing levels of spill, they did not emphasize that passage efficiency can be increased independently from the spill volume (e.g. surface collectors and spill weirs). ISAB did not mention that harvest was not accounted for in the SAR calculations, which would bias SAR calculations in all years in which harvest was not proportional to abundance (this is not a problem when harvest is based on abundance) . While ISAB mentioned GBT impacts to resident fish and other biota, they did not specifically mention ESA-listed bull trout that inhabit some of the affected river reaches.
Brian

From: Berg, Kerry [mailto:kberg@nwcouncil.org]
Sent: Friday, February 21, 2014 10:29 AM
To: 'Reller,Mark D (BPA) - DKR-MSGL'; Marotz, Brian
Subject: FW: ISAB Review of the Proposed Spill Experiment

You may or may not have seen this already.

From: Merrill, Erik
Sent: Thursday, February 20, 2014 6:39 PM
To: Council Members; F&W Plus; F&W State Staff; Public Affairs Division; 'John Stein - NOAA Federal'; 'Mike.Ford@noaa.gov'; 'Paul Lumley'; 'Phil Roger'; ''Robert Naiman' (naiman@uw.edu)'; 'Greg Ruggerone'; 'Rich Alldredge ([redacted])'
Subject: ISAB Review of the Proposed Spill Experiment

ISAB Administrative Oversight Panel:

Bill Bradbury, Chair, Northwest Power and Conservation Council
Paul Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission
John Stein, Science Director, NOAA-Fisheries Northwest Fisheries Science Center

In response to the Northwest Power and Conservation Council request, the ISAB reviewed the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program.

The ISAB summarizes its findings in the report's overview:

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

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- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
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- possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
- future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
  - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
  - an monitoring and evaluation plan for TDG, biological and physical parameters; and
  - changes to dam-specific spill patterns.

The Council asked that the ISAB consider a number of questions. Detailed answers to those questions are provided in the ISAB's full report, attached and available at www.nwcouncil.org/fw/isab/isab2014-2.

Sincerely,

Erik

Erik Merrill
Manager, Independent Scientific Review Program
Northwest Power and Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
503-222-5161
800-452-5161 (toll-free)

From:	Lut,Agnes (BPA) - KEWR-4
To:	John Ferguson; Al Giorgi (al.giorgi@bioanalysts.net)
Cc:	Sweet,Jason C (BPA) - KEWR-4
Subject:	FW: ISAB Review of the Proposed Spill Experiment
Date:	Friday, February 21, 2014 10:47:52 AM
Attachments:	ISAB 2014-2 SpillStudyReview_20feb.docx

Al, John
Please find attached the ISAB review of the spill proposal, including a brief summary of their findings in the email below.

I just spoke with Jason and we are looking forward to your review of the ISAB report at a high level. Specifically, do you see any issues, either short -term or long-term that need to be addressed?
We can discuss those issues at a face to face meeting in mid-March. Jason, also requested that we include (sorry I'm totally going to get this name wrong) Josh Meroasky who is knowledgeable with PIT tags.

Please let me know if you three are available the afternoon of March 20 or 21 for a meeting at BPA.

Take care, and talk soon.
Agnes-

Agnes Lut
Fish Biologist | Hydro, Policy and Planning, KEWR-4 BONNEVILLE POWER ADMINISTRATION bpa.gov | P 503-230-5651 | C 971-271-4784 Please consider the environment before printing this email.

_____
From: Merrill, Erik
Sent: Thursday, February 20, 2014 5:38 PM
To: Council Members; F&W Plus; F&W State Staff; Public Affairs Division; 'John Stein - NOAA Federal'; 'Mike.Ford@noaa.gov'; 'Paul Lumley'; 'Phil Roger'; ''Robert Naiman' (naiman@uw.edu)'; 'Greg Ruggerone'; 'Rich Alldredge (b)(6) '
Subject: ISAB Review of the Proposed Spill Experiment

ISAB Administrative Oversight Panel:
Bill Bradbury, Chair, Northwest Power and Conservation Council Paul Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission John Stein, Science Director, NOAA-Fisheries Northwest Fisheries Science Center

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Manager, Independent Scientific Review Program Northwest Power and Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
503-222-5161
800-452-5161 (toll-free)

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

ISAB Members

J. Richard Alldredge, Ph.D., Emeritus Professor of Statistics at Washington State University

Kurt Fausch, Ph.D., Professor of Fisheries and Aquatic Sciences, Department of Fish, Wildlife, and Conservation Biology at Colorado State University

Colin Levings, Ph.D., Scientist Emeritus at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, West Vancouver, British Columbia, Canada

Alec Maule, Ph.D., Fisheries Consultant and former head of the Ecology and Environmental Physiology Section, United States Geological Survey, Columbia River Research Laboratory

Bonnie McCay, Ph.D., Board of Governors Distinguished Service Professor at Rutgers University, New Brunswick, New Jersey in the Department of Human Ecology of the School of Environmental and Biological Sciences

Kate Myers, Ph.D., Research Scientist, Aquatic and Fishery Sciences, University of Washington (Retired)

Robert J. Naiman, Ph.D., Professor of Aquatic and Fishery Sciences at University of Washington

Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants

Laurel Saito, Ph.D., P.E., Director of the Graduate Program of Hydrologic Sciences at the University of Nevada Reno

Dennis Scarnecchia, Ph.D., Professor of Fish and Wildlife Resources at University of Idaho

Steve Schroder, Ph.D., Fisheries Consultant and former Fisheries Research Scientist at the Washington Department of Fish and Wildlife

Carl Schwarz, Ph.D., Professor of Statistics and Actuarial Science at Simon Fraser University, Canada

Chris C. Wood, Ph.D., Scientist Emeritus at the Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada

Staff

Erik Merrill, J.D., Independent Science Program Manager, Northwest Power and Conservation Council

Cover photo: McNary Dam spillway by Tony Grover.

ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

    (a) Does the experiment include an adequately researched hypothesis?
    (b) Is the experiment appropriately designed to test the hypothesis?
    (c) Is the proposed duration of the experiment sufficient?
    (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:

    - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

    - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

    - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.

3. Monitoring Smolt-to-Adult survival rates.

4. Comparing survival rates against both past survival rates and prospective model predictions.

5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.

6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
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    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) **Does the experiment include an adequately researched hypothesis?**

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models

that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project's spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

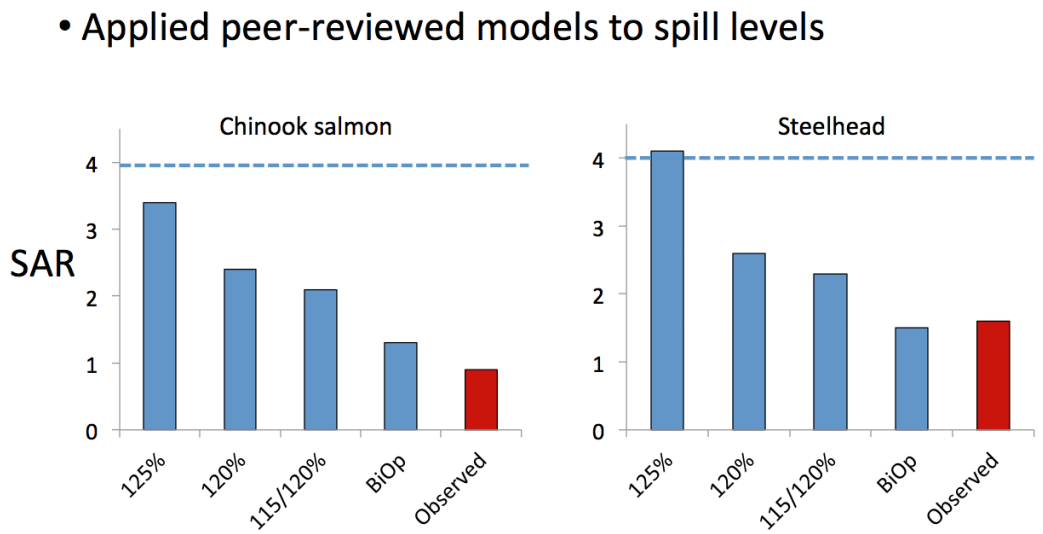

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have

increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead

should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE

funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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Norris,Tony (BPA) - PGPO-5

From: Harwood,Holly C (BPA) - PGB-5
Sent: Friday, February 21, 2014 10:51 AM
To: Gendron,Mark O (BPA) - P-6; Pendergrass,Richard M (BPA) - PG-5; Connolly,Kieran P (BPA) - PGS-5; Kerns,Steven R (BPA) - PGSP-5; Van Calcar, Pamela M (BPA) - PGSD-5; James,Eve A L (BPA) - PGST-5; Ko,Tina G (BPA) - PGP-5; MacKay,Robyn L (BPA) - PGPO-5; Simms,Scott R (BPA) - PGPR-5; Pytlak,Erik S (BPA) - PGPW-5; Koehler,Birgit G (BPA) - PGPL-5; Jones,Mark A (BPA) - PGF-6; Roberts,Timothy C (BPA) - PGL-5; Rapacz,Andy (BPA) - PGC-RICHLAND; Spencer,Nancy A (BPA) - PG-5
Cc: Spear,Daniel J (BPA) - PGB-5; Norris,Tony (BPA) - PGPO-5; Koski,Paul T (BPA) - PGPO-5; Bettin,Scott W (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Stiffler,Peter B (BPA) - PSR-6; Williams,Peter T (BPA) - PB-6
Subject: FW: ISAB spill review
Attachments: ISAB2014-2.pdf

The ISAB review of the Oregon spill proposal is attached and the emails below provide initial thoughts from EF&W. I have not read it yet, but it sounds like they generally agreed that there were problems with the proposal. Jason Sweet's email below is particularly insightful I think. I'm also copying in here the language from the transmittal email that the ISAB sent with the report which includes a short summary of their report.

ISAB Administrative Oversight Panel:
Bill Bradbury, Chair, Northwest Power and Conservation Council
Paul Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission
John Stein, Science Director, NOAA-Fisheries Northwest Fisheries Science Center

In response to the Northwest Power and Conservation Council request, the ISAB reviewed the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program.

The ISAB summarizes its findings in the report's overview:

<u>Potential Biological or Other Benefits</u>

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

<u>Potential Biological or Other Risks</u>

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:

- greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
- increased delay and/or predation of juvenile fish in tailraces;
- increased fallback and/or passage delays of adult salmon at the dams;
- difficulty in holding spill levels at desired levels, for example in a low water year;
- increased spillway erosion problems;
- possible navigation issues for commercial and juvenile fish transportation barges at dams;
- possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
- future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

The Council asked that the ISAB consider a number of questions. Detailed answers to those questions are provided in the ISAB's full report, attached and available at www.nwcouncil.org/fw/isab/isab2014-2.

From: McNary,Sarah R (BPA) - A-7
Sent: Friday, February 21, 2014 8:10 AM
To: Milstein,Michael C (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7; Harwood,Holly C (BPA) - PGB-5; Pendergrass,Richard M (BPA) - PG-5; Francis,Rose (BPA) - LC-7; Majkut,Paul S (BPA) - L-7
Subject: RE: ISAB spill review

Thanks so much to Jason and Michael for their speedy review and analysis of this report. I am attaching a copy to ensure that the power and legal team also are aware.
S.

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, February 20, 2014 11:06 PM

To: Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: RE: ISAB spill review

And perhaps a benefit of all this may be that as they refine their proposal as the ISAB suggests they will be forced to learn about the true complexities of the system, which could be a constructive step toward real collaboration.

One interesting detail I noticed on closer reading: The ISAB cites unpublished research that they say is in press suggesting that delayed mortality is caused by high TDG levels above 125%. It does not show up until the fish get out into the plume.

From: Sweet,Jason C (BPA) - KEWR-4
Sent: Thursday, February 20, 2014 8:41 PM
To: Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: Re: ISAB spill review

I think there is plenty of fodder for both the proponents of the spill test and the AA's in this review, but the ISAB definitely recognized and appreciated the issues we brought forward. This ISAB analysis is actually very strongly worded in many sections and serves to confirm our view that the proposed spill test was not ready for review. The ISAB noted that many significant scientific issues need to be addressed and many broad policy issues to be considered before a study of this nature is ever implemented.

The ISAB also recognized that a study of this nature may never return definitive results but would instead only serve to advance our knowledge (which they tacitly support).

On the whole, I think this was a very positive review for us that highlighted the significant uncertainties surrounding this proposal, but it also gave the supporters of the spill test a lot of material to consider as they refine their proposal. This review seems to support our current approach of keeping the lines of communication open with the spill test supporters, but it certainly doesn't provide any short-term support for a high spill test to 125% TDG limits.

From: Maslen,Bill (BPA) - KEW-4
Sent: Thursday, February 20, 2014 06:30 PM
To: Cogswell,Peter (BPA) - DK-7; Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: Re: ISAB spill review

I think Erik Merrill's summary bullets to Council are pretty definitive and to the point...lots of uncertainty, lots of risk, not sufficiently developed.

From: Cogswell,Peter (BPA) - DK-7
Sent: Thursday, February 20, 2014 06:12 PM
To: Milstein,Michael C (BPA) - KE-4; Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Maslen,Bill (BPA) - KEW-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: RE: ISAB spill review

I think it is better than mixed bag, – bottom line interpretation as I see it: this thing needs a lot of work.

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, February 20, 2014 6:01 PM
To: Bodi,Lorri (BPA) - KE-4; McNary,Sarah R (BPA) - A-7; Maslen,Bill (BPA) - KEW-4; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7; Cogswell,Peter (BPA) - DK-7
Subject: ISAB spill review

Just posted.

Have only skimmed, but appears to be a mixed bag. They say study design is incomplete and not fully researched, relies on correlations that do not establish causation, with potential confounding factors and could cause unintended negative consequences. Also they say it's unlikely spill could be isolated as a causative factor. However they say the proponents should be encouraged to develop a more complete proposal that responds to Action Agency concerns. Also they say a properly designed experiment could produce useful information about spill and juvenile passage survival.

From:	Ball,Crystal A (BPA) - DKR-7
To:	Cogswell,Peter (BPA) - DK-7; Klumpp,Elizabeth C (BPA) - DKR-7; Bodi,Lorri (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4; McNary,Sarah R (BPA) - A-7; Harwood,Holly C (BPA) - PGB-5; Sweet,Jason C (BPA) - KEWR-4; Milstein,Michael C (BPA) - KE-4; Wingert,Kevin M (BPA) - DKPM-7; Marker,Douglas R (BPA) - DKR-7; Barco III,John W (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Reller,Mark D (BPA) - DKR-MSGL; Zimmer,Pat R (BPA) - DKN-WASH
Subject:	FW: ISAB report out
Date:	Friday, February 21, 2014 3:24:44 PM
Attachments:	ISAB 2014-2 SpillStudyReview 20feb.docx

Forwarding just in case you haven't already seen Terry's take.

_____
From: Terry Flores [tflores@nwriverpartners.org]
Sent: Friday, February 21, 2014 10:36 AM
Subject: ISAB report out

The ISAB issued its findings on the experimental spill test this morning and hammered it pretty hard. However, as we anticipated, they also couldn't resist the lure of making suggestions as to how the study could be designed and suggesting if properly done it could provide useful information.. On the whole, however, their report is very good for us even while I can see the plaintiffs cherry picking some of the statements, for example, "...it appears that the increased spill hypothesis stand as a possible candidate for testing" and, "The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions".

The seminal finding is its conclusion:

"The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects."

I will put together a short statement on it for folks to use as they wish!

Terry Flores, Executive Director
Northwest RiverPartners
(503) 367-9997 cell
(503) 274-7792 office

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
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851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

ISAB Members

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Kurt Fausch, Ph.D., Professor of Fisheries and Aquatic Sciences, Department of Fish, Wildlife, and Conservation Biology at Colorado State University

Colin Levings, Ph.D., Scientist Emeritus at Centre for Aquaculture and Environmental Research, Department of Fisheries and Oceans, West Vancouver, British Columbia, Canada

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Bonnie McCay, Ph.D., Board of Governors Distinguished Service Professor at Rutgers University, New Brunswick, New Jersey in the Department of Human Ecology of the School of Environmental and Biological Sciences

Kate Myers, Ph.D., Research Scientist, Aquatic and Fishery Sciences, University of Washington (Retired)

Robert J. Naiman, Ph.D., Professor of Aquatic and Fishery Sciences at University of Washington

Greg Ruggerone, Ph.D., Fisheries Scientist for Natural Resources Consultants

Laurel Saito, Ph.D., P.E., Director of the Graduate Program of Hydrologic Sciences at the University of Nevada Reno

Dennis Scarnecchia, Ph.D., Professor of Fish and Wildlife Resources at University of Idaho

Steve Schroder, Ph.D., Fisheries Consultant and former Fisheries Research Scientist at the Washington Department of Fish and Wildlife

Carl Schwarz, Ph.D., Professor of Statistics and Actuarial Science at Simon Fraser University, Canada

Chris C. Wood, Ph.D., Scientist Emeritus at the Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada

Staff

Erik Merrill, J.D., Independent Science Program Manager, Northwest Power and Conservation Council

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ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

    (a) Does the experiment include an adequately researched hypothesis?
    (b) Is the experiment appropriately designed to test the hypothesis?
    (c) Is the proposed duration of the experiment sufficient?
    (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:

    - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

    - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

    - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.

3. Monitoring Smolt-to-Adult survival rates.

4. Comparing survival rates against both past survival rates and prospective model predictions.

5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.

6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) **Does the experiment include an adequately researched hypothesis?**

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models

that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project's spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

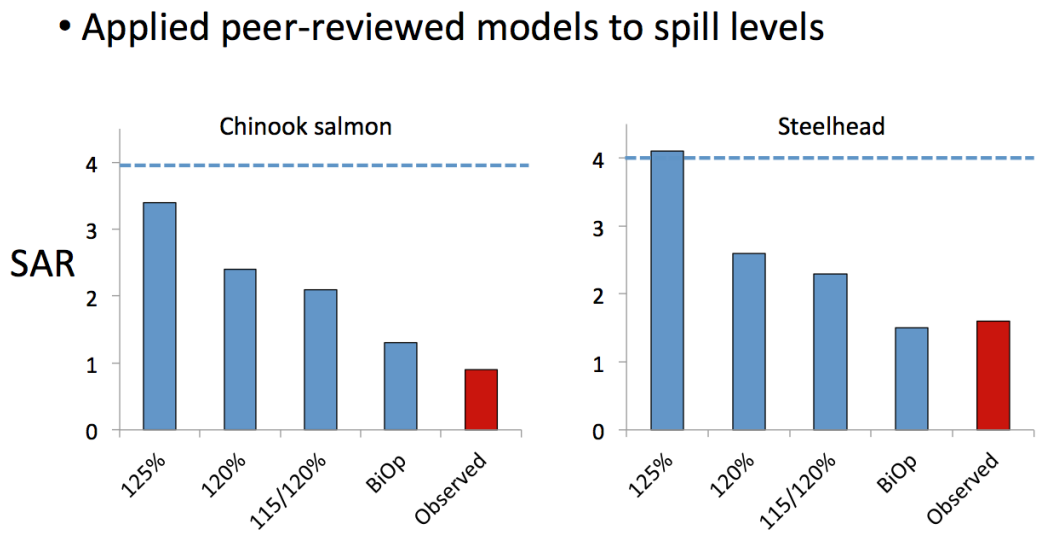

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have

increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead

should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE

funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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From:	Klumpp,Elizabeth C (BPA) - DKR-7
To:	Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; Sweet,Jason C (BPA) - KEWR-4; Maslen,Bill (BPA) - KEW-4; McNary,Sarah R (BPA) - A-7; Lut,Agnes (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Marker,Douglas R (BPA) - DKR-7; Wingert,Kevin M (BPA) - DKPM-7; Milstein,Michael C (BPA) - KE-4
Subject:	Seattle City Light Perspective on Spill Test Proposal
Date:	Friday, February 21, 2014 6:17:51 PM
Attachments:	SCL Response to BiOp proposed Spill TestFinal2-6-14.docx

FYI

From: Brueger, Maura [mailto:Maura.Brueger@seattle.gov]
Sent: Friday, February 21, 2014 11:55 AM Pacific Standard Time
To: Klumpp,Elizabeth C (BPA) - DKR-7
Cc: Feliciano, Rose <Rose.Feliciano@seattle.gov>
Subject: FW: Seattle City Light Perspective on Spill Test Proposal

Hey Liz;

We finally got it out. Feel free to share. Interestingly, the NWEC actually encouraged us to share it with folks so that it could be considered as part of the review of the ISRB review (I see that they came out with their study as well).

Maura

From: Brueger, Maura
Sent: Friday, February 21, 2014 11:26 AM
To: 'Karier, Tom'; 'prockefeller@nwcouncil.org'; 'keith.phillips@ofm.wa.gov'
Cc: Feliciano, Rose (Rose.Feliciano@seattle.gov); Best, Lynn (Lynn.Best@seattle.gov)
Subject: Seattle City Light Perspective on Spill Test Proposal

It took a little while to get clearance from the City's Office of Intergovernmental Relations and I do want to add the caveat that this is a City Light product and not the City of Seattle's perspective.

That said we felt that Ed Connors, City Light senior fish biologist's expertise and perspective might be helpful as you review the Independent Science Review Board's review of the spill test proposal. I know it was released today but have not reviewed it myself or asked Ed to review it either. Although, I understand that they expressed similar concerns as Ed.

Please let me know if you have any questions or would like to discuss this issue further. As a utility with a strong reputation for environmental stewardship and expertise in large dam operations with an emphasis on protection of fish, we felt it was important to express our concerns.

Maura

Maura Brueger | *Director, Government & Legislative Affairs* | Seattle City Light | T: 206.684.3015 | M: 206.707.3306 | maura.brueger@seattle.gov |

City of Seattle

Seattle City Light

February 6, 2014

Response to
Proposed Experimental Spill Test Proposal

The experimental spill proposal that is currently under review by the Independent Science Advisory Board at the request of the NW Power and Conservation Council is being justified on the basis of several recent studies that found a positive correlation between in-river conditions including spill volumes and marine survival (measured as smolt-to-adult returns or SARs). A recent paper by scientists at the University of Washington (UW) identifies significant flaws in the statistical analysis used in these studies to show this correlation.

The UW paper suggests that many of the "independent'" variables that are used in the spill volume versus SAR analysis are actually not independent of each other. The problem is that marine conditions and river flow conditions are intercorrelated. Both are affected by the Pacific decadal oscillation (PDO), an index of surface sea temperatures in the North Pacific. River flows tend to be higher during the cool phases of the PDO which also favor salmon survival in the marine environment. The cool ocean conditions are well-documented to have a positive impact on SARs (much better food production for salmon). Because of this intercorrelation, higher flow conditions and the resulting higher spills may appear to be improving SARs when in fact the actual thing improving SAR rates are cooler temperatures and more abundant food in the ocean. The spill experiment is based on the assumption that higher spills are improving marine survival. However, there could well be no cause-and-effect relationship here, just an intercorrelation between river conditions and ocean conditions.

Based upon years of research, we know that spills over 120% harm out-migrating juvenile fish. Oregon Department of Fish & Wildlife (ODFW) and the other proponents of the experimental spill proposal are arguing that spills that result in Total Dissolved Gas (TDG) levels over 120% improve marine survival to the point where it offsets in-river mortality caused by TDG. However, if the actual improvement in marine survival is caused solely by ocean conditions, than the experimental spill test proposal will achieve very little (or nothing) at cost to both the ratepayers and to the smolts.

700 Fifth Avenue, Suite 3200, P.O. Box 34023, Seattle, WA 98124-4023
Tel: (206) 684-3000, TTY/TDD: (206) 684-3225, Fax: (206) 625-3709
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Seattle City Light is the 10th largest publicly owned utility in the nation dedicated to exceeding our customers' expectations in safely producing and delivering power that is low cost, reliable and environmentally responsible.

The proponents of the experimental spill test proposal need to provide some type of biological evidence that demonstrates a cause-and-effect relationship between spills and marine survival. Prior to a costly experiment that could potentially result in a lot of harm to fish, we would typically want to have "multiple lines of evidence", including a well-established biological mechanism between dam spills and survival, that would support the assumption that there is indeed a cause-and-effect relationship (and simply not a spurious correlation) between spills and SARs. For example, if dam spills resulted in higher in-river growth rates or lipid levels in smolts, then this would provide biological support for the correlation between spills and SARs.

More detail on the proposal, the major concerns with the proposal, and recommendations for alternative analysis presented below.

The spill test proposal calls for the following:

1. Implement spill levels greater than historical levels, particularly during low flow years. Spill would be increased to 125% of TDG levels. The increased spills would occur during the spring (April 3 through June 20) for a period of 10 years, with a comprehensive assessment of the spill test results conducted after 5 years. The test spills would be conducted at the four lower Snake River dams, and on the main stem Columbia at McNary, John Day, The Dalles, and Bonneville dams.
2. PIT-tagging methods would be used to assess in-river survival during the tests.
3. Smolt-to-adult survival rates would be monitored during the 10-year test period (note: given that most Chinook and steelhead spend between 2 and 4 years in the ocean, we won't be able to calculate SARs until the fifth year of the test). These results will be used to evaluate the validity of the statistical and life-cycle models being used to predict improvements in SARs from increased spills.
4. The spill test would include provisions to insure "hydro system power generation viability", as well as facilitate use of non-hydro renewable energy sources (e.g., wind farms).

From a scientific perspective, there are three major criticisms for the proposal that have been identified:

1. The correlation between in-river migration conditions and marine survival may be the result of a "spurious" correlation (described above), meaning that another variable (likely shifts in ocean conditions) are actually responsible for the long-term patterns in SARs being observed in Columbia River chinook and steelhead. The presence of a statistical correlation does not mean that there is a cause-and-effect relationship between in-river migration conditions and marine survival (SARs). More sophisticated statistical tests are required to account for statistical interactions between in-river conditions and ocean conditions. The effects of

ocean conditions need to be fully accounted for and "backed out" of the statistical model. Only then can in-river migration effects be evaluated in a statistical model.

2. The biological "mechanism" that links in-river conditions to improved SAR rates has yet to be determined. The proponents of the experimental spill measures frequently state that passage through the dam turbines is resulting in "delayed mortality" in the ocean. This implies that the fish are injured during turbine passage, and these non-lethal injuries result in lower marine survival rates. However, data is lacking concerning the effects of turbine passage on long-term survival. The proponents also suggest that reduced travel times through the river result in increased SARs. The biological effects of reduced travel times on SARs has not been well documented, though the spill proponents state that fish condition and growth may be favored by reduced in-river travel times. Given that the experimental spill tests will not likely change the volume of water passing through the river at any time, the reduced travel time hypotheses would not apply to the proposed spill experiment.
3. The PIT-tagging methods employed to show a linkage between in-river conditions and SARs may bias results. Recent studies have found that tagged fish have significantly higher mortality rates than untagged fish, and this bias would need to be addressed in any proposed spill experiment studies.

Based on the information above, we would strongly advise not proceeding with the experimental spill test as proposed. However, there is analysis that could be considered to further inform us on the impacts of spill on fish survival.

1. Identify cause-and-effect relationships between in-river survival and SARs prior to initiating an experimental spill program. Any biological mechanism that links in-river conditions to spill should be clearly identified through expanded in-river biological monitoring, and through experiments on the effects of turbine passage and barge transport on long-term survival. The models that are being used to predict SARs from in-river survival should be updated to include physiological and energetic components. Any link between in-river survival and SARs will likely involve improved physiological conditions, lower long-term disease rates, or improved energetic condition (e.g., greater growth rates) that are a direct result of in-river passage.
2. Complete a rigorous statistical analysis of in-river and SAR data that fully accounts for any interactions between in-river environmental variables and ocean variables. The well-known effects of ocean conditions need to be fully "backed out" of the model before the in-river variables can be analyzed.
3. Compare long-term SAR trends for Chinook and steelhead in the Columbia River system with SAR trends observed in other west coast systems, including the Puget Sound, western Washington, and western Oregon. The SAR rates in some of these systems have long-term trends that are very similar to those observed

in the Columbia. For example, SAR rates for steelhead in the Puget Sound greatly declined during the same period when they declined in the Columbia River system. This implies that ocean conditions are likely the major factor influencing long-term patterns in SARs. SAR rates in other major river systems can be used as a "control" for examining the influence of in-river conditions on Columbia River smolts.

Prepared by Dr. Ed Connor, Senior Fish Biologist, Seattle City Light
ed.connor@seattle.gov
206-615-1128

From: Wingert,Kevin M (BPA) - DKPM-7
To: Lut,Agnes (BPA) - KEWR-4
Subject: Fw: Liz Hamilton"s glowing take on the ISAB
Date: Monday, February 24, 2014 9:15:11 AM

For your records.

From: Zimmer,Pat R (BPA) - DKN-WASH
Sent: Monday, February 24, 2014 09:10 AM
To: Wingert,Kevin M (BPA) - DKPM-7; Cogswell,Peter (BPA) - DK-7; Johnson,G Douglas (BPA) - DKPM-7; Bodi,Lorri (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4; Milstein,Michael C (BPA) - KE-4; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7; Weiss,Steven D (BPA) - DKR-7
Subject: RE: Liz Hamilton's glowing take on the ISAB

Fascinating. She actually says nothing about the ISAB's findings per se. She just talks about NSIA's opinions and what they "expect" the Council will ask for.

From: Wingert,Kevin M (BPA) - DKPM-7
Sent: Monday, February 24, 2014 12:04 PM
To: Cogswell,Peter (BPA) - DK-7; Johnson,G Douglas (BPA) - DKPM-7; Bodi,Lorri (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4; Milstein,Michael C (BPA) - KE-4; Zimmer,Pat R (BPA) - DKN-WASH; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-7
Subject: Liz Hamilton's glowing take on the ISAB

Lorri, et. al.,

Don't know if you'd seen this yet. Liz Hamilton has a very interesting take on the ISAB's actions regarding the CSS test. She completely ignores the rejection of the ISAB for a lack of a sound hypothesis as well as use of dubious causal correlations touted by the test. Instead, she writes a glowing article touting the success of the effort and how the ISAB's has laid the groundwork for the NPCC to initiate an intimate effort between CSS proponents and the ISAB.

The one slight acknowledgement of how the ISAB's review may have been less than stellar comes back as an attack on the Action Agencies with:

"Hamilton also noted that all of the assumptions and models used by BPA, the Corps, and NOAA would benefit from the same robust scientific review that has been applied to the CSS and spill test design."

http://www.theoutdoorwire.com/story/13932396596sbfqyx9v4j

NSIA Recommends Moving Forward in Salmon Recovery Plan

In its continuing goal to recover salmon, the Northwest Sportfishing Industry Association is pleased with the review released by the Independent Scientific Advisory Board of the Northwest Power and Conservation Council. It reviewed the Proposed test of expanded spill supported by the Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), NSIA, environmental and fishing groups, and individuals calling for a ten-year spill test to see the effect on salmon recovery.

"Today is a great day for salmon and all of the businesses that are dependent on them," said Liz Hamilton, executive director of the NSIA. "We are convinced increasing spill has the potential to double salmon runs headed to Idaho, and are encouraged that the ISAB's recommendations will strengthen the test and answer some of the most important questions surrounding salmon recovery in the basin."

The ISAB's review came after the state of Oregon recommended an experimental spill program be included in the Northwest Power and Conservation Council's 2014 Fish and Wildlife Program. The proposal was based on the findings of state, federal and tribal scientists that indicate an expansion of spill could dramatically increase salmon survival rates in the Columbia basin.

Hamilton expects the Council will instruct the ISAB to work with the scientists from the Comparative Survival Study (CSS) to more fully flesh out the experimental design to move quickly into implementation.

Last September NSIA filed comments that urged the Northwest Power and Conservation Council to do the spill test as well as conduct an economic impact study of salmon from the Columbia Basin on the regional economy.

NSIA has been deeply involved in Columbia River salmon recovery since the mid-1990s and with today's report, Hamilton said she feels a robust spill test will help settle the long-standing debates surrounding the benefits of spill. She also expressed her optimism that an increase of spill to appropriate levels has the potential to recover fish runs to levels outlined in the Council's Fish and Wildlife Plan, keep dams in place and not impact farmers.

"The bottom line is that we know that spill improves salmon runs. The fish have been talking to us, the question is, are we going to listen?" Hamilton said. "With the ISAB's recommendations for a more robust spill test, we have a very good shot at having salmon management policy being set by facts instead of performance standards that do not measure smolt-to-adult ratios. By doing the spill test, conducting an economic study and continuing the coded-wire tag program, we can manage the Columbia system in a way where we can balance the needs of the Bonneville Power Administration and the fish. We are hopeful that this recommendation could lead to a win-win-win situation for all involved."

Hamilton also noted that all of the assumptions and models used by BPA, the Corps, and NOAA would benefit from the same robust scientific review that has been applied to the CSS and spill test design.

Last September the NSIA filed with the council several concerns, which are listed below:

• Adopt testing methods to test increased levels of spill in the spring to achieve better, more reliable survival of smolts passing through the hydro system.

• Conduct an economic impact study on the benefits of fishing activities in the Columbia basin. This would help drive policy that balances the economics of the issue with the science.

• Continue funding SAFE areas in the lower Columbia to benefit wild stocks when providing enhanced economic utilization of hatchery fish.

• Continue supporting the coded-wire tag program to give data for run forecasting and harvest management.

"We feel that all of these issues are important to find common-ground solutions based in

fact," Hamilton said. "We expect that the Council will direct the ISAB to work with the CSS scientists on a spill test for their 2014 Fish and Wildlife Program. NSIA will continue to work hard to be a part of the solution to these very complex and difficult issues."

Very Respectfully,

Kevin Wingert
Public Affairs Specialist
Bonneville Power Administration
503-230-4140 / 971-207-8390
kwingert@bpa.gov

From:	Ball,Crystal A (BPA) - DKR-7
To:	Sweet,Jason C (BPA) - KEWR-4
Subject:	FW: Spill Materials
Date:	Tuesday, February 25, 2014 1:08:21 PM
Attachments:	Fish-Spill-Feb3_2014.pptx ISAB spill test presentation17Jan2014.pptx

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From: Ball,Crystal A (BPA) - DKR-7
Sent: Monday, February 03, 2014 5:27 PM
To: WHITMAN Richard M * GOV (richard.m.whitman@state.or.us)
Subject: FW: Spill Materials

FYI. Lorri sent this email to all 8 NW Power Council members.

From: Bodi,Lorri (BPA) - KE-4
Sent: Monday, February 03, 2014 3:12 PM
To: Bbradbury@nwcouncil.org
Cc: Cogswell,Peter (BPA) - DK-7; Maslen,Bill (BPA) - KEW-4
Subject: Spill Materials

Dear Bill,

As you continue to discuss and consider mainstem hydro mitigation as part of the Program amendments, we wanted to share with you some of the biological information the Corps and BPA presented recently to the ISAB regarding current hydro operations (including spill actions) and a proposal from some parties for a future experimental spill test. We appreciate your attention to this issue, since spill, tailored at each dam, is at the heart of FCRPS hydro mitigation actions. In fact, spill using surface passage has been key to recent increases in fish passage effectiveness survivals, as well as faster travel times for migrating fish.

The first part of these materials describes the actions and results we have seen from our efforts over the last five years, and the follow through we expect over the next five years, to achieve our dam survival performance standards (93-96% per dam) and inriver survival metrics under the BiOp. We are on track to achieve these objectives by 2018, and are also demonstrating high levels of SPE (spill passage efficiency) and improved fish travel times. Our testing for performance is rigorous and precise.

In addition, we are pleased to see that the overall abundance of wild fish for listed species has been much improved since listing decisions were made in the 1990s. The Council certainly deserves a lot of the credit for these improvements because of the leadership it has provided through the Program.

The second part of the materials describes the questions and concerns we have identified regarding the proposal to change direction and test higher levels of spill for the next ten years or so. We believe there are significant questions regarding the correlations underlying the proposal, the asserted biological benefits of the proposal, and the nature of the test.

As you will see, these materials do not address the operational and financial implications of the proposed spill test. Peter plans to send you BPA's preliminary assessment of these implications in the near future.

We would be glad to meet with you to answer any questions you may have regarding this information. We look forward to the completion of the latest updates to the Columbia Basin Fish and Wildlife Program and our continued partnership in implementing the Program.

Regards,

Lorri

Implementation of the 2008-2018 All-H Strategy: Recent Hydro Improvements and Benefits of Smart Spill

February 3, 2014

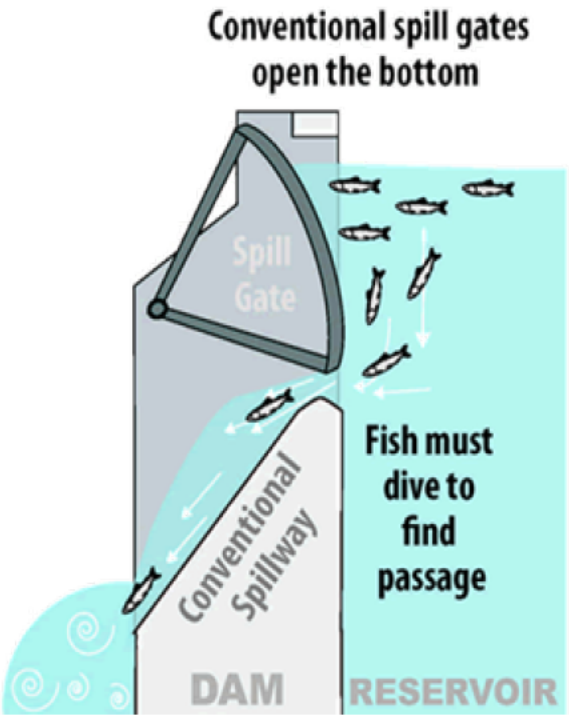
The 2008 Hydro Plan is Underway and Deserves a Chance to Show Results

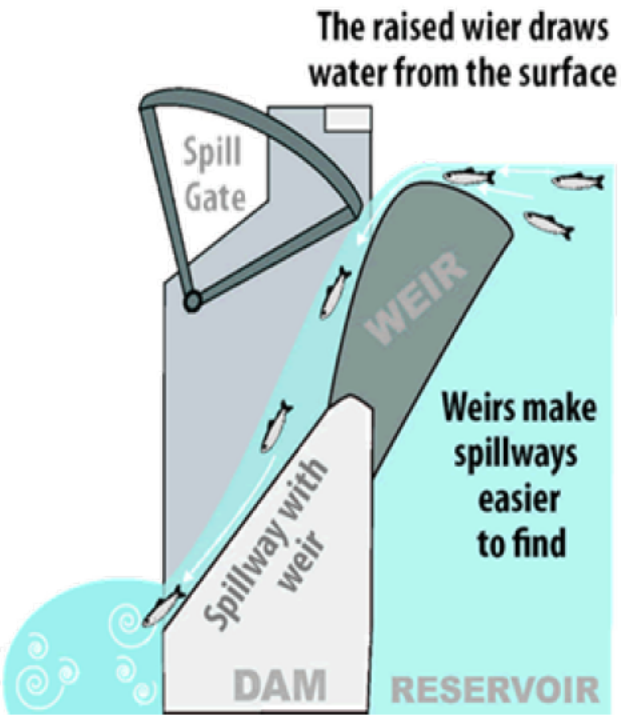
- Congress and BPA ratepayers, in collaboration with the region, have invested heavily in recent years to achieve ambitious performance standards and in-river survival targets.
  - Research guides passage improvements at each dam.
  - Rigorous testing measures progress toward dam passage performance standards and in-river survival targets.
  - Physical hydraulic models inform best spill patterns at each dam to avoid adverse effects.
- Current action plan (2008-2018) includes major dam modifications (e.g. The Dalles Spill Wall), surface passage, Smart Spill, turbine screens and relocation of bypass outfalls.
- Actions and testing are on track but still underway; it is too early to change course.

"Smart Spill" is a Key Component of the Federal Strategy to Improve Fish Survival

- Spill ***effectiveness*** is more important to safe fish passage than spill ***volume.*** *(And increasing spill does not increase flow or speed of river.)*
- With smart spill, fish survival is on track to meet juvenile dam passage performance standards of 96 percent survival for spring migrating fish and 93 percent for summer migrants.
- Spill levels and patterns are tailored for each dam, balancing adult and juvenile fish passage and the unique characteristics of each dam.
- Combines scientifically designed spill operations with surface passage and other structural changes (such as bypass outfall improvements) to increase juvenile fish survival beyond conventional spill.

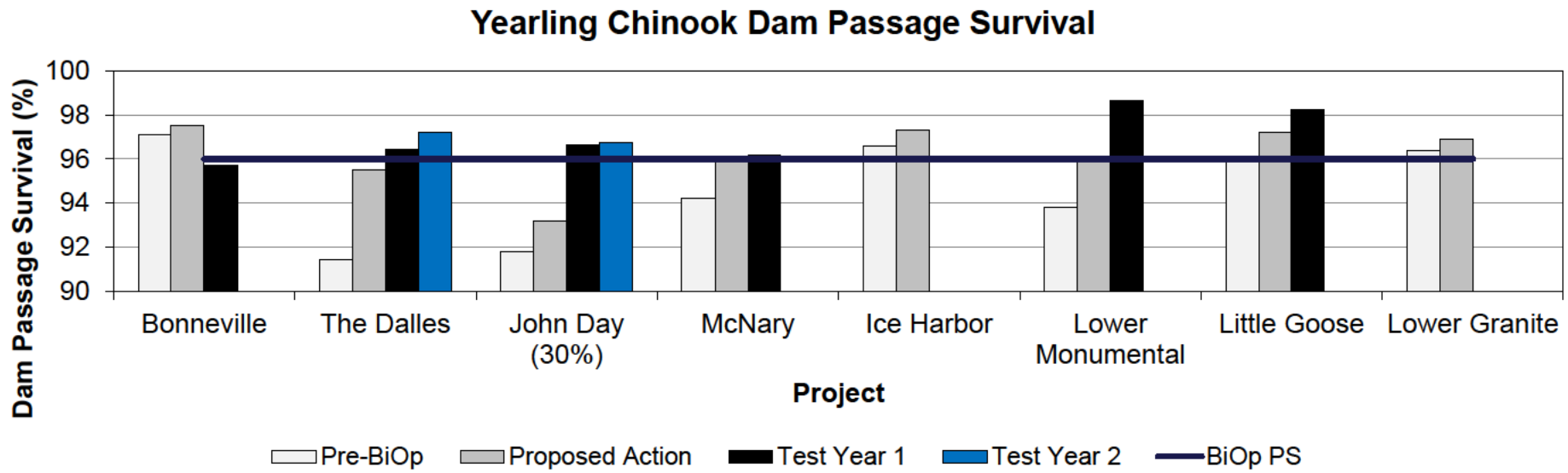
Surface Passage Characteristics

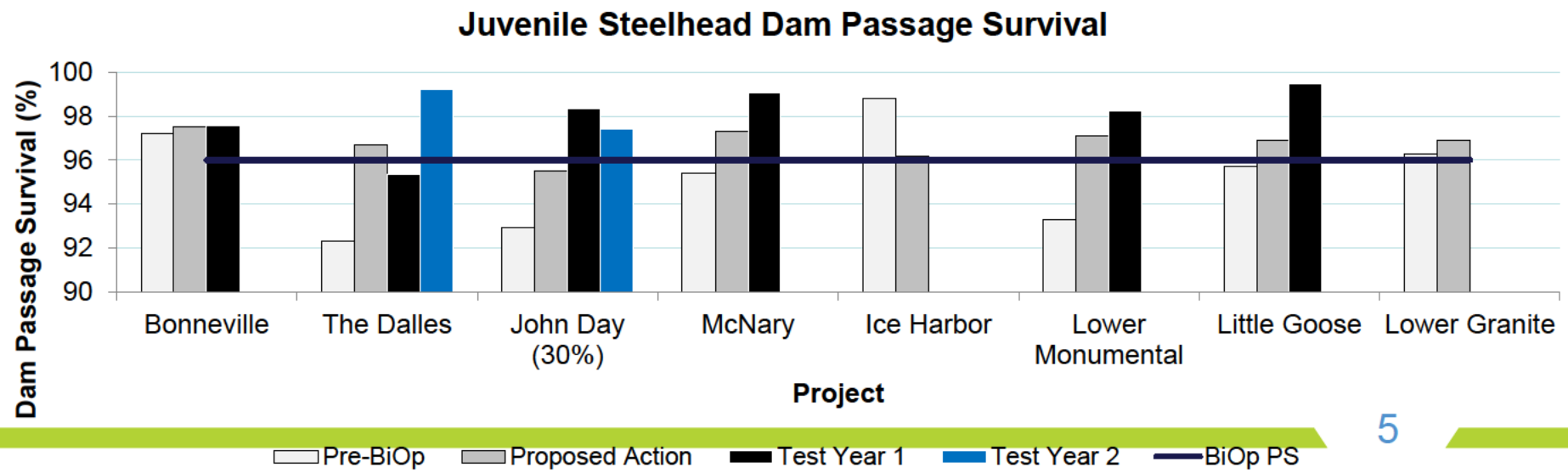




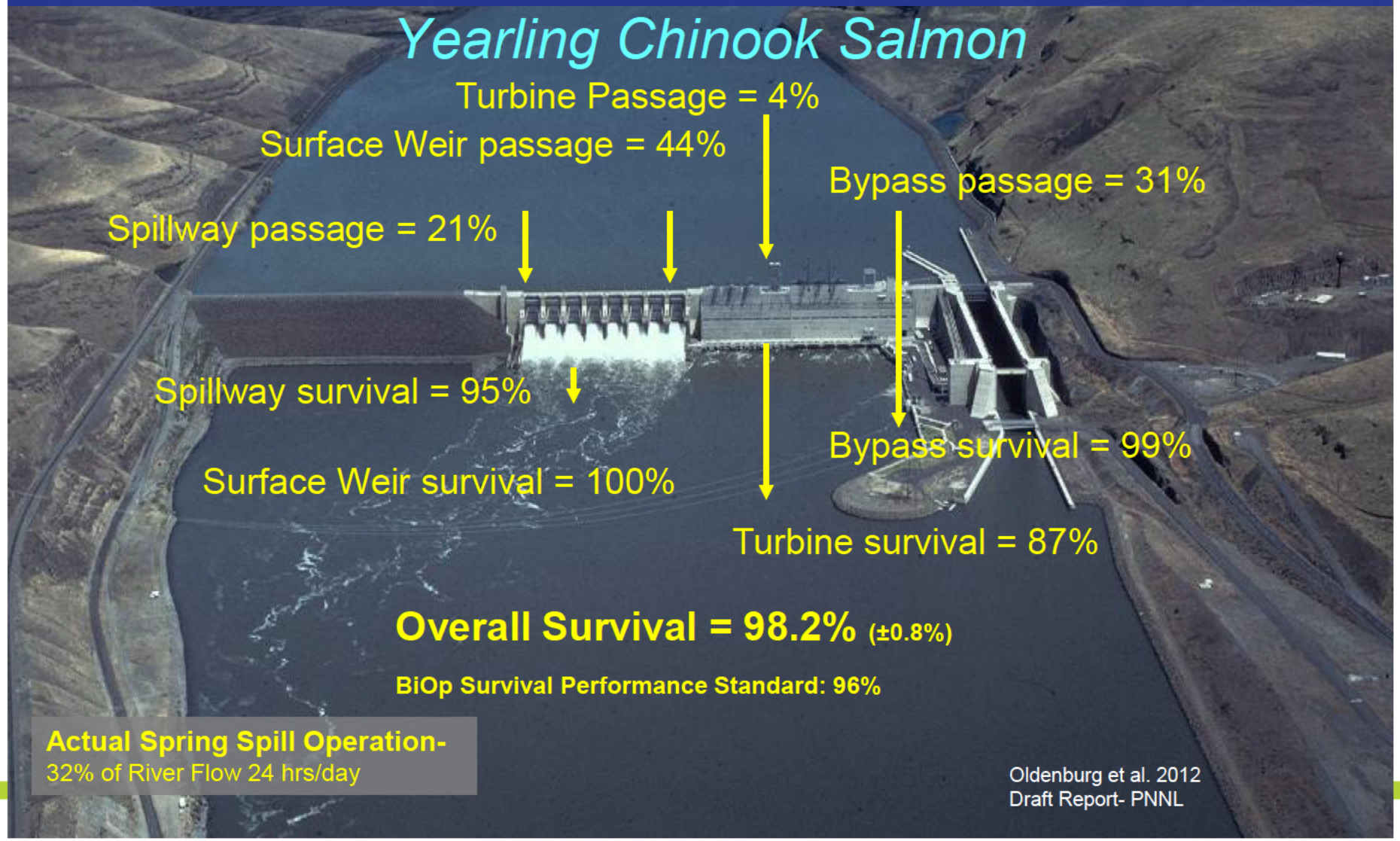
- Spillway weirs and other surface passage structures provide a surface route of passage and allow fish to pass dams at depths where they naturally migrate
  - Easier for fish to find; reduce migration delay and minimize exposure to predation near dams
  - Generally provide the highest survival of all passage routes at dams; consistently at or near 100 percent survival
  - Pass the most fish relative to the volume of water, making them the most effective passage route
  - Increase spill passage efficiency (% of fish that pass through spill); as many as 4-times the percent of fish pass the dam through spill bays equipped with spillway weirs
  - Reduces the number of fish that pass through turbines
- Surface passage routes currently exist at all 8 dams

Juvenile Dam Passage Survival Performance Standards



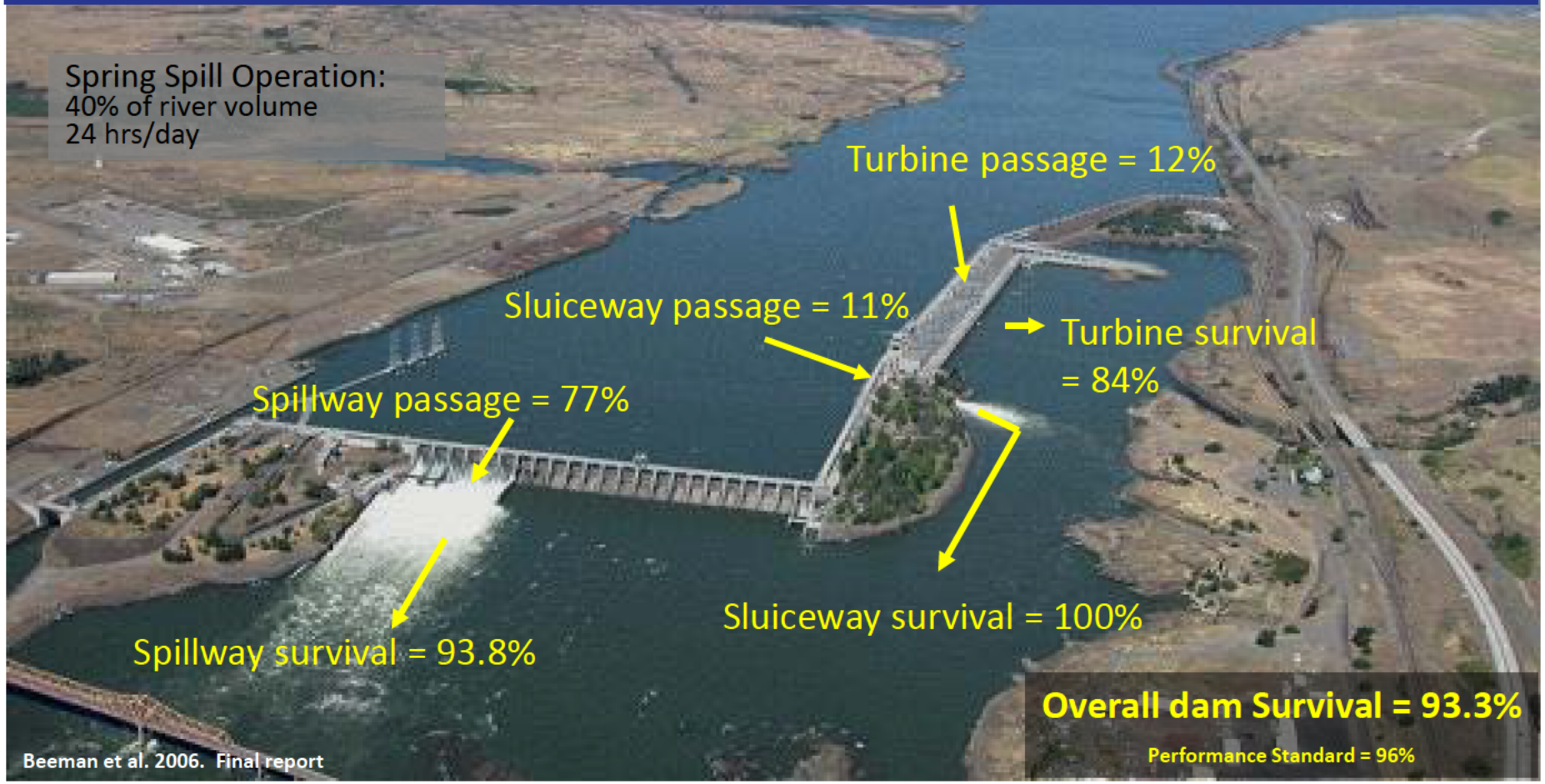


Little Goose Dam
2012 Passage and Survival Metrics



Structural Changes at FCRPS Dams have Improved Survival

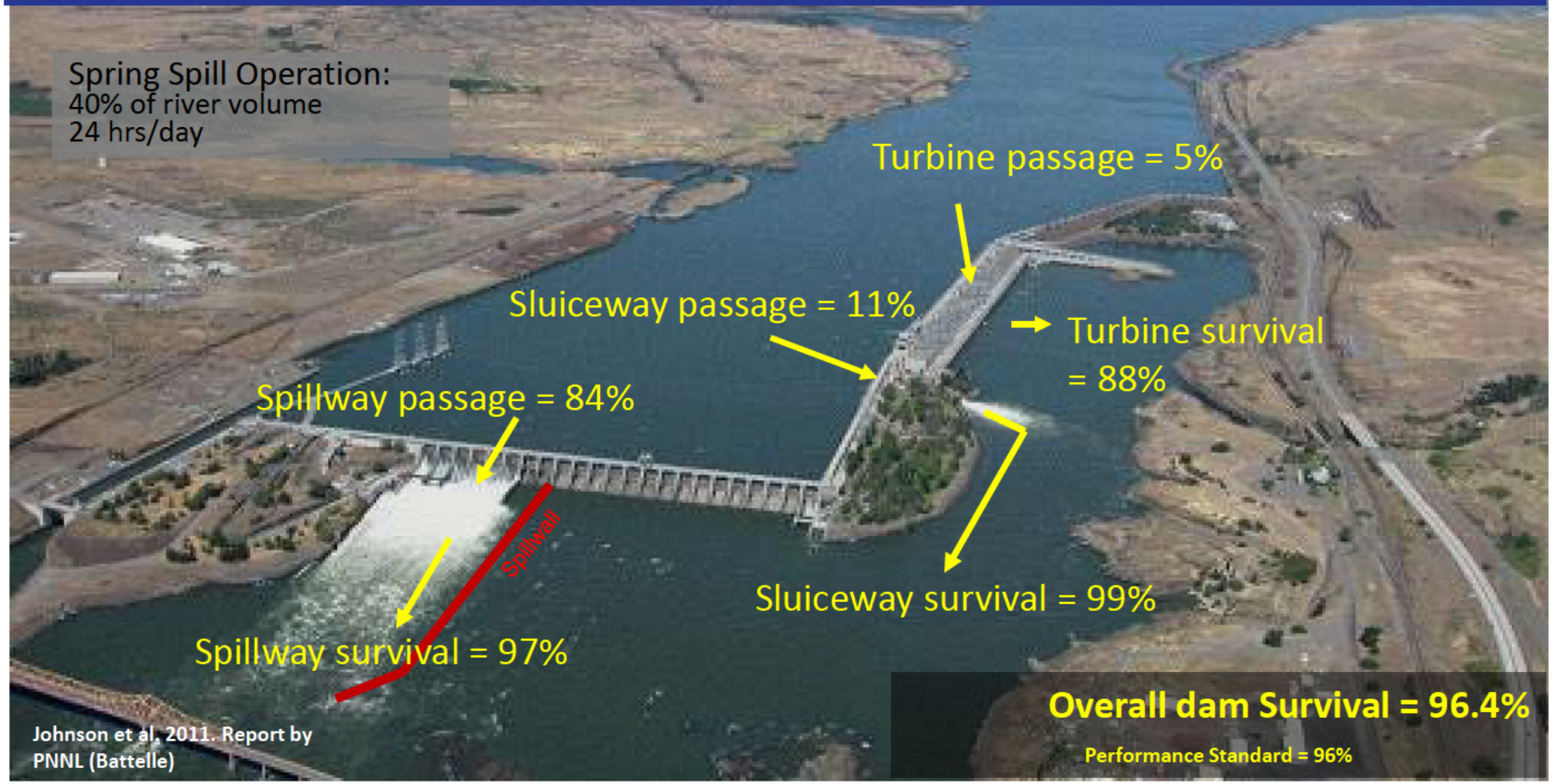
***2005** - The Dalles Dam: Spring Chinook*



Beeman et al. 2006. Final report

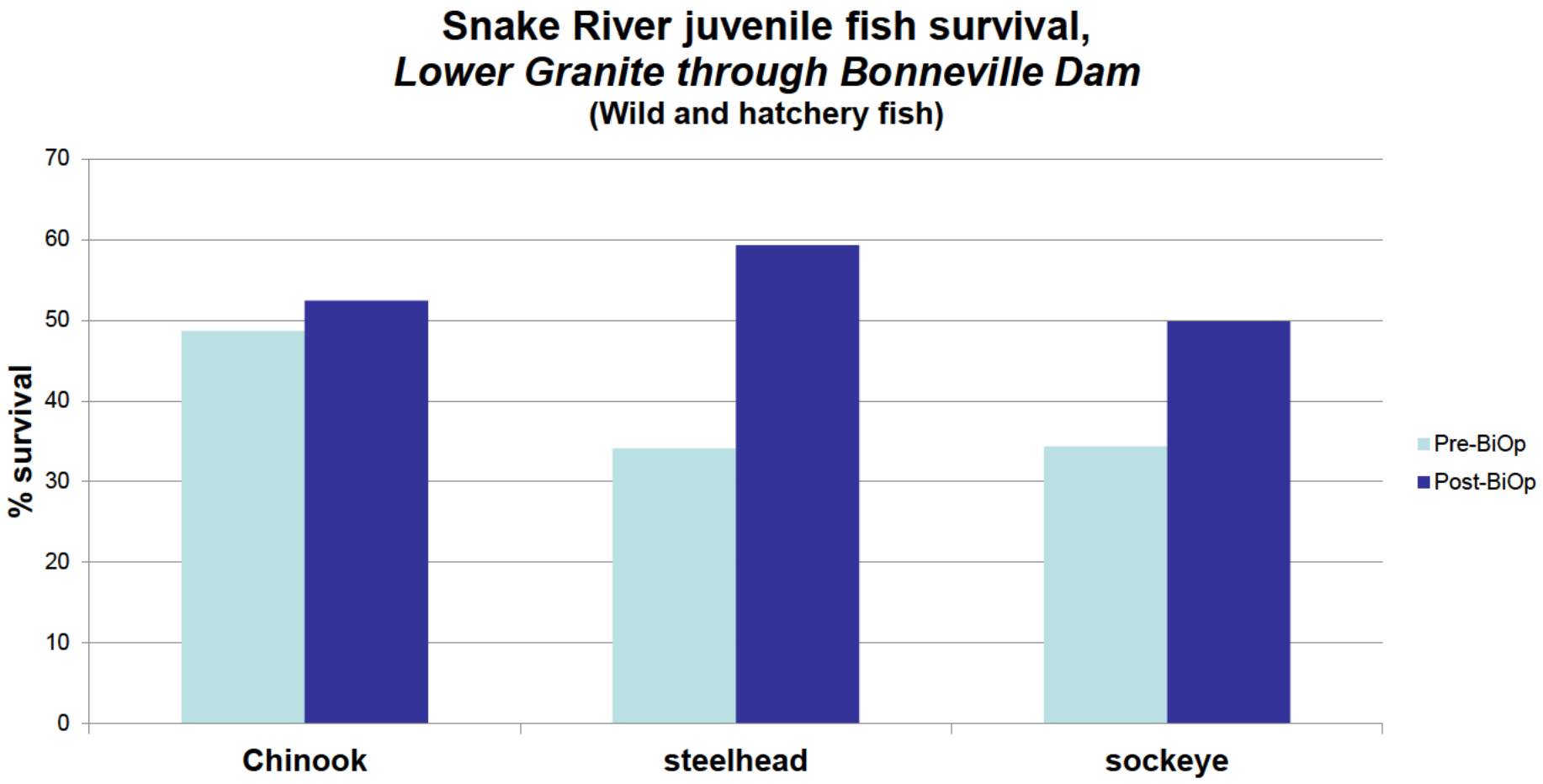
Structural Changes at FCRPS Dams have Improved Survival

***2010** - The Dalles Dam: Spring Chinook*



Johnson et al. 2011. Report by PNNL (Battelle)

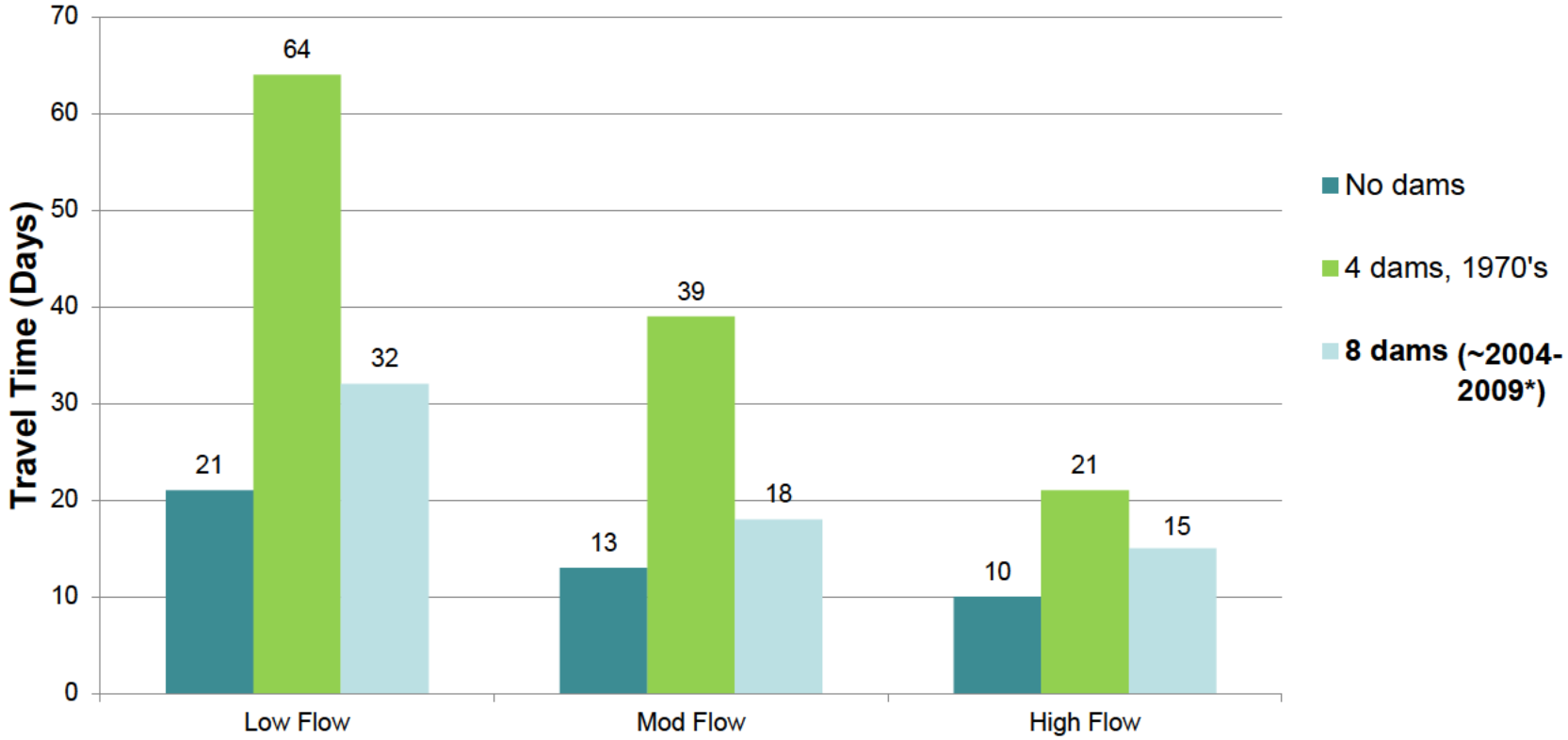
In-river Survival has Increased with Smart Spill



Pre-BiOp period: 1997 – 2007
Post-BiOp period: 2008 - 2012

Fish Travel Time is Decreasing

Lower Granite Dam to Bonneville Dam Fish Speed Migration in Travel Time per Day under 3 Flow Conditions (low, moderate, high)



Data currently being updated by NOAA.

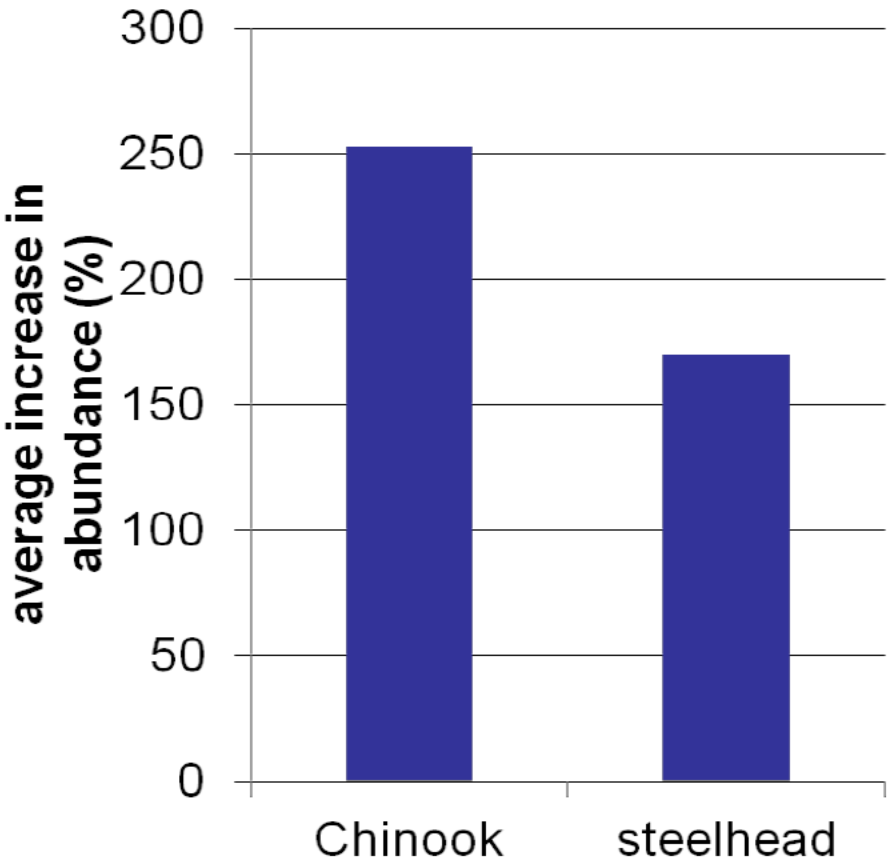
* Muir does not explicitly state the years he used to calculate the 8 dam travel time, but did state "last 5 years" since publishing his paper in 2010.

SOURCE: Muir, W.D., Williams, J.G. 2012. Improving connectivity between freshwater and marine environments for salmon migrating through the lower Snake and Columbia River hydropower system. Ecol. Eng. 48: 19-24

Wild Adult Fish Abundance is Increasing

Based on 10 years of data, 2002 – 2011:

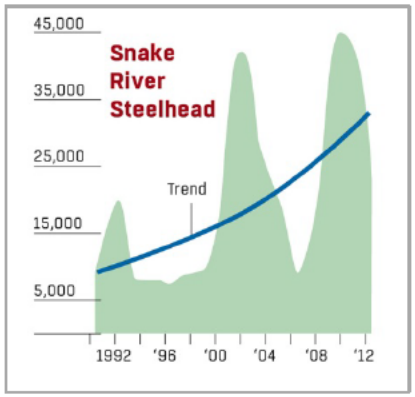
- On average, wild Chinook salmon populations have more than tripled in abundance.
- On average, wild steelhead populations have more than doubled in abundance.

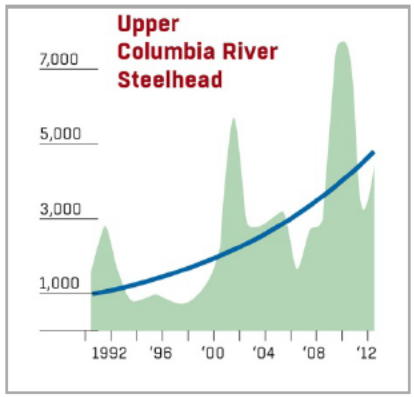


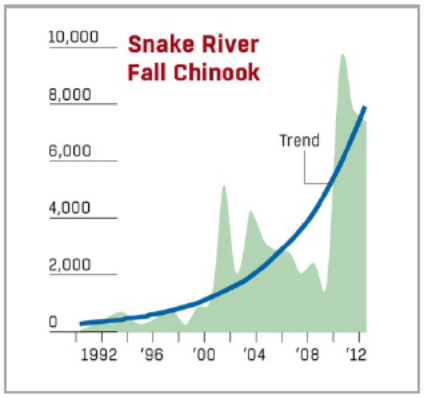
Note: Based on comparison of geometric mean of abundance from 1990-1999 to most recent 10 years, generally 2002-2011.

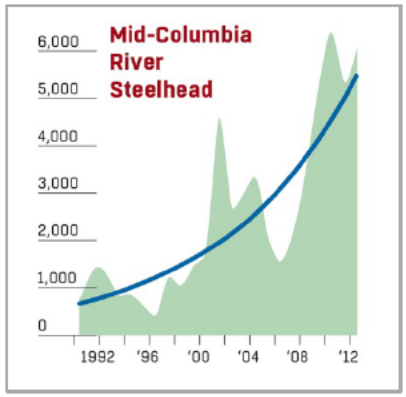
Status of Adult Fish

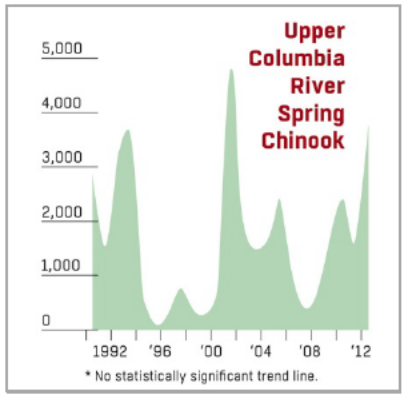
Of the 49 Interior Columbia Basin wild adult fish populations where data are available, 47 have increased in abundance since listings in the 1990s.

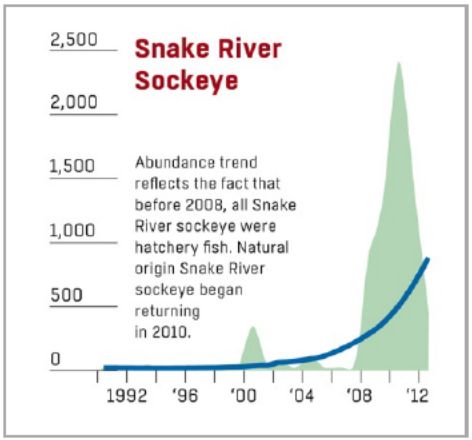


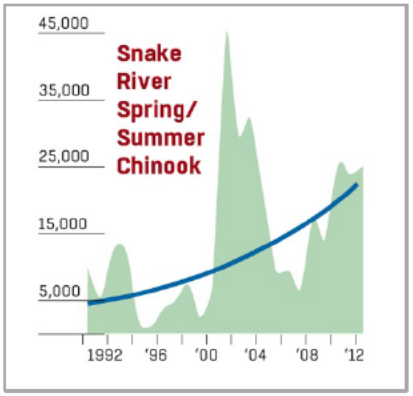












Note: Abundance monitoring and reporting started with the first ESA salmonid listing.

Summary: Hydro Results are Ongoing and Promising

- Research-based improvements are delivering improved passage, higher in-river survival and faster fish travel time.
- Smart Spill is tailored to conditions at each dam, enhancing both spill effectiveness and efficiency.
- As of 2010, all mainstem dams have been equipped with a surface passage route.
- Improvements and testing are ongoing and still proving their value to the region. We need to maintain the course for this current performance-based approach.

Spill Test Issues and Questions

Summary of Experimental Spill Proposal

- Increases spill levels significantly.
- Spring "Experimental Spill Management Program":
  - Spill up to 125% TDG level
  - April 3 – June 20, 24 hours per day
  - Use CSS framework to monitor SARs, which Oregon expects to increase significantly
- Spill test exceeds Oregon and Washington water quality criteria and requires regulatory changes.
- Oregon's proposal indicated some constraints, but without specifics that can be evaluated.

There are Science-based Concerns About the Proposed Spill Test

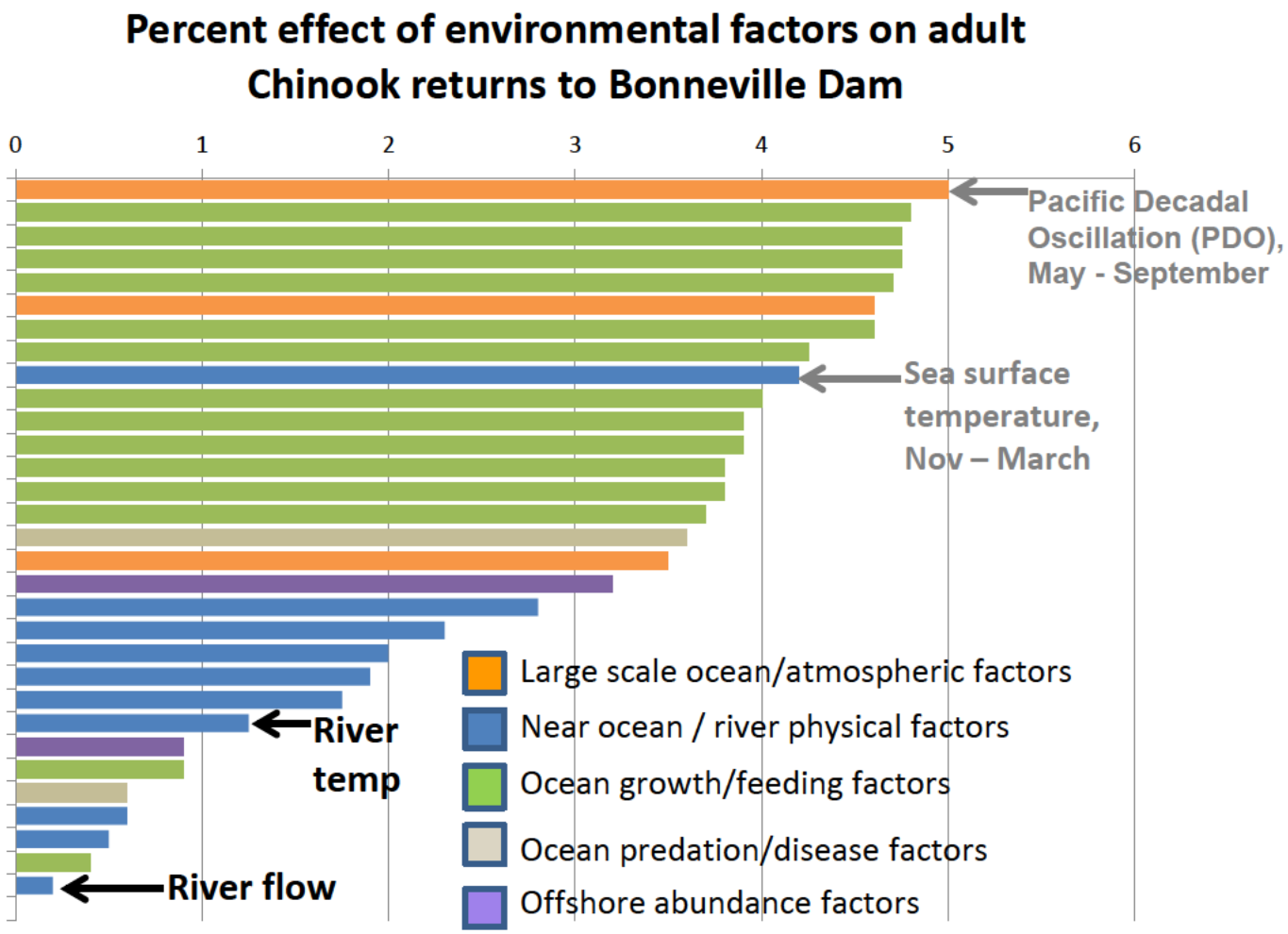
- Uses a 2-6% target for Smolt-to-Adult Returns (SARs) as a measure of the effect of spill, but SARs reflect more than hydro system.
- Relies on a Comparative Survival Study (CSS) model, and is based on simplified correlations that tie spill volume directly to adult returns. This correlation between spill and SARs requires oversimplified hydro system spill assumptions (e.g., average system-wide spill volumes rather than dam specific spill operations that balance juvenile and adult passage) that are taken beyond the available data.
- Assumes delayed mortality of juvenile migrants, but significant scientific debate remains over the magnitude and/or cause of delayed mortality.

SARs are not an Appropriate Measure of Hydrosystem Performance

- Hydro performance is more appropriately measured by:
  - Juvenile dam passage survival which directly measures changes to survival as a result of improvements made at the dams by the Action Agencies.
  - Total in-river and reach survival (e.g. Lower Granite to Bonneville) of juveniles and adults monitors survival through the reservoirs of the FCRPS*, not just the dams.
- Dam operators cannot control or influence the vast majority of the factors that affect adult fish returns and SARs.
  - Approximately 60% of the environmental factors influencing Chinook returns to Bonneville Dam are related to large scale ocean/atmospheric conditions, and ocean growth/feeding. (Burke et al. 2013)
- So many factors affect SARs that tests that attempt to isolate the effects of different spill conditions may require several decades to show a statistically reliable effect on SARs.

*Federal Columbia River Power System

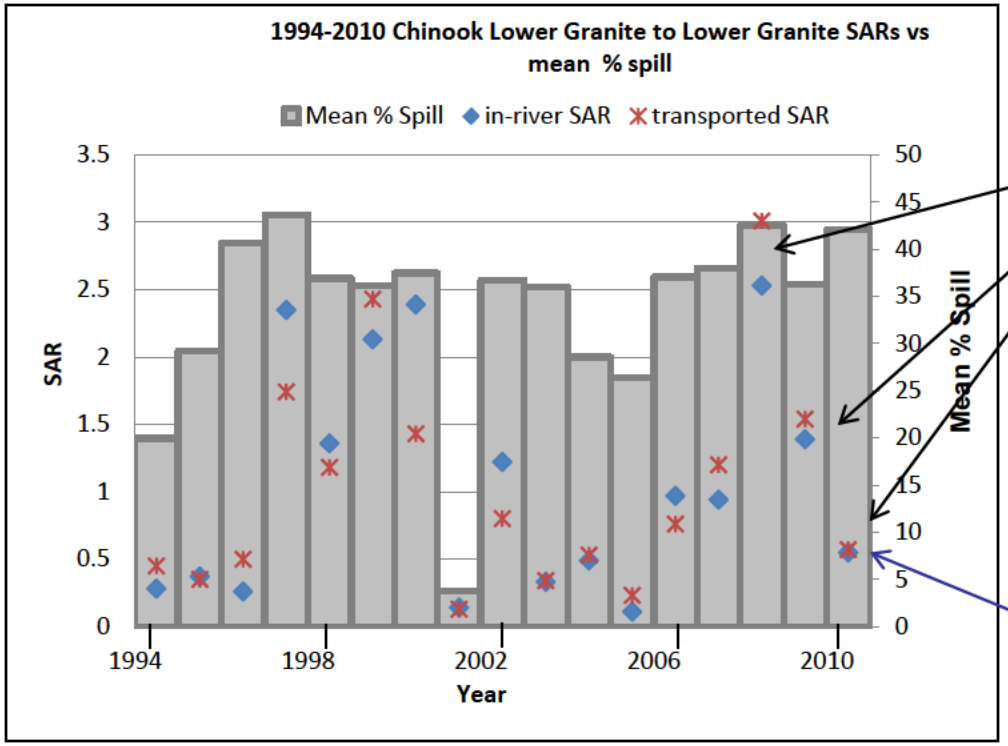
Ocean Conditions, not Spill Levels, have the Greatest Influence on Adult Returns



Source: Burke et al. (2013)

Similar Trends for Transported and In-river Fish Suggest Factors Other than Spill are Driving SARs

- The SARs of transported fish that did not experience spill have a similar correlation to spill as the SARs of in-river migrants that did experience spill. This demonstrates that other factors, besides spill, are affecting SARs of both groups.



In 2008, 2009, and 2010 Chinook SARs were similar for transported and in-river fish.

Even though the mean % spill was high in 2010, Chinook SARs were low for both transported and in-river fish.

Source: 2012 CSS Annual Report

Delayed Mortality Hypotheses Remain Questionable

- There are substantial questions about the magnitude and cause of delayed mortality and whether it is attributable to the hydro system.
- In 2007, the ISAB strongly advised against continuing to try to measure delayed (latent) mortality (since it cannot be measured against a dam-less reference) and instead called for focusing on in-river versus transport mortality that can be measured directly.
- BiOp action plan takes this focused approach.
- Studies conflict over evidence of delayed (latent) mortality. ISAB stated in 2007 that, "Any signal we can detect will be subtle at best and confusing at worst, contributing to the confusion over latent mortality", and in 2012 they stated that "the factors responsible for latent mortality remain poorly understood and inadequately evaluated."

Spill Benefits Fish, But Too Much Spill Can Cause Harm

Too much spill, without being carefully calibrated to each dam, can impact:

- Adults
  - Delay adults migrating upstream, confusing adult fish trying to find fish ladders.
  - Sweep adult fish that have successfully climbed fish ladders back downstream through the spillway, known as “fallback” (tiring the fish, causing migration delay, and increasing their vulnerability to predation in the case of Bonneville Dam).
- Juveniles
  - Create eddies below dams that trap juvenile fish and expose them to predators by delaying downstream juvenile egress.
  - Draw fish away from surface passage routes, which are generally safer and faster.

High Spill can Conflict with Known Project Constraints to Delay Passage and Reduce Survival

Examples:

	Biological Impacts	Structural Constraints*
Bonneville	Adult fallback increases over 100kcfs	Erosion of the spillway stilling basin
The Dalles	Dam survival has been demonstrated to decrease as spill increases	Spill levels above 40% can lead to spill outside of the spill wall or less safe gate openings
John Day	Spill above 40% can negatively affect conditions in the tailrace reducing overall dam survival.	Erosion of the spillway stilling basin
Little Goose	Adult passage can be blocked/delayed at spill levels greater than 30%	Erosion of north fishway entrance
Lower Granite	Higher spill levels can pull fish away from surface passage and into conventional spill which has lower survival	Erosion of the spillway stilling basin

* At this time, a project by project comprehensive evaluation has not yet been completed to determine what the actual structural constraints are, beyond erosion of the spillway stilling basin.

High Spill Creates Harmful Gas Conditions in the River

Total dissolved gas (TDG) is a pollutant that causes bubbles in the cardiovascular system of aquatic species, similar to when divers get the "bends."

The proposed spill test requests spill to 125% TDG in the tailrace. This would increase the occurrence of gas bubble trauma and impacts on both salmonids and other aquatic species.

- Environmental Protection Agency's national criterion for TDG is 110%.
- The states granted special exceptions (forebay limit of 115% in WA and tailrace limit of 120% in OR & WA) on the Snake and Columbia Rivers to allow increased spill for improved juvenile salmon and steelhead migration.
- Fish passage spill is managed to not exceed these limits because of the risk to salmon and other aquatic species.
- NOAA Fisheries has stated that to protect migrating salmon and steelhead tailrace TDG conditions should not exceed 120%.

CSS Provides a Long-Term Data Set that is Useful, but Lacks Technical Basis for the High Spill Test

- CSS confirms that spill is an important tool for improved fish survival which is consistent with the BiOp spill program.
- CSS documents this relationship at a very broad level using averaged spill volumes.
- Because spill effectiveness is more important for fish survival than averaged spill volumes, CSS results do not address unique passage characteristics.
- In 2012, the ISAB reviewed the correlations used in CSS and stated that their finding of "indirect evidence for latent mortality as a consequence of bypass passage does not provide definitive evidence of causation. The positive correlation between in-river and ocean survival rates could be related to other factors such as fish size or climate variables not considered explicitly in the CSS analysis."

CSS Assumptions Underlying the Proposed High Spill Test are Oversimplified

- Dam passage survival and passage condition data are out of date and do not reflect recent Smart Spill advancements
  - CSS does not consider 10+ years of cumulative route-specific acoustic tag information from BiOp juvenile performance standard and survival testing for each dam
  - CSS assumes passage by volume rather than using actual route specific information based on smart spill
- Dam specific biological and structural constraints, including total dissolved gas constraints, are not included, making the proposal incomplete.
- Results are extrapolated beyond the range of empirical data thus assuming that if some spill improves survival then more spill will provide further increases proportionate to volume.

Best Available Science Supports Existing Path Forward

- The federal agencies just completed a 5-year comprehensive evaluation of our ten-year strategy, with very good results and measurable metrics for accomplishments. This program of research-based improvements and rigorous testing is demonstrating positive results and should be completed as planned, such as:
  - Juvenile Dam Passage Performance Standards
  - In-river passage and reach survival of juveniles and adults, including adult abundance
- Outstanding science questions remain about impacts of higher spill, the rationale for the proposed test and delayed mortality.
- The region could benefit from further discussion of the science behind these issues between now and 2018.

Statistical Design & Analysis Considerations Regarding a Proposed Spill Study

John R. Skalski
University of Washington

Properties of Scientific Experiments

Fisher (1947)

- Replication
- Randomization
- Error control
- Treatment contrasts

Cox (1958)

- Elimination of confounding factors
- Precision
- Useful range of validity
- Simplicity
- Ability to estimate error variance

Proposed "Spill Experiment"

Fisher (1947) Criteria

- Replication: 10 consecutive years
- Randomization: None
- Error control: Whatever nature presents
  - No control for ocean effects
  - No control for fish health, size, etc.
  - No control for harvest changes
- Treatment contrasts: None
  - Single spill level, year after year

Proposed "Spill Experiment"

Cox (1958) Criteria

- Elimination of confounding factors
  - Confounding with time appears problematic
- Precision
  - No reference to sample sizes, precision, or statistical power
- Useful range of validity
  - Only one spill level evaluated
- Simplicity
  - Current proposal is too simplified
- Ability to estimate an error variance
  - No hypothesis to formally test

Other Study Considerations

1. No formal selection of response variable(s)

Possible Response Variable ($\hat{\theta}$)	Precision	Confounding Factor	Biological Relevance
Inriver survival	1	1	3
SAR	2	2	2
Adult returns	3	3	1

- Choice will influence how success or failure is measured
- Need *a priori* prioritization of response variables to measure success

Other Study Considerations (Cont.)

2. No formal tests of hypotheses

- Possible candidates mentioned:

A. Test of Means

$$H_O: \hat{\bar{\theta}}_{Before} \geq \hat{\bar{\theta}}_{Test}$$

$$H_a: \hat{\bar{\theta}}_{Before} < \hat{\bar{\theta}}_{Test}$$

Difficulties

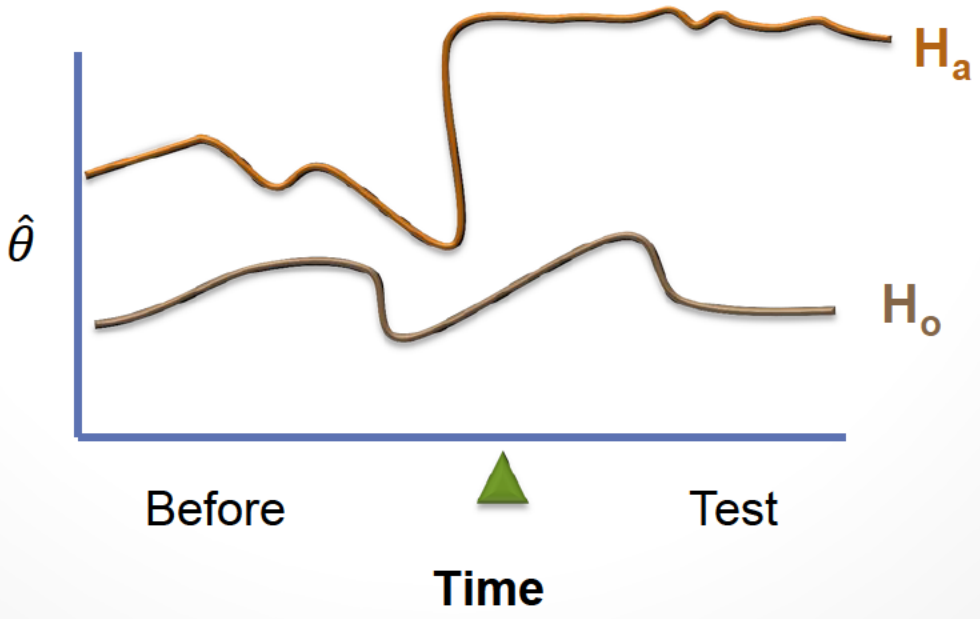
- Confounded with time
- No error control – very noisy

Other Study Considerations (Cont.)

B. Time Series Analysis

H_o: Time series stationary

H_a: Shift in response after intervention

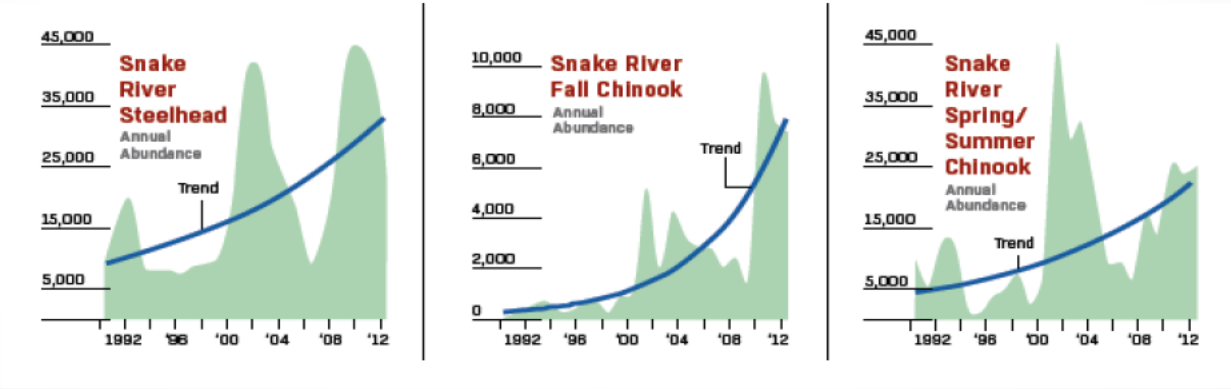


Other Study Considerations (Cont.)

B. Time Series Analysis (cont.)

Difficulties

- 5 or 10 years are not long for time series
- Paulsen & Hinrichsen (2002) found time series half as powerful as treatment contrasts
- Currently system not stationary
  - 6/7 ESUs have **upward** trends

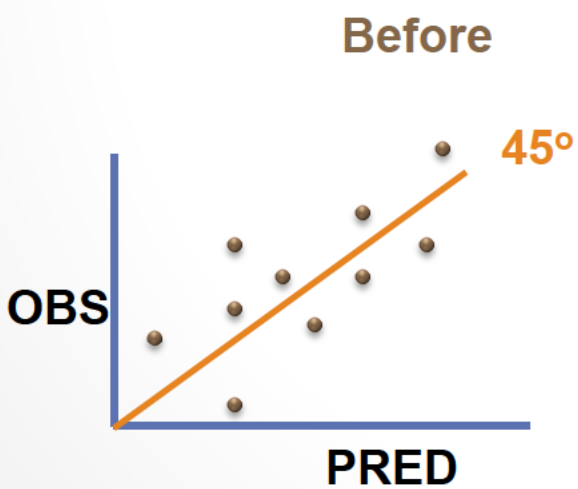


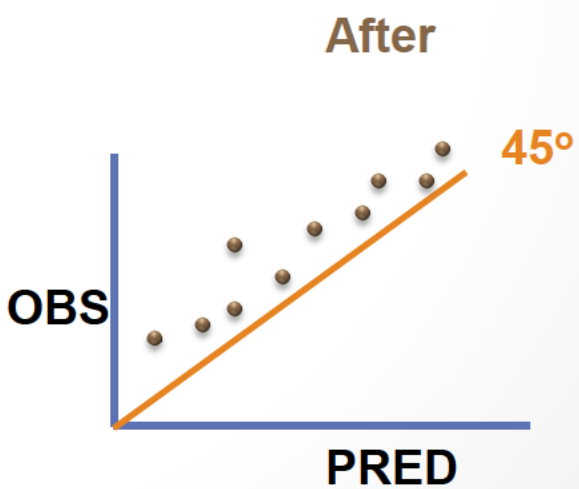
From: USACE, USBR, BPA. 2013. Citizen's Guide to the 2013 Comprehensive Evaluation.

Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions

$$H_o: \ \hat{\bar{\theta}}_{OBS} \leq \hat{\bar{\theta}}_{PRED}$$
$$H_a: \ \hat{\bar{\theta}}_{OBS} > \hat{\bar{\theta}}_{PRED}$$





Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions (cont.)

Difficulties

- Model must be selected *a priori*
- Predictive model needs to be reasonably accurate (i.e., unbiased) and precise
- Predictive model must be calibrated beyond current range of spill
- Currently, predictions of adult returns fairly poor

Other Study Considerations (Cont.)

D. No power calculations/No sample size calculations

- Calculations not possible without formal tests of hypotheses
  - No justification for 10-year study
  - No specification of within-year tagging effort
- No specification of the size of Δ that is reasonable to expect and detect under proposed spill plan
  - Haeseker et al. (2012) suggested
    - SARS : 4 – 8 times larger
    - Inriver survival: +0.30

UW Power Calculations

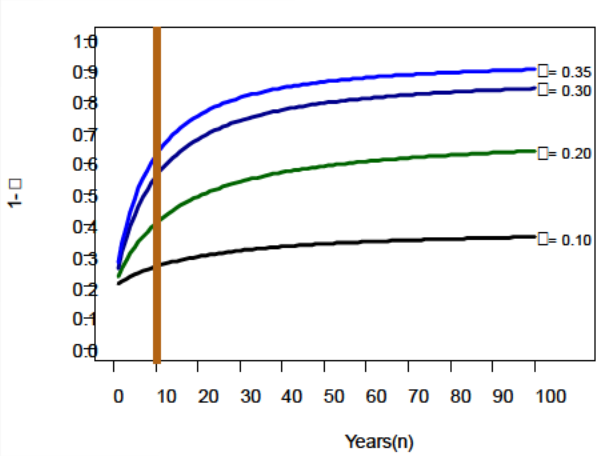
Statistical Power

- **Response variable**
- **Test of hypotheses**
- **α-level**
- **Sample size**

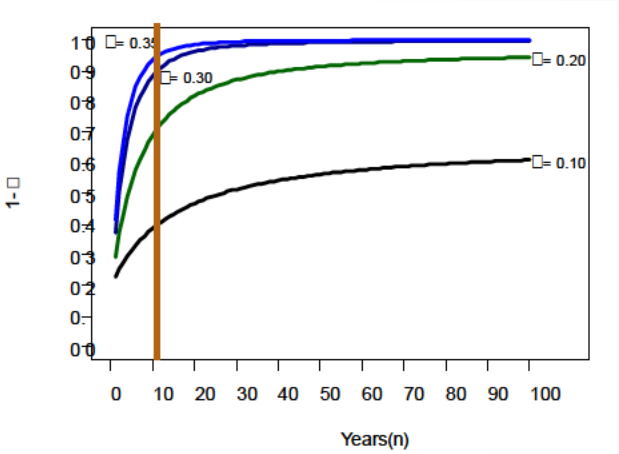
- SARs
  - Two orders of magnitude of interannual variation
  - Need century of observations
- TIRs
  - Transports control for fish condition, ocean, harvest effects
  - Vary by factor of 5 or less
  - Still need multiple decades

UW Power Calculations (cont.)

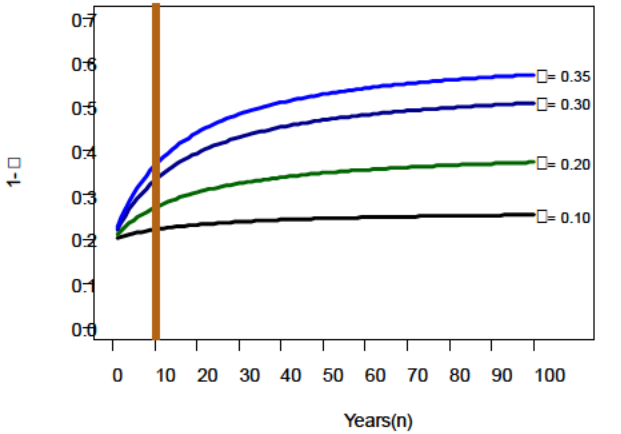
Hatchery spring Chinook (2001 omitted)



Wild steelhead (2001 omitted)



Hatchery summer Chinook (2001 omitted)



α = 0.10, one-tailed test

Other Study Considerations (Cont.)

D. No ancillary studies of extraneous effects

- Monitoring for change in smolt condition or size that could confound study
- Monitoring for increased incidence of gas bubble disease under 125% TDG
- Monitoring for changes in adult migration
- No trigger to stop study if problems occur

Other Study Considerations (Cont.)

E. No decision rules

- Plan specifies comprehensive testing in 5 and 10 years
  - No sequential testing proposed
  - No decision rules to continue or stop study

Conclusions

- Numerous design and analysis considerations central to the success of a spill study have not been fully specified
- *A priori* specifications of response variables and tests of hypotheses essential for an objective evaluation
- Preliminary calculations suggest inriver survival will need to increase substantially (i.e., $\Delta \geq 0.30$) for study to have moderate to reasonable power in 10 years
- A formal, peer-reviewed design and analysis plan must be developed prior to the investigation

Action Agency Conclusions: Best available science supports existing path forward

- The federal agencies just completed a 5-year comprehensive evaluation of our ten-year program, with very good results and measurable metrics for accomplishments, such as:
  - Juvenile Performance Standards
  - In-river passage and reach survival of juveniles and adults, including adult abundance
- This program of research-based improvements and rigorous testing is demonstrating positive results and should be completed as planned
- The proposed spill test uses a 2-6% target for Smolt-to-Adult Returns (SARS) as measure of success, but SARS reflect more than hydro system impacts.
- The proposal relies on the CSS model, which is based on oversimplified correlations between juvenile survival and SARS with averaged environmental indices (spill %, flow, etc). ISAB's annual review advised further refinement of the model.
- Outstanding science questions remain about impacts of higher spill, the rationale for the proposed test, and latent mortality.

Questions?

From: Sweet,Jason C (BPA) - KEWR-4
To: "Gilly Lyons"
Cc: Weiss,Steven D (BPA) - DKR-7
Subject: RE: Latest edition of the Smart Spill presentation
Date: Wednesday, February 26, 2014 1:36:00 PM
Attachments: ISAB spill test presentation17Jan2014.pptx
System Analysis More Spill 2-5-14.pptx

Here you go... Again, please let me know if you have any questions. Thanks.

Jason

Jason Sweet
Manager | Fish and Wildlife Policy and Planning
BONNEVILLE POWER ADMINISTRATION
bpa.gov | P 503-230-3349 | C 503-318-5749
Please consider the environment before printing this email.

From: Gilly Lyons [mailto:gilly@wildsalmon.org]
Sent: Wednesday, February 26, 2014 8:59 AM
To: Sweet,Jason C (BPA) - KEWR-4
Subject: Re: Latest edition of the Smart Spill presentation

Hi Jason -

No worries at all! Thanks so much - anytime is great. I truly appreciate it!

All the best,

Gilly

Sent from my iPhone

On Feb 26, 2014, at 7:12 AM, "Sweet,Jason C (BPA) - KEWR-4" <jcsweet@bpa.gov> wrote:

> Hi Gilly,
>
> Sorry for the delay in getting back to you, but I've been working off of my blackberry the last couple of days and Steve has been on leave. I will be back at my desk this afternoon and would be happy to forward on the material that we presented last month. Once you see the slides, please feel free to call or email with any questions. Thanks.
>
> Jason Sweet
>
> ---

From: Gilly Lyons [mailto:gilly@wildsalmon.org]
Sent: Tuesday, February 25, 2014 09:23 AM
To: Weiss,Steven D (BPA) - DKR-7; Sweet,Jason C (BPA) - KEWR-4
Subject: Latest edition of the Smart Spill presentation

Hi Steve and Jason -

First of all, I am quite remiss in thanking you both for taking the time to meet with us in Portland at the end of last month - thank you! I was wondering if you might be at liberty to share an electronic version of the PowerPoint slides that we viewed. Thanks so much!

All the best,

Gilly

Gilly Lyons
Policy and Legal Director
Save Our Wild Salmon Coalition

1631 NE Broadway, #613
Portland, OR 97232-1425
Office: (503) 230-0421
Cell: (503) 975-3202
Email: gilly@wildsalmon.org
Web: www.wildsalmon.org

Recent Hydro Improvements Since the 2008 Federal Columbia River Power System Biological Opinion

Presentation to the
Independent Scientific Advisory Board
January 17th, 2014

U.S. Army Corps of Engineers®

Two Part Agenda

- Part I. Overview of Recent Improvements in the FCRPS Hydrosystem
- Part II. Questions and Concerns surrounding the proposed spill test (Dr. Skalski- University of Washington)

Results of Action Agencies (Federal) Non- Hydro Investments since 2007

- Added 180 miles of stream complexity.
- Restored 135,000 acre-feet of water to streams increasing habitat.
- Opened nearly 2,000 habitat miles (2x length of Columbia River).
- Protected or Restored 3,700 acres of estuary floodplain habitat.
- Hatchery evaluations and reforms
- Predation Management (avian, piscine, marine mammal)

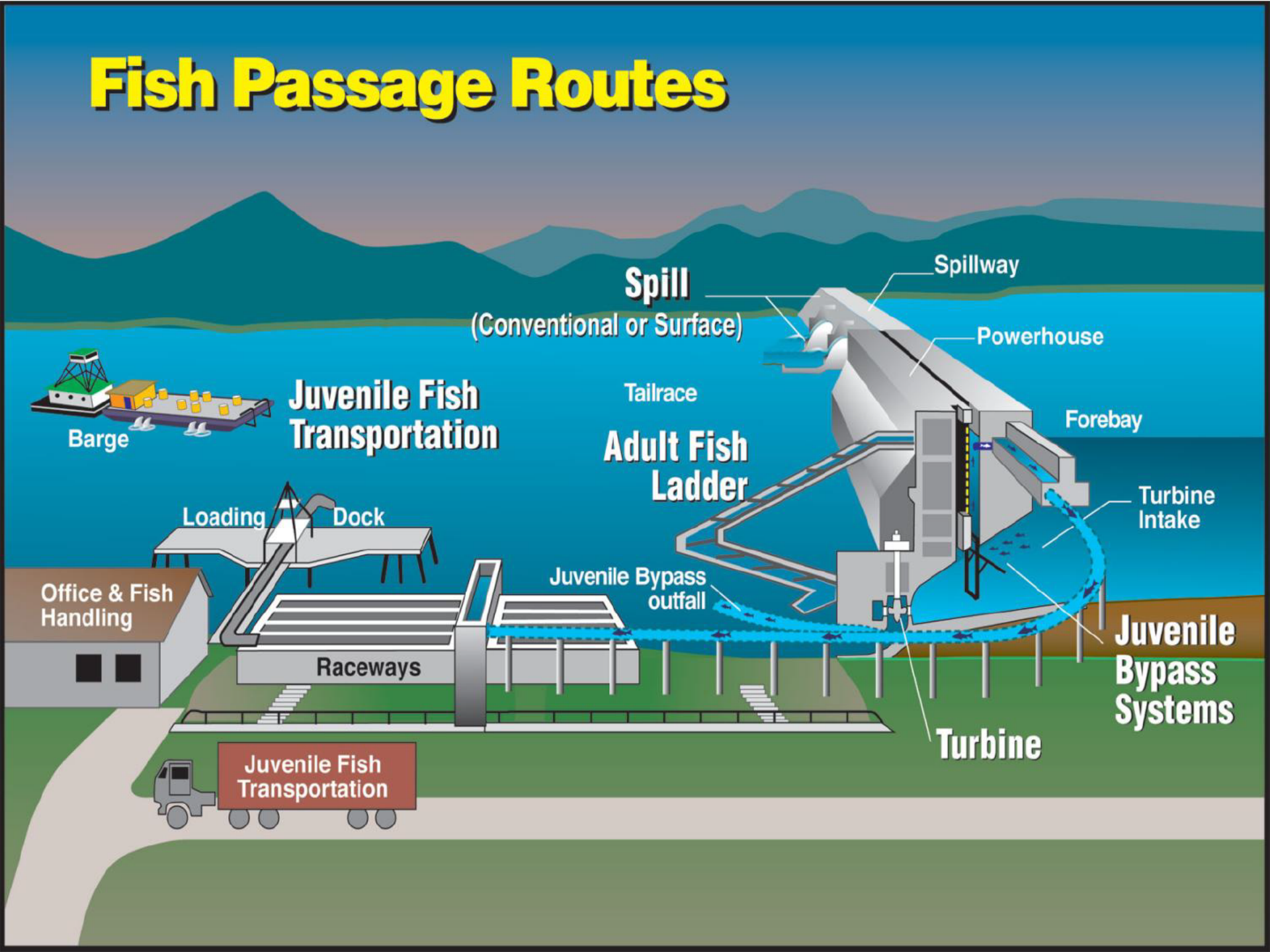
Overview:

The 2008 hydro plan is underway and deserves a chance to show results

- Congress and BPA ratepayers, in collaboration with the region, have invested heavily in recent years to achieve performance standards and in-river survival targets.
  - Research guides passage improvements at each dam.
  - Rigorous testing measures progress toward performance standards and in-river survival targets.
  - Physical models determine best spill patterns at each dam and avoid adverse effects.
- Current action plan (2008-2018) includes major dam modifications (e.g. The Dalles Spill Wall), surface passage, project specific spill volumes and patterns, turbine screens and relocation of bypass outfalls.
- Results so far are demonstrating improved fish survival.
- Actions and testing are still underway; it is too early to change course.

Columbia River Basin
Corps of Engineers Dams
Dams owned by Others
Mica
Revelstoke
Arrow Lakes
Duncan
Kootenay Lake
Keenleyside
Canada
U.S.
Libby
Hungry Horse
Grand Coulee
Chief Joseph
Albeni Falls
Wells
Noxon
Rocky Reach
Columbia R.
Pend Oreille Lake
Flathead Lake
Rock Island
Kerr
Seattle
Little Goose
Montana
Lower Monumental
Wanapum
Lower Granite
Priest Rapids
Washington
Dworshak
The Dalles
Ice Harbor
Portland
McNary
Hells Canyon
Bonneville
John Day
Oxbow
Brownlee
Idaho
Willamette R.
Oregon
Jackson Lake
Boise Projects
Snake R.

Fish Passage Routes



Implementation of 2008/10/14 BiOp

Configuration Improvements

- Hydropower Strategy 2 – Modify Columbia and Snake River Dams to Maximize Juvenile and Adult Fish Survival
  - Numerous configuration improvements to increase fish survival have been completed since 2007 and include:
    - Minimum gap runner turbines at Bonneville Dam Powerhouse I
    - Adult fish ladder improvements at John Day Dam
    - Juvenile screened bypass system improvements and/or outfall relocation at Bonneville, McNary, Lower Monumental, and Little Goose dams
    - Juvenile screened bypass system full-flow PIT detection at Bonneville, John Day, Lower Monumental, and Little Goose dams
    - Tailrace avian wire arrays at The Dalles and John Day dams
    - Spillway flow deflectors at John Day (spillbay 20) and Little Goose (spillbays 1 and 8) dams
    - Extended-length spillwall at The Dalles Dam
    - Conversion of the Bonneville Dam Powerhouse I ice and trash sluiceway to a surface passage route
    - Spillway weirs at John Day, McNary, Lower Monumental, and Little Goose dams

Implementation of 2008/10/14 BiOp

Configuration Improvements

Lower Monumental Spillway Weir

Lower Granite Spillway Weir

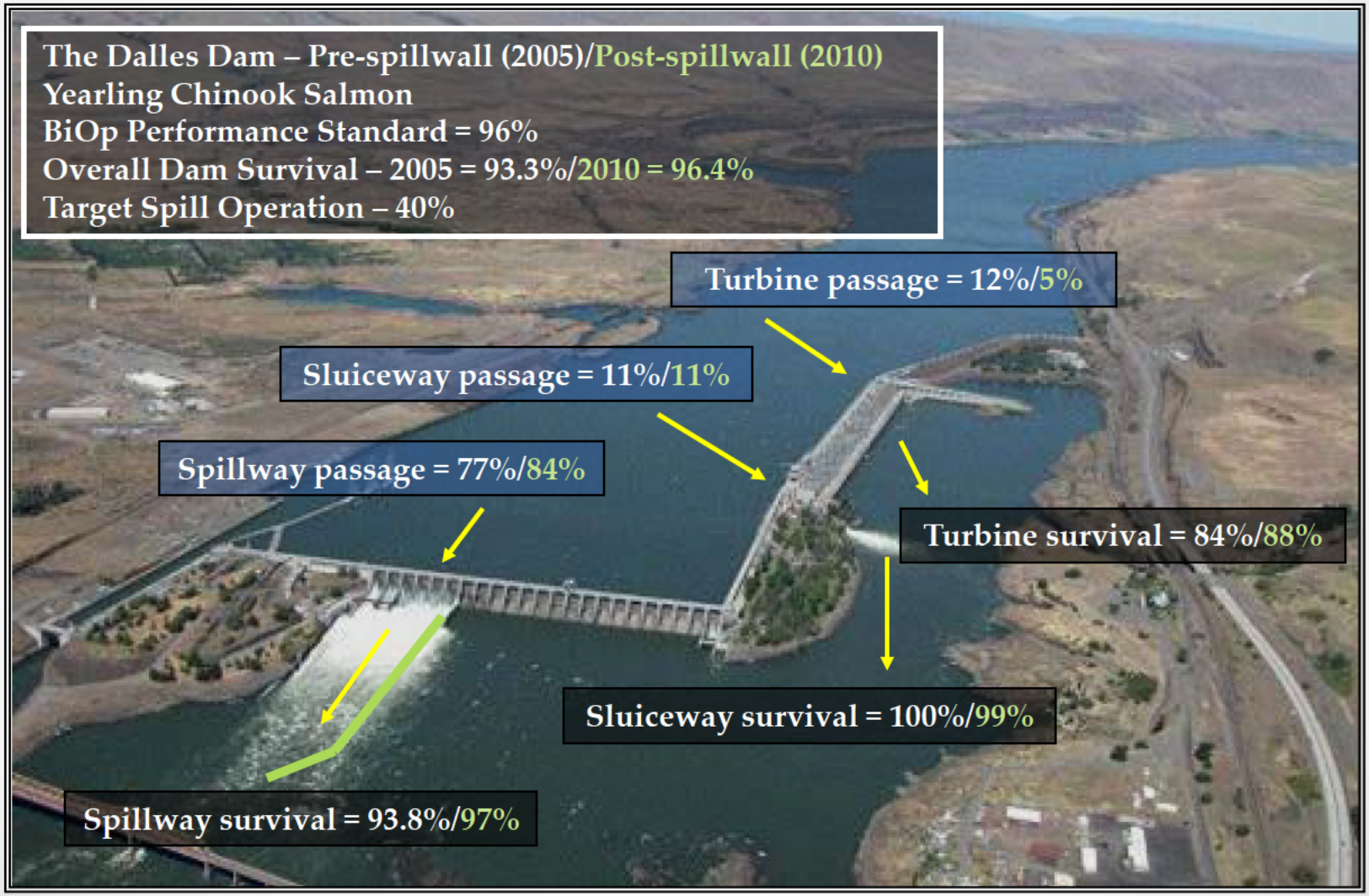
Bonneville MGR

The Dalles Spillwall

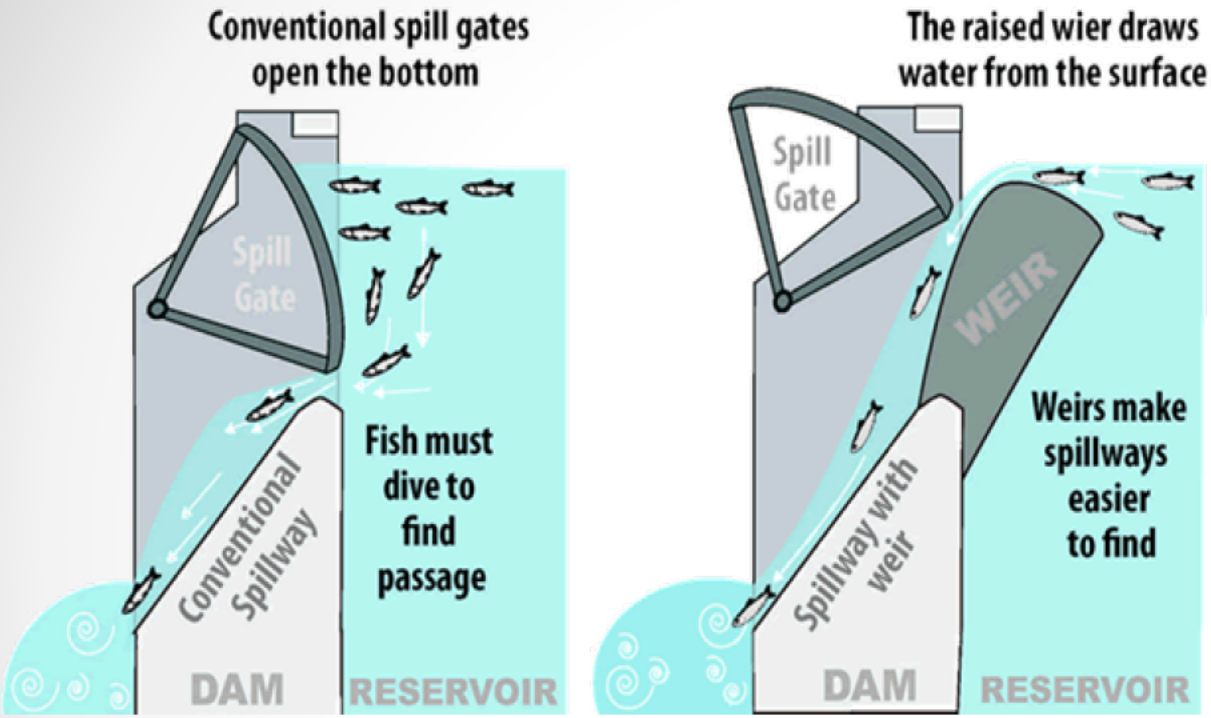
Lower Monumental Juvenile Bypass Outfall Relocation

McNary Juvenile Bypass Outfall Relocation

Yearling Chinook Dam Passage and Survival
The Dalles Dam - Pre vs. Post Spillwall



Surface Passage Characteristics



- Spillway weirs and other surface passage structures provide a surface route of passage and allow fish to pass dams at depths where they naturally migrate
  - Easier for fish to find; reduce migration delay and minimize exposure to predation near dams
  - Generally provide the highest survival of all passage routes at dams; consistently at or near 100 percent survival
  - Pass the most fish relative to the volume of water, making them the most effective passage route
  - Increase spill passage efficiency (% of fish that pass through spill); as many as 4-times the percent of fish pass the dam through spill bays equipped with spillway weirs
  - Reduces the number of fish that pass through turbines
- Surface passage routes currently exist at all 8 dams

Implementation of 2008/10/14 BiOp

Operational Improvements

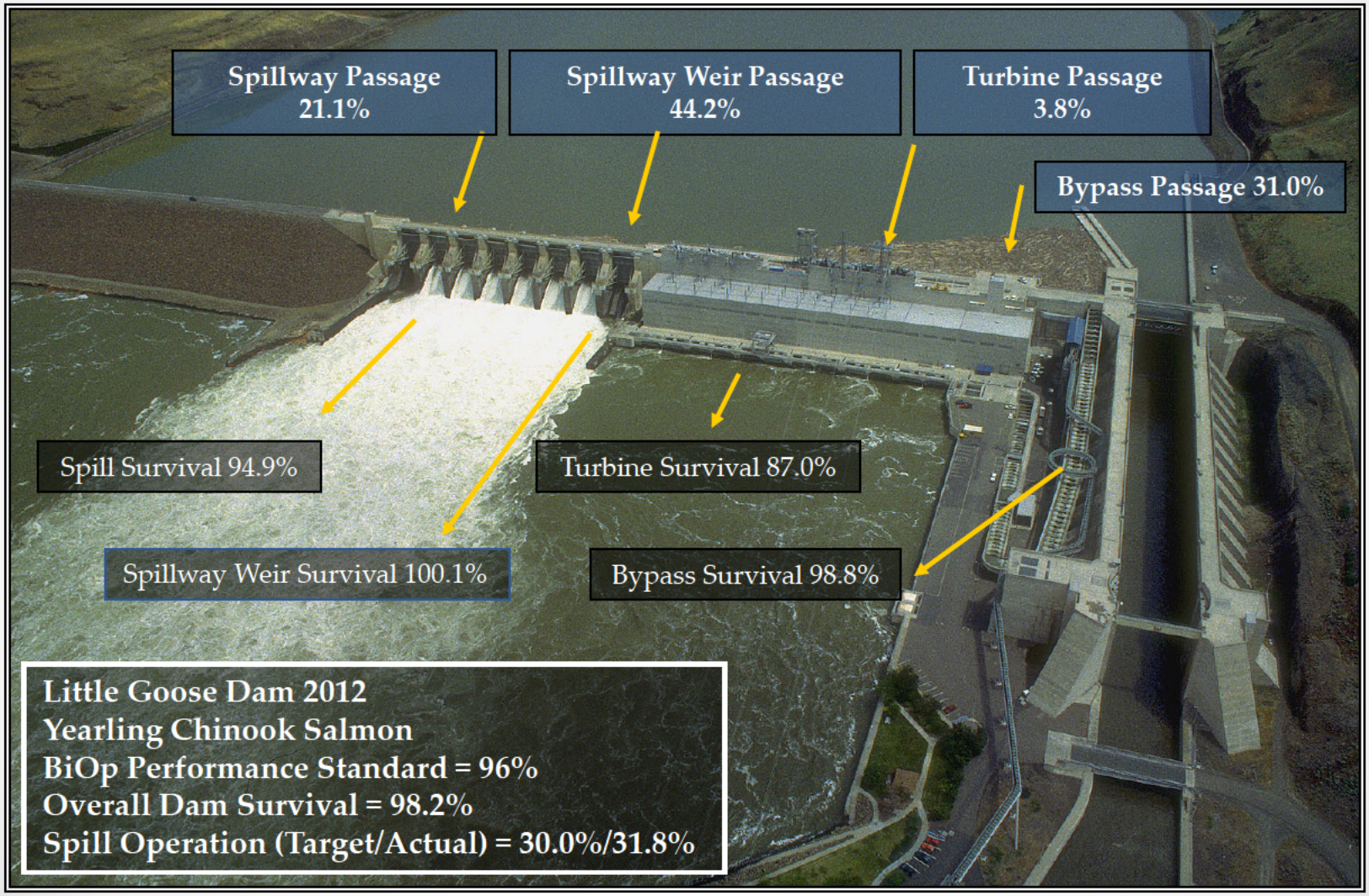
- Hydropower Strategy 3 – Implement Spill and Juvenile Transportation Improvements at Columbia and Snake River Dams
  - Spill operations coupled with configuration improvements completed at each dam are a key component of BiOp implementation to increase fish survival as they migrate through the hydrosystem
  - 24-hour spill operations occur at all eight dams from early April through August
  - Planned spring spill operations for 2014-18 are specified below

Project	Spring Spill Levels	Spring Planning Dates
Bonneville	100 kcfs	4/10 - 6/15
The Dalles	40% of total river flow	4/10 - 6/15
John Day	April 10-April 27: 30% of total river flow April 27-June 15: 30% and 40% of total river flow	4/10 - 6/15
McNary	40% of total river flow	4/10 - 6/15
Ice Harbor	April 3-April 28: 45 kcfs/Gas Cap April 28-May 31: 30% of total river flow and 45 kcfs/Gas Cap	4/3 - 5/31
Lower Monumental	Gas Cap (~27 kcfs) (bulk pattern)	4/3 - 5/31
Little Goose	30% of total river flow	4/3 - 5/31
Lower Granite	20 kcfs	4/3 - 5/31

Juvenile Dam Passage Survival Performance Standards

- As part of the 2008 BiOp implementation, configuration and operational improvements have been developed and implemented to achieve the juvenile dam passage survival performance standards of 96 percent for spring migrants and 93 percent for summer migrants specified in the BiOp
- Spill levels and spill patterns at each dam have been developed and tailored to facilitate juvenile fish passage without hindering adult passage by accounting for the unique characteristics and configuration of each dam
  - Strategy utilizes spill coupled with surface passage and other structural improvements (such as screened bypass system upgrades) to increase juvenile fish survival
- Current spill operations along with existing and planned configuration improvements outlined in the Action Agencies' Implementation Plan, are expected to help achieve the juvenile dam passage survival performance standards of 96 percent and 93 percent survival at all dams by 2018
- Performance standard testing is underway and expected to be complete by 2018

Little Goose Dam Performance Standard Testing Yearling Chinook Salmon



Recent Passage and Survival Estimates

Acquired From Performance Standard Testing

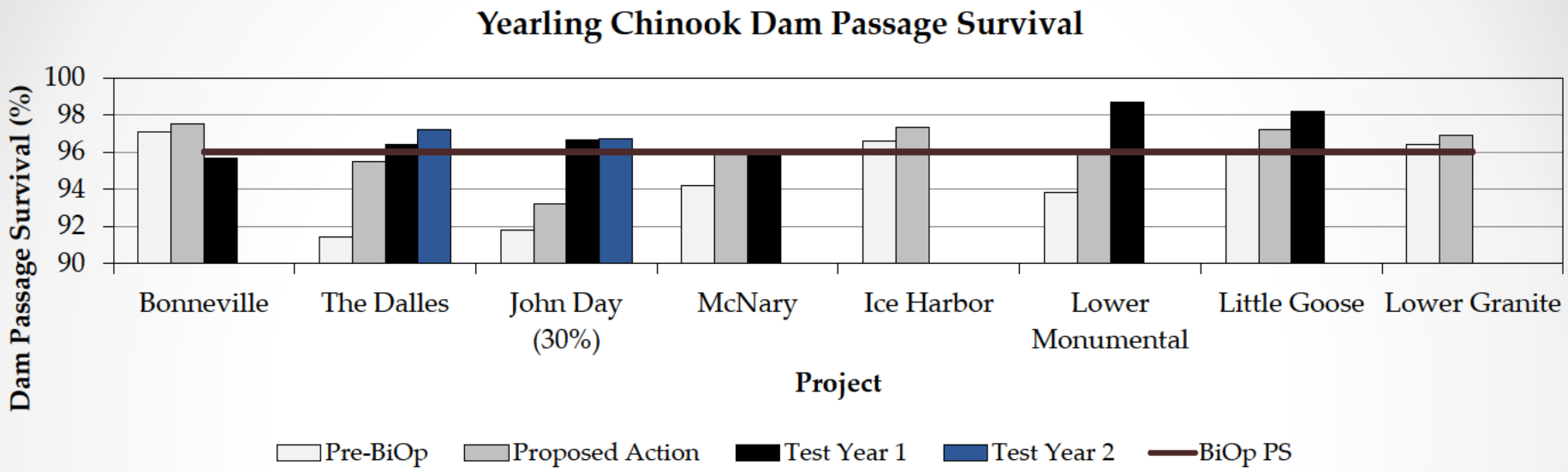
Project	Yearling Chinook Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	58.1	95.7	8.3	99.3[1], 96.9[2]	66.4	4.3	98.2	28.3	94.7[3], 96.8[4]	95.69	100 kcfs	2011
The Dalles	65.8	96.1	17.3	99.1	83.1	na	Na	16.9	93	96.0	40%	2011
John Day	39.9	97.4	23.8	95.8	63.7	24.8	99.3	11.5	91	96.66 (30% spill)	30 and 40%	2011
McNary	64.3	97.1	8.3	97.6	72.6	24.2	93.6	3.2	95.5	96.16	40%	2012
Ice Harbor	22.1	98	51.3	94.7	73.4	19.1	98.3	7.5	Na	96.1 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	16.6	94.6	62.3	99.8	79.1	15.9	100	5.3	93.2	98.68	Gas Cap	2012
Little Goose	21.1	94.9	44.2	100.1	65.3	31	98.8	3.8	87	98.22	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

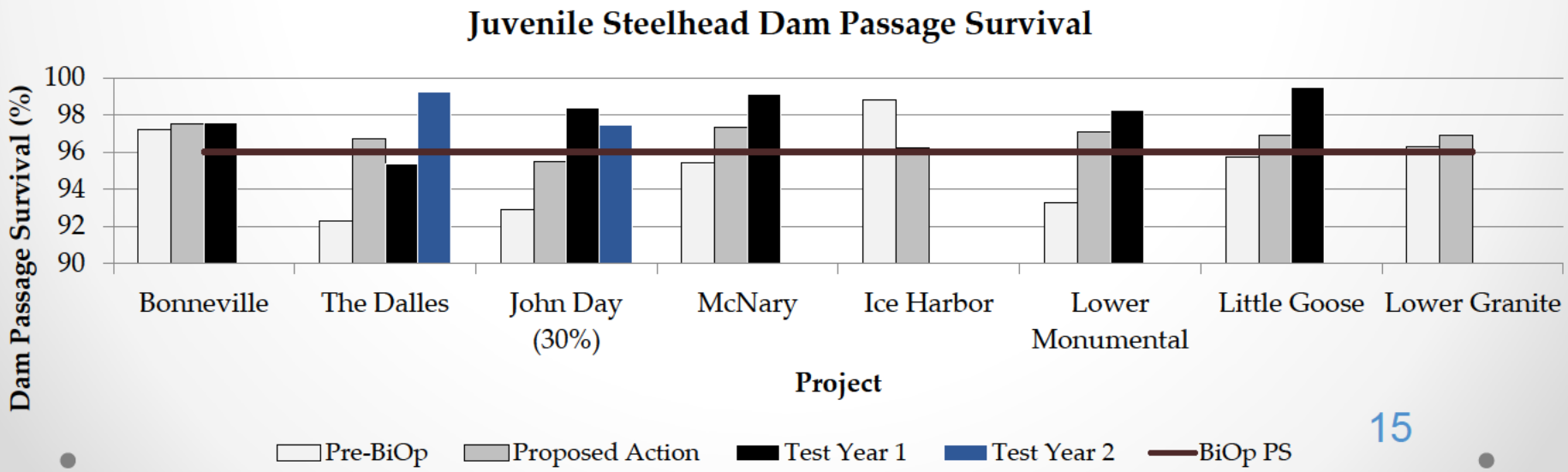
1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

Project	Steelhead Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	56	96.5	17.2	98.8[1], 95.3[2]	73.2	1.7	93.8	25.1	91.9[3], 93.6[4]	97.55	100 kcfs	2011
The Dalles	75.4	100.4	13.8	101	89.2	na	na	10.9	91.9	99.52	40%	2011
John Day	30.5	99	32.3	98.9	62.8	33.2	100.3	4	79.7	98.36 (30% spill)	30 and 40%	2011
McNary	59.9	99.4	23.3	97.6	83.2	14.5	100	2.3	83.1	99.08	40%	2012
Ice Harbor	23.9	101.9	37.5	101.7	61.4	36.6	99.7	2	na	100.7 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	12.6	98.3	53.2	99.1	65.8	30.7	99.1	3.5	81.4	98.26	Gas Cap	2012
Little Goose	15.7	99.2	40.4	100.1	56.1	41.9	99.7	2	80.5	99.48	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

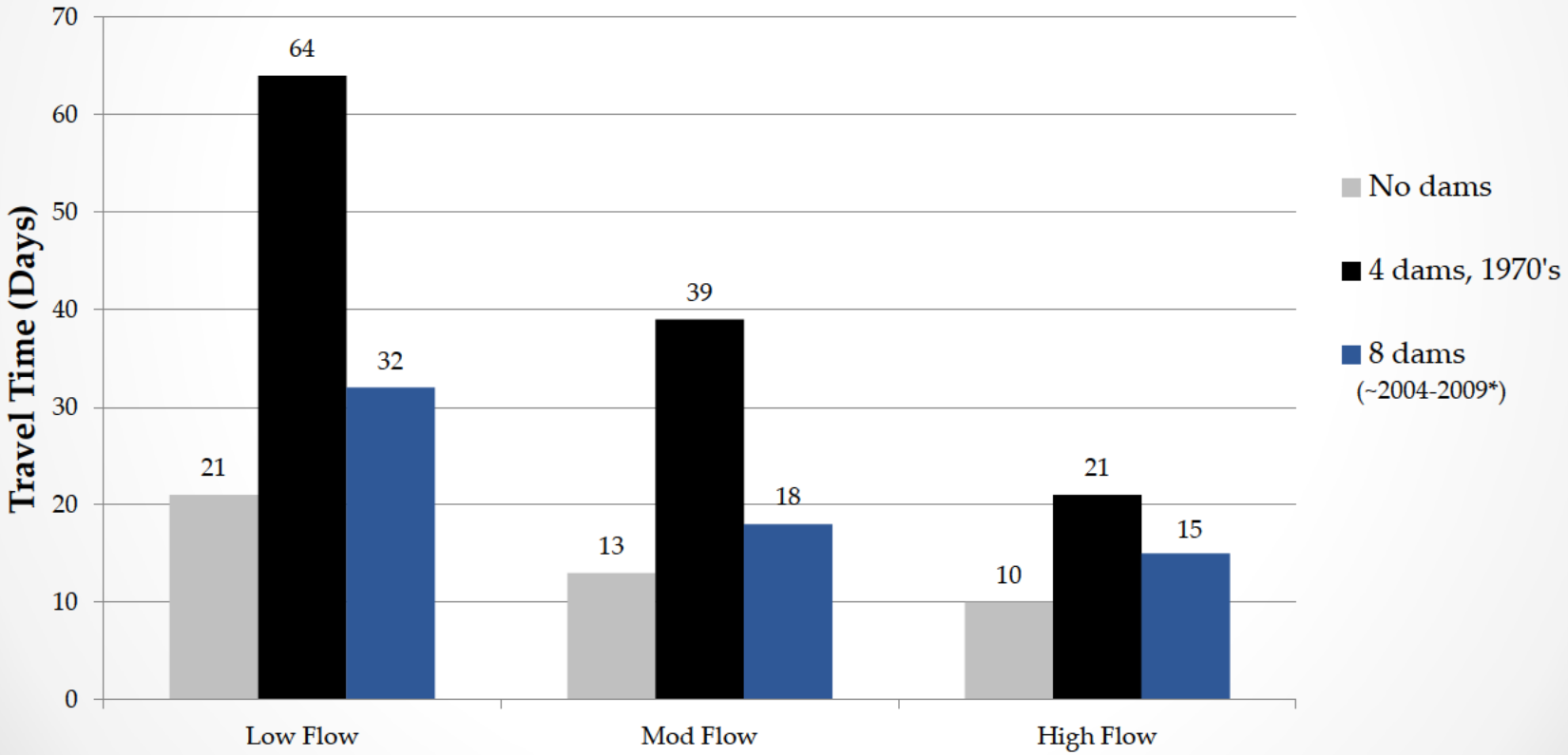
Juvenile Dam Passage Survival Performance Standards





Juvenile Fish Travel Time Through the FCRPS

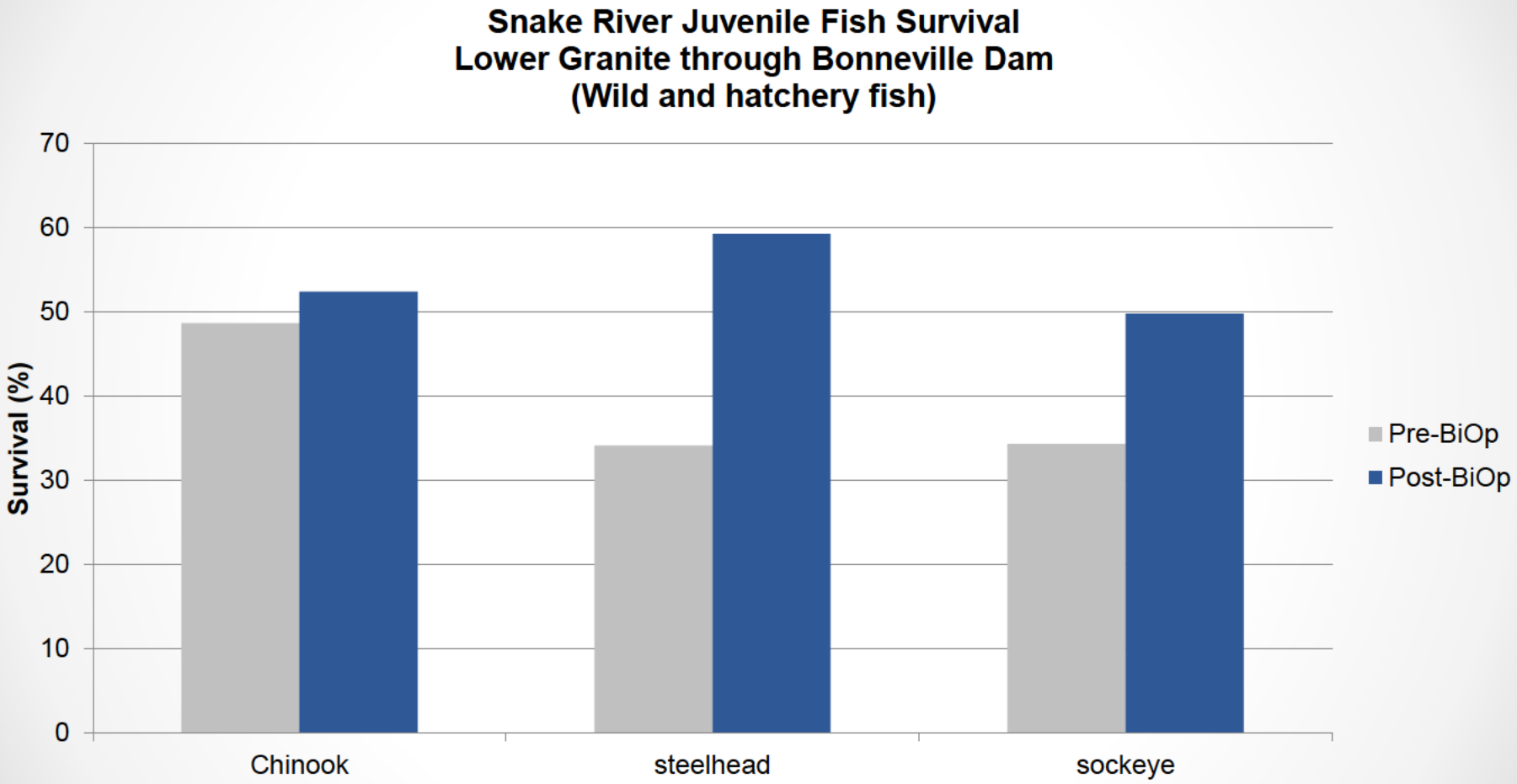
Lower Granite to Bonneville Dam Fish Migration Travel Time
Under 3 Flow Conditions (low, moderate, high)



SOURCE: Muir, W.D., Williams, J.G. 2012. Improving connectivity between freshwater and marine environments for salmon migrating through the lower Snake and Columbia River hydropower system. Ecol. Eng. 48: 19-24

In-river Juvenile Fish Survival

Pre-BiOp vs. Post-BiOp

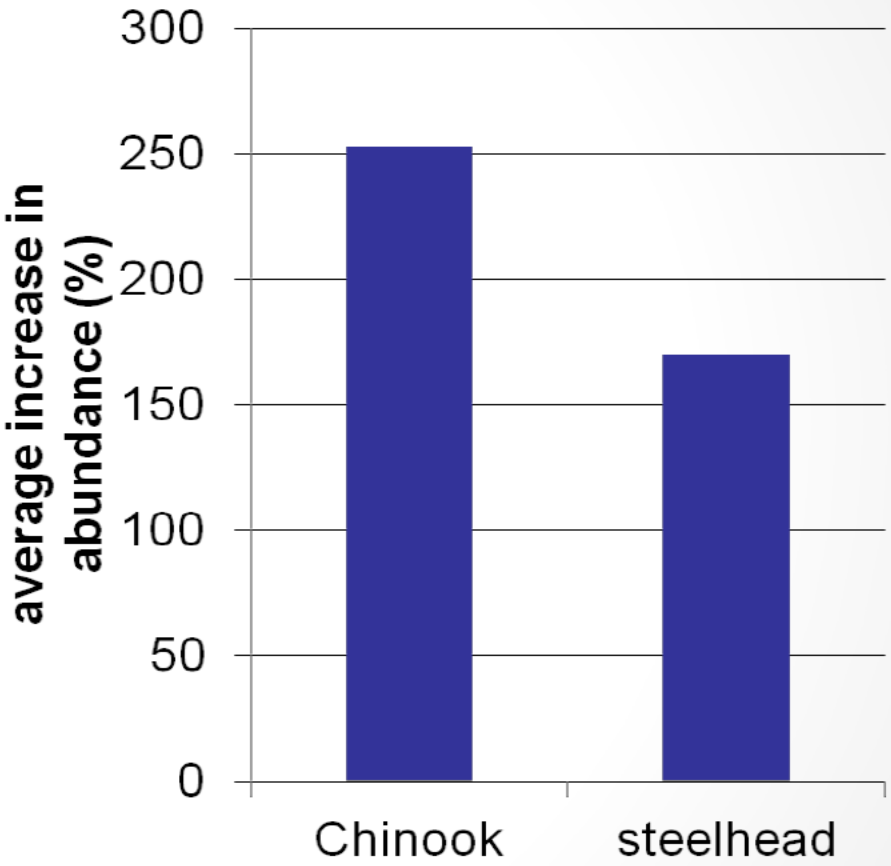


Pre-BiOp period: 1997 – 2007
Post-BiOp period: 2008 – 2012

Wild adult fish abundance is increasing

Based on 10 years of data, 2002 – 2011:

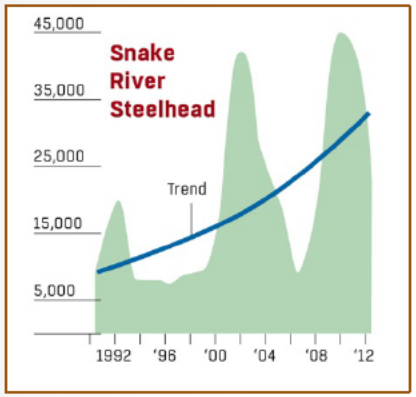
- On average, wild Chinook salmon populations have more than tripled in abundance.
- On average, wild steelhead populations have more than doubled in abundance.

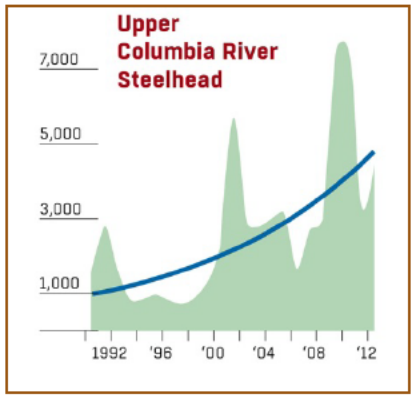


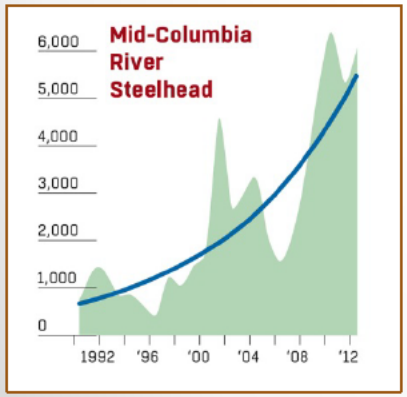
Note: Based on comparison of geometric mean of abundance from 1990-1999 to most recent 10 years, generally 2002-2011.

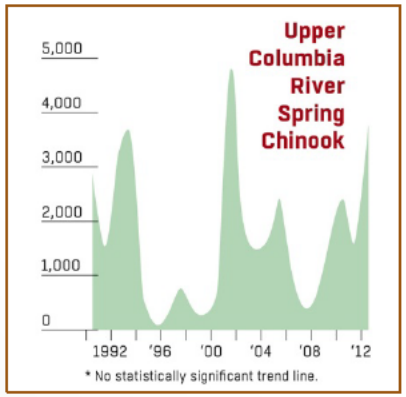
Status of wild adult fish

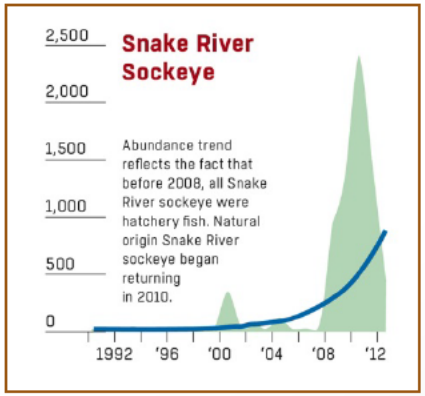
Of the 49 Interior Columbia Basin wild adult fish populations where data are available, 47 have increased in abundance since listings in the 1990s.

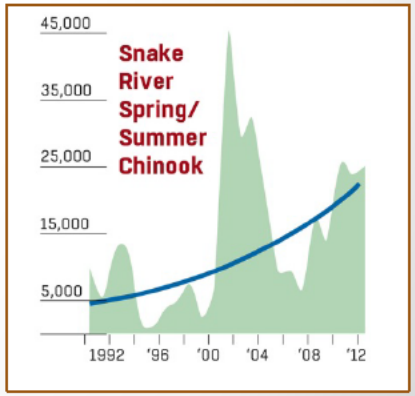












Summary: Hydro results are ongoing and promising

- Research-based improvements are delivering improved passage, higher in-river survival and faster fish travel time.
- Spill volumes and spill patterns are tailored to conditions at each dam, enhancing spill effectiveness.
- Improvements and testing are ongoing and still proving their value to the region.
- As of 2010, all mainstem dams have been equipped with a surface passage route…It is too early to change course from this current performance-based approach.

Spill Test Issues and Questions

Proposed Spill Test

- **Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:**

- What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

- When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

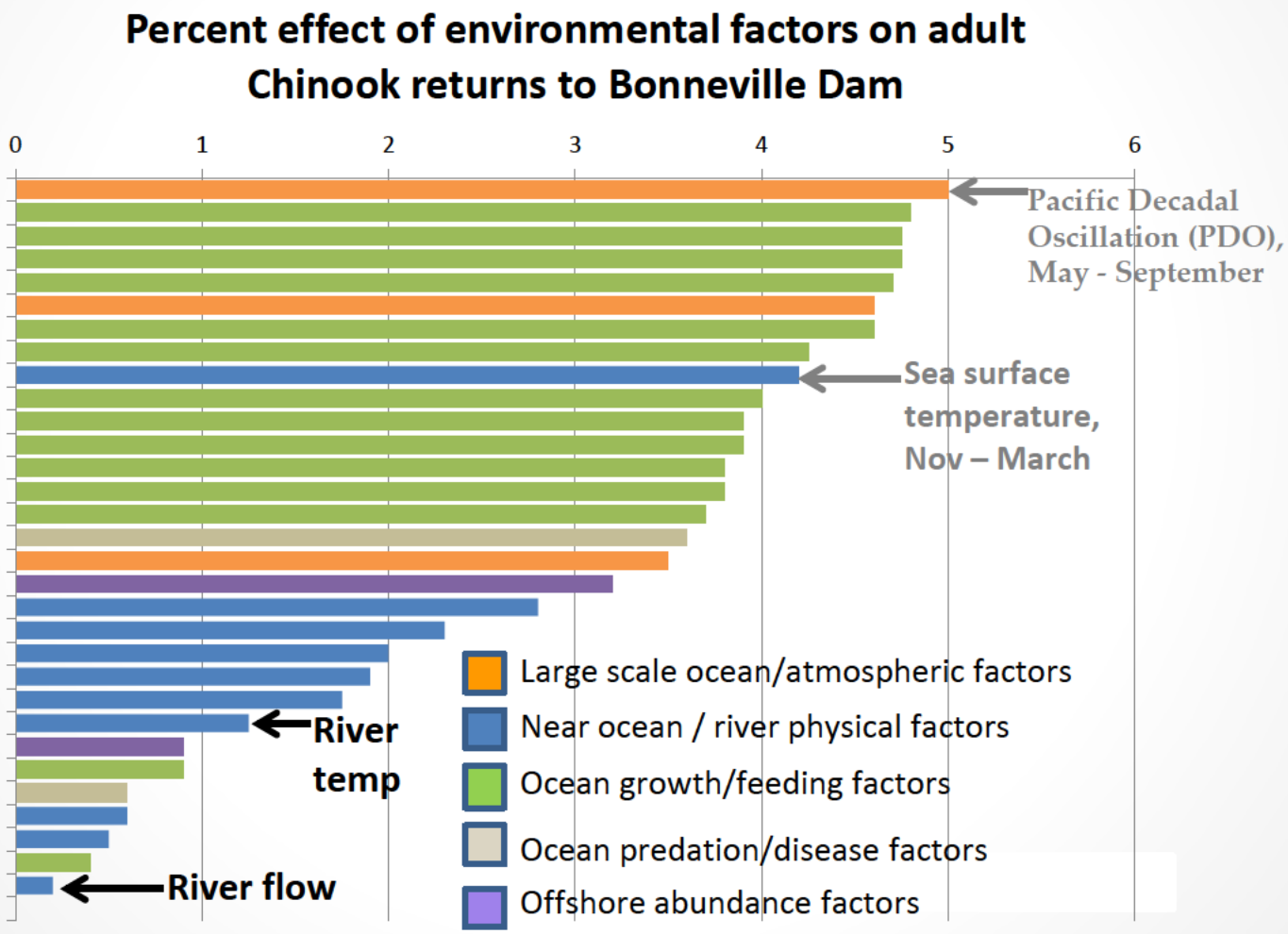
- Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects -- Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

- Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.
- Monitoring Smolt-to-Adult survival rates.
- Comparing survival rates against both past survival rates and prospective model predictions.
- Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.
- Inclusion of sideboards or "off-ramps"…

Confounding factors make SARS a difficult metric to guide hydrosystem modifications

- Hydro performance is more appropriately measured by:
  - Juvenile dam survival which is a direct measure of hydro performance and therefore more appropriate than SARS.
  - Total in-river and reach survival (e.g. Lower Granite to Bonneville) of juveniles and adults also provide a measure of hydro performance.
- Dam operators cannot control or influence the vast majority of the factors that affect adult fish returns.
  - Approximately 60% of the environmental factors influencing Chinook returns to Bonneville Dam are related to large scale ocean/atmospheric conditions, and ocean growth/feeding. (Burke et al. 2013)
- So many factors affect SARS that tests comparing different spill conditions may require several decades to show a statistically reliable effect on SARS.
- Current rigorous survival performance standard testing at the dams and in-river survival monitoring produce reliable results on smolt survival each year.

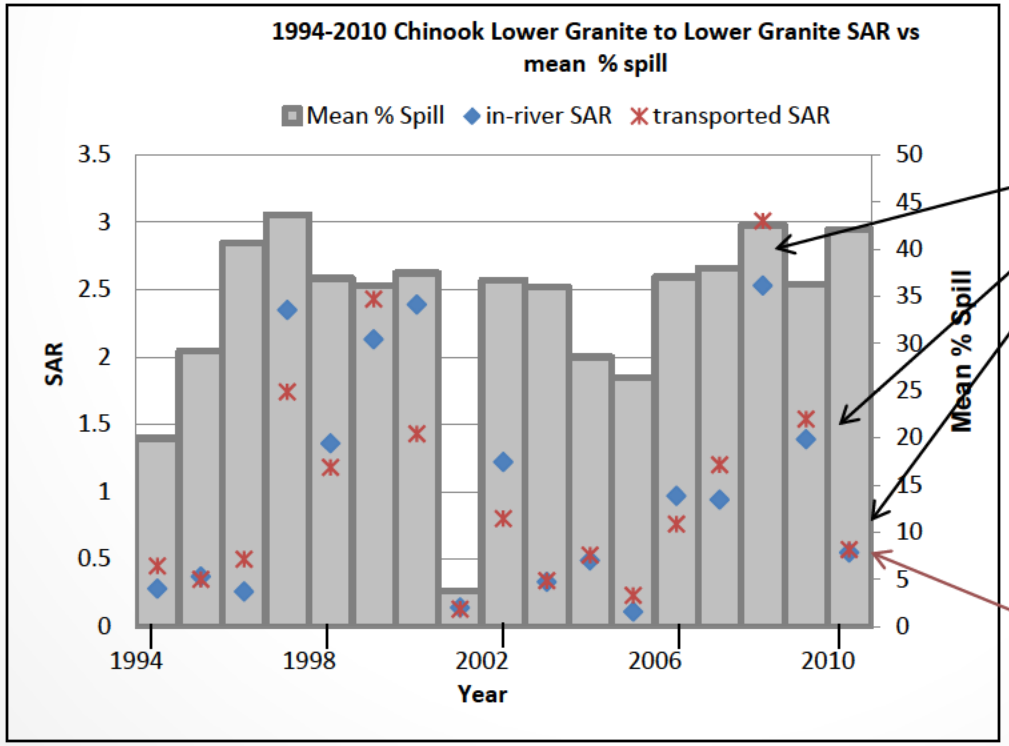
Ocean conditions, not spill levels, have the greatest influence on adult returns



Source: Burke et al. (2013)

Similar trends for transported and in-river fish suggest larger factors driving SARS

- The SARs of transported fish have similar relationships to spill as their in-river counterparts even though the transported fish did not experience spill. This demonstrates that other factors, besides spill, are affecting SARs of both groups.



In 2008, 2009, and 2010 Chinook SARS were similar for transported and in-river fish.

Even though the mean % spill was high in 2010, Chinook SARS were low for both transported and in-river fish.

Source: 2012 CSS Annual Report

CSS assumptions underlying the proposed high spill test are oversimplified

- Dam survival and passage condition data do not reflect recent advancements in the federal spill program
  - CSS does not consider 10+ years of cumulative route-specific acoustic tag information from BiOp juvenile performance standard and survival testing for each dam

- Dam specific biological and structural constraints, including total dissolved gas constraints, are not included, making the results incomplete.

- Results are extrapolated beyond the range of empirical data thus assuming that if some spill improves survival then more spill will provide further increases proportionate to volume.

Statistical Design & Analysis Considerations Regarding a Proposed Spill Study

John R. Skalski
University of Washington

Properties of Scientific Experiments

Fisher (1947)

- Replication
- Randomization
- Error control
- Treatment contrasts

Cox (1958)

- Elimination of confounding factors
- Precision
- Useful range of validity
- Simplicity
- Ability to estimate error variance

Proposed "Spill Experiment"

Fisher (1947) Criteria

- Replication: 10 consecutive years
- Randomization: None
- Error control: Whatever nature presents
  - No control for ocean effects
  - No control for fish health, size, etc.
  - No control for harvest changes
- Treatment contrasts: None
  - Single spill level, year after year

Proposed "Spill Experiment"

Cox (1958) Criteria

- Elimination of confounding factors
  - Confounding with time appears problematic
- Precision
  - No reference to sample sizes, precision, or statistical power
- Useful range of validity
  - Only one spill level evaluated
- Simplicity
  - Current proposal is too simplified
- Ability to estimate an error variance
  - No hypothesis to formally test

Other Study Considerations

1. No formal selection of response variable(s)

Possible Response Variable ($\hat{\theta}$)	Precision	Confounding Factor	Biological Relevance
Inriver survival	1	1	3
SAR	2	2	2
Adult returns	3	3	1

- Choice will influence how success or failure is measured
- Need *a priori* prioritization of response variables to measure success

Other Study Considerations (Cont.)

2. No formal tests of hypotheses

- Possible candidates mentioned:

A. Test of Means

$$H_O: \hat{\bar{\theta}}_{Before} \geq \hat{\bar{\theta}}_{Test}$$

$$H_a: \hat{\bar{\theta}}_{Before} < \hat{\bar{\theta}}_{Test}$$

Difficulties

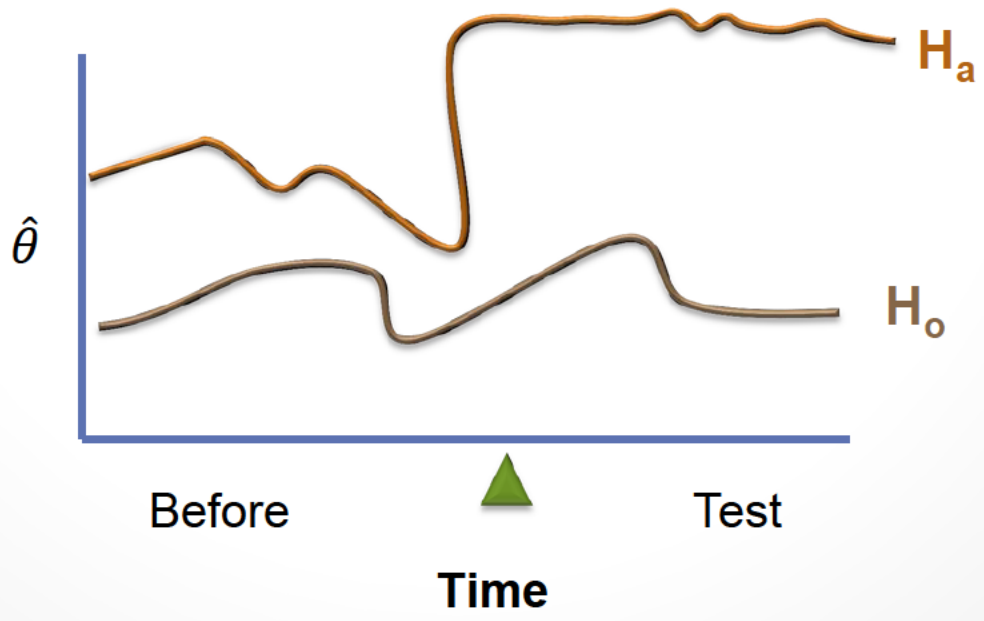
- Confounded with time
- No error control – very noisy

Other Study Considerations (Cont.)

B. Time Series Analysis

H_o: Time series stationary

H_a: Shift in response after intervention

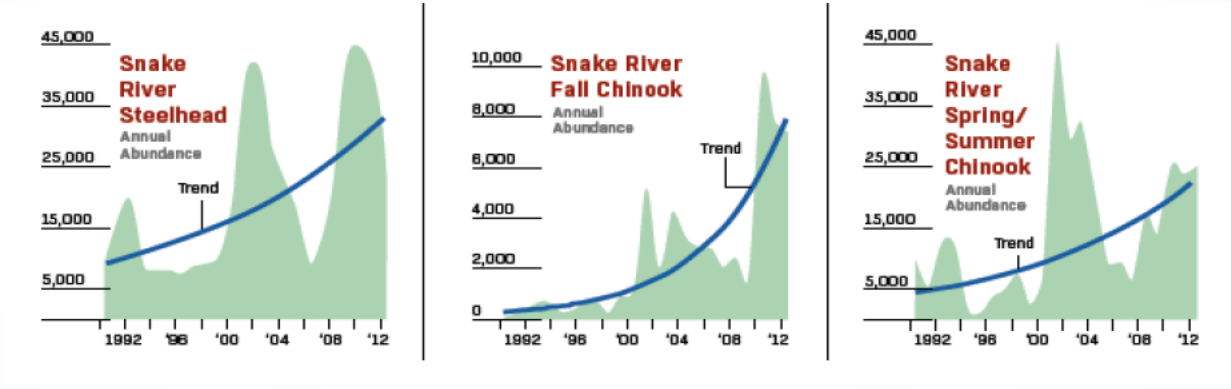


Other Study Considerations (Cont.)

B. Time Series Analysis (cont.)

Difficulties

- 5 or 10 years are not long for time series
- Paulsen & Hinrichsen (2002) found time series half as powerful as treatment contrasts
- Currently system not stationary
  - 6/7 ESUs have **upward** trends

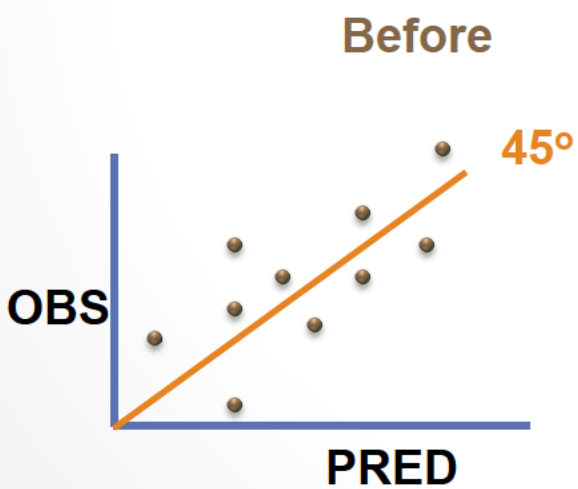


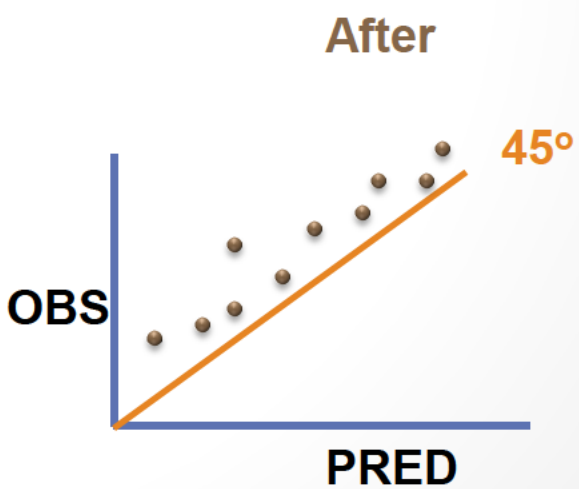
From: USACE, USBR, BPA. 2013. Citizen's Guide to the 2013 Comprehensive Evaluation.

Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions

$$H_o: \ \hat{\bar{\theta}}_{OBS} \leq \hat{\bar{\theta}}_{PRED}$$
$$H_a: \ \hat{\bar{\theta}}_{OBS} > \hat{\bar{\theta}}_{PRED}$$





Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions (cont.)

Difficulties

- Model must be selected *a priori*
- Predictive model needs to be reasonably accurate (i.e., unbiased) and precise
- Predictive model must be calibrated beyond current range of spill
- Currently, predictions of adult returns fairly poor

Other Study Considerations (Cont.)

D. No power calculations/No sample size calculations

- Calculations not possible without formal tests of hypotheses
  - No justification for 10-year study
  - No specification of within-year tagging effort
- No specification of the size of Δ that is reasonable to expect and detect under proposed spill plan
  - Haeseker et al. (2012) suggested
    - SARS : 4 – 8 times larger
    - Inriver survival: +0.30

UW Power Calculations

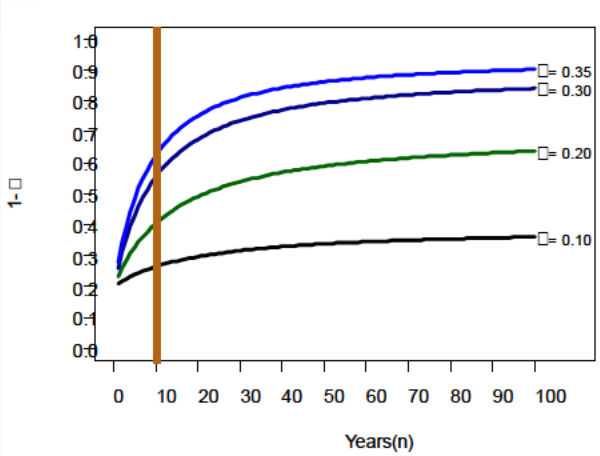
Statistical Power

- **Response variable**
- **Test of hypotheses**
- **α-level**
- **Sample size**

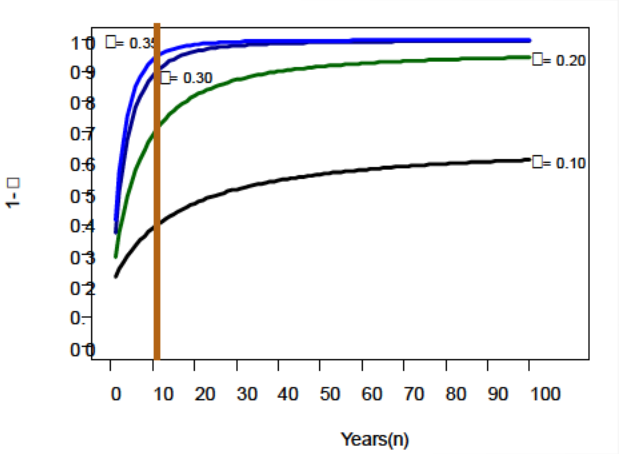
- SARs
  - Two orders of magnitude of interannual variation
  - Need century of observations
- TIRs
  - Transports control for fish condition, ocean, harvest effects
  - Vary by factor of 5 or less
  - Still need multiple decades

UW Power Calculations (cont.)

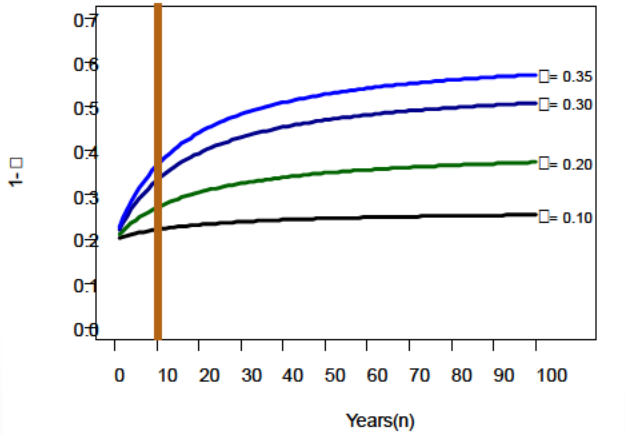
Hatchery spring Chinook (2001 omitted)



Wild steelhead (2001 omitted)



Hatchery summer Chinook (2001 omitted)



α = 0.10, one-tailed test

Other Study Considerations (Cont.)

D. No ancillary studies of extraneous effects

- Monitoring for change in smolt condition or size that could confound study
- Monitoring for increased incidence of gas bubble disease under 125% TDG
- Monitoring for changes in adult migration
- No trigger to stop study if problems occur

Other Study Considerations (Cont.)

E. No decision rules

- Plan specifies comprehensive testing in 5 and 10 years
  - No sequential testing proposed
  - No decision rules to continue or stop study

Conclusions

- Numerous design and analysis considerations central to the success of a spill study have not been fully specified
- *A priori* specifications of response variables and tests of hypotheses essential for an objective evaluation
- Preliminary calculations suggest inriver survival will need to increase substantially (i.e., $\Delta \geq 0.30$) for study to have moderate to reasonable power in 10 years
- A formal, peer-reviewed design and analysis plan must be developed prior to the investigation

Action Agency Conclusions: Best available science supports existing path forward

- The federal agencies just completed a 5-year comprehensive evaluation of our ten-year program, with very good results and measurable metrics for accomplishments, such as:
  - Juvenile Performance Standards
  - In-river passage and reach survival of juveniles and adults, including adult abundance
- This program of research-based improvements and rigorous testing is demonstrating positive results and should be completed as planned
- The proposed spill test uses a 2-6% target for Smolt-to-Adult Returns (SARS) as measure of success, but SARS reflect more than hydro system impacts.
- The proposal relies on the CSS model, which is based on oversimplified correlations between juvenile survival and SARS with averaged environmental indices (spill %, flow, etc). ISAB's annual review advised further refinement of the model.
- Outstanding science questions remain about impacts of higher spill, the rationale for the proposed test, and latent mortality.

Questions?

Preliminary Analysis of Spill Test

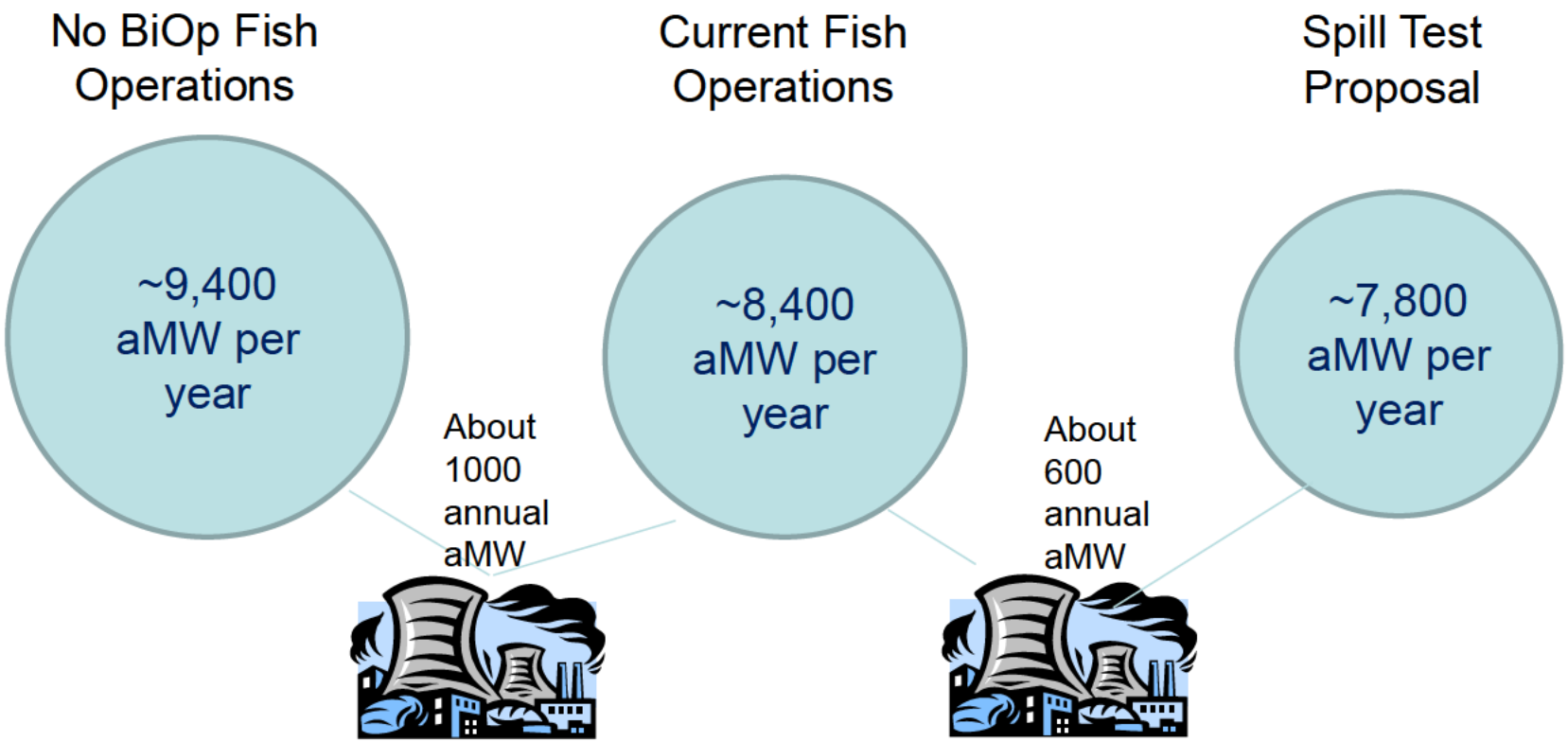
February 4, 2014

Preliminary Analysis

- A Spill Test at 125% TDG from April 3 to June 20 for 24 hours a day has been submitted through a number of venues including NOAA's draft FCRPS Biological Opinion, the federal Action Agencies draft 2014-2018 FCRPS Biological Opinion Implementation Plan and the Northwest Power and Conservation Council Fish & Wildlife Program Amendment process.

- At the request of constituents, we have conducted a preliminary analysis of the more spill proposal as we understand it. The proposal contains caveats in a number of areas, but the details were not included.

Spill Test Would Reduce Average Annual Federal Generation by 600 aMW



For perspective: City of Seattle uses about 1,171 aMW per year
Columbia Generating Station (nuclear plant in Richland) produces about 1,030 aMW per year
Centralia Coal Plant produces about 1,200 aMW per year

Estimated annual average megawatts, based on an evaluation of the historical 80 year water supply record

Lost Generation Would be Concentrated in the Spring

Current Fish Operations

~10,000 aMW produced in Spring

Generation would be reduced – on average – every hour in the spring by 2,500 MW

Spill Test Proposal

~7,500 aMW produced in Spring

For perspective: It would take more than six typical 400 MW combined cycle gas plants to produce the amount of energy removed from the system in the spring. Energy efficiency cannot replace this magnitude of power in the spring in the NW.

Estimated average megawatt hours, April 3 – June 20, based on an evaluation of the historical 80 year water supply record

10-Year Test – Would Reduce Value of Hydro System by Over One Billion Dollars

- $100 million per year in lost firm power (450 aMW per year)
- $10 million per year in lost secondary power sales (150 aMW per year)

Total Rate Effect: Almost 8% Increase

- Oregon's spill proposal increases rates since it both reduces secondary energy sales revenue that offset BPA's operating costs and and decreases the number of megawatt hours BPA has to sell – which means BPA's cost per megawatt hour will be higher
- In addition, customers will also have to replace the lost 450 annual aMW of lost firm power they can no longer get from the federal system
- The overall wholesale rate effect to BPA's customer utilities is estimated to be an increase of nearly 8 percent

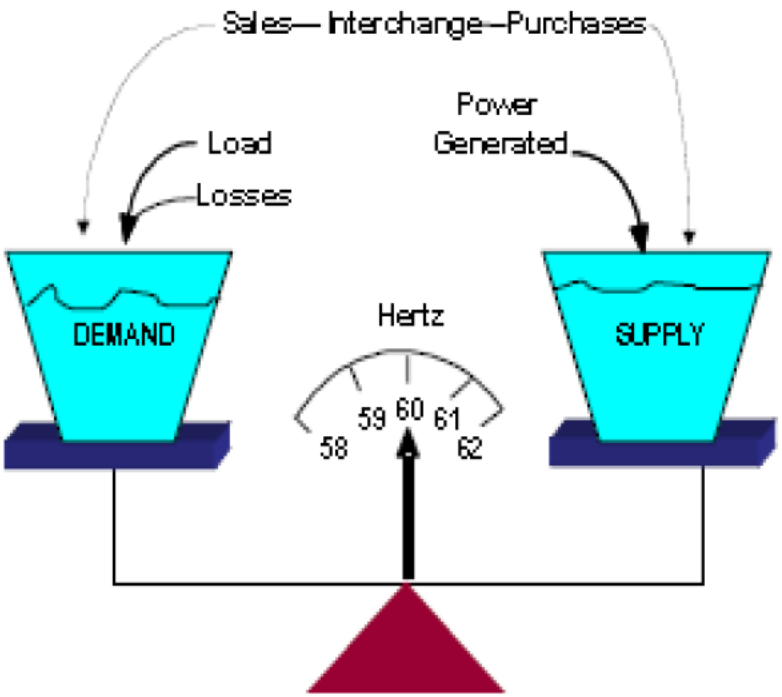
Carbon Impacts of Replacement Energy

- CO_2 production increase: ~ 1.9 million metric tons (MT)
- **$55 million per year in social cost of carbon***
- This estimate is based on a study prepared by the Northwest Power and Conservation Council in 2008
  - In the Pacific Northwest, hydro, wind, and other renewables are used before combustion turbines and coal as they have lower costs to run.
  - For most of the year, natural gas fired power plants are the last resource brought online to supply power instantaneously and to respond to decreases in hydropower production
  - A typical combined cycle natural gas fired power plant emits 800 lbs. of $C0_2$ per megawatt hour
  - A one megawatt hour decrease in hydropower results in 800 lbs. of CO_2 production
- The equivalent of about 440,000 cars or 28,000 tanker trucks of gasoline consumed

** Based on data from the May 2013 Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866. Using $29.15 per metric ton of CO2 (the medium probability case)*

Operations Impacts

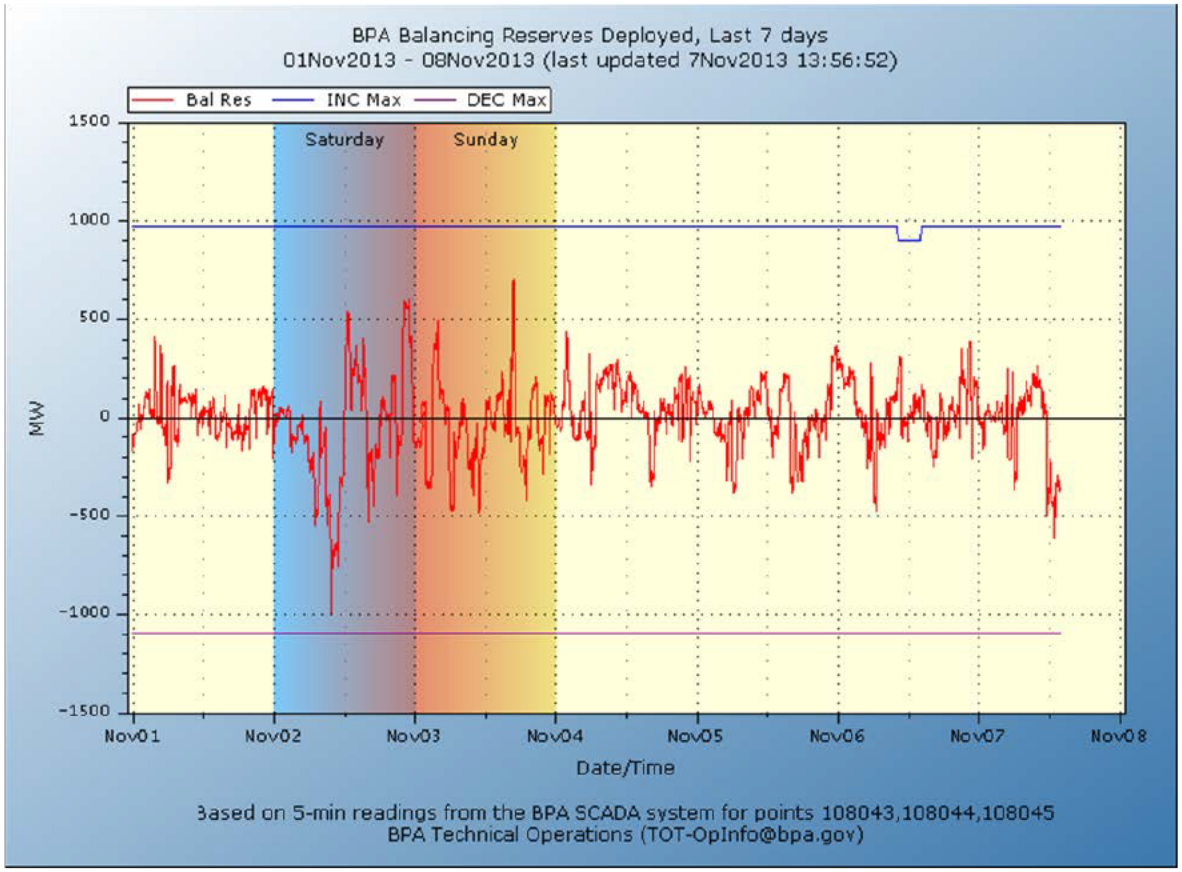
- The flexibility of the federal hydro system is used to balance changes in resources and loads on a second by second basis.
- Proposed spill test would significantly reduce the flexibility of the FCRPS to respond to changes in loads or wind output.



Generation-Demand Balance

Balancing Reserves

- The hydro system has limits on what it can provide and still comply with all hydraulic objectives including current fish operations
- Reduced flexibility could severely reduce quantity of balancing reserves that could be provided by the hydro system.
- With the addition of a large wind fleet the need for balancing reserves has increased
- With the spill proposal, new resources likely would be needed to provide balancing services for <u>both</u> existing and future variable renewable resources which would likely increase the cost to provide these resources



Oversupply of Generation

- Spilling to 125% TDG for 11 weeks may reduce the implementation of oversupply management protocol (displacement of wind);
- But the magnitude of more spill is on average 600 aMWs of hydropower, while our experience with oversupply situations has resulted in displacements of: 11 aMWs in 2011, 6 aMWs in 2012, and zero aMWs in 2013.
- We forecast oversupply situations only in about 50% of the years; not every year.
- Increased spill would <u>also</u> reduce hydropower supply in the hours when the federal power is needed to meet firm load requirements in the Northwest.
- This potential reduction in oversupply may be offset by a change in resource mix in the region. Thermal plants that normally shut down in the spring may need to continue running to meet loads. This change may contribute to oversupply because of minimum generation and run-time requirements at the thermal plants.
- Potential impacts to transmission interties may reduce access to markets outside the BPA Balancing Authority

Transmission Impacts

Initial assessments identified the following likely impacts of more spill:

- Reduced intertie transfer capacity
- Increased congestion on North of John Day and North of Hanford transmission paths
- Would be a significant change from current operating paradigm and may cause operating issues that we do not currently face

RECORD OF DECISION

following

NOAA's January 2014
Supplemental Biological Opinion

to the

May 2008 FCRPS Biological Opinion and
May 2010 Supplemental Biological Opinion
for Operation of the Federal Columbia River Power System

February 27, 2014

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ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

2008 FCRPS BiOp	NOAA's May 2008 Biological Opinion on operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program.
2008 BPA ROD	BPA's Record of Decision to implement the 2008 FCRPS BiOp RPA and ITS.
2010 Supplemental FCRPS BiOp	NOAA's May 2010 Supplemental Biological Opinion on operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program.
2010 BPA ROD	BPA's Record of Decision to implement the 2008 FCRPS BiOp and RPA, as amended by the 2010 Supplemental FCRPS BiOp.
2011 Amended BPA ROD	BPA's amended Record of Decision to implement the 2008 FCRPS BiOp and RPA, as amended by the 2010 Supplemental FCRPS BiOp, until such time as NOAA issued a new or supplemental BiOp as required by the Opinion and Order by the United States District Court for the District of Oregon in *National Wildlife Federation v. National Marine Fisheries Service*, 829 F.Supp.2d 1117 (D.Or. 2011).
2014 Supplemental FCRPS BiOp	NOAA's May 2010 Supplemental Biological Opinion on operation of the Federal Columbia River Power System.
2014 BPA ROD	BPA's Record of Decision to implement the 2008 FCRPS BiOp RPA and ITS, as amended by the 2010 Supplemental FCRPS BiOp and the 2014 Supplemental FCRPS BiOp.
Action Agencies	U.S. Department of the Interior Bureau of Reclamation, U.S. Army Corps of Engineers, and U.S. Department of Energy Bonneville Power Administration, the agencies responsible for management and operation of federal hydroelectric projects in the Columbia and Upper Snake Rivers.
Adaptive Management	The process of adjusting management actions and/or directions based on new information.
AMIP	Adaptive Management Implementation Plan, adopted by the Action Agencies on September 11, 2009.

Anadromous Fish	Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.
BA	Biological Assessment
Biological Assessment	The Action Agencies' analysis of impacts of their proposed actions on species listed and proposed to be listed under the ESA. The Action Agencies produced biological assessments on projects in the Federal Columbia River Power System in the Columbia River and on projects in the Upper Snake River. (See definition at 50 C.F.R. § 402.02)
Biological Opinion	*Biological opinion* is the document that states the opinion of the NOAA Fisheries as to whether or not the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. (See 50 C.F.R. § 402.02)
BiOp	Biological Opinion
BPA	U.S. Department of Energy, Bonneville Power Administration
Clean Water Act	Federal Water Pollution Control Act, *codified generally as* 33 U.S.C. §§ 1251-1387.
Columbia Basin Fish Accords	Agreements signed by the Action Agencies, six tribes, and two states to support the 2008 FCRPS BiOp and provide additional benefits to fish. Also includes an Agreement signed with the State of Washington to support the 2008 FCRPS BiOp and provide additional benefits to fish in the estuary.
Comprehensive Analysis (CA)	The analysis conducted by the Action Agencies to assess impacts of proposed operation of major projects in the Federal Columbia River Power System (FCRPS). The CA provides the basis underlying the biological assessments on the FCRPS and Upper Snake projects.
Corps	U.S. Army Corps of Engineers
Council	Pacific Northwest Electric Power and Conservation Planning Council (aka Northwest Power and Conservation Council)
CRITFC	Columbia River Intertribal Fish Commission
Cumulative Effects	Effects of future State or private activities, not involving federal activities, that are reasonably certain to occur. (See definition at 50 C.F.R. § 402.02)
CWA	Clean Water Act

DPS	Distinct Population Segment
Distinct Population Segment	A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NOAA policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.
EFH	Essential fish habitat under the Magnuson-Stevens Act
EIS	Environmental Impact Statement under the National Environmental Policy Act
Environmental Baseline	Past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 Consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. (See definition at 50 C.F.R. § 402.02)
ESA	Endangered Species Act, 16 U.S.C. 1531 et seq.
ESA Recovery Plan	A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.
ESU	Evolutionarily Significant Unit
Evolutionarily Significant Unit (ESU)	A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other specific units and (2) represents an important component of the evolutionary legacy of the species. Equivalent to a distinct population segment and treated as a species under the Endangered Species Act.
FCRPS	Federal Columbia River Power System

Jeopardize	To reduce appreciably the likelihoods of survival and recovery of a species listed as threatened or endangered under the ESA. (See 50 C.F.R. § 402.02, definition of "jeopardize".)
ISAB	Northwest Power and Conservation Council's Independent Scientific Advisory Board
ISRP	Northwest Power and Conservation Council's Independent Scientific Review Panel
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act, *codified as amended at* 16 U.S.C. §§ 1801-1891d.
MSA	Magnuson-Stevens Act
NEPA	National Environmental Policy Act
NOAA	National Marine Fisheries Service, an agency within the National Oceanic and Atmospheric Administration.
Northwest Power Act	Pacific Northwest Electric Power Planning and Conservation Act, *codified at* 16 U.S.C. §§ 839-839h.
Northwest Power and Conservation Council	Pacific Northwest Electric Power and Conservation Planning Council, created under the Pacific Northwest Electric Power Planning and Conservation Act, which develops power plans and fish and wildlife programs to guide activities by the Bonneville Power Administration and other federal and nonfederal entities in the Pacific Northwest.
Reasonable and Prudent Alternative (RPA)	Recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the purposes of the action, that is consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that NOAA believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat. (See definition at 50 C.F.R. § 402.02)
Reclamation	U.S. Department of Interior, Bureau of Reclamation
Recovery	Improvement in the status of a species to the point at which listing under the ESA is no longer appropriate. (See definition of "conservation" at 50 C.F.R. 402.02)
RM&E	Research, Monitoring, and Evaluation

ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
Spill	Water released from a dam over the spillway instead of being directed through the turbines.
Supplemental Comprehensive Analysis (SCA)	An analysis by NOAA of the effects of three actions in the context of the environmental baseline and cumulative effects. The SCA provides the analysis underlying the evaluations in NOAA's BiOps on operation of FCRPS projects, operation of Upper Snake River projects, and harvest activities under *U.S. v. Oregon*.
U.S. v. Oregon	Litigation under which federal, state, and tribal parties resolve differences respecting harvest levels of anadromous fish.
U.S.C.	United States Code

I. Summary

On January 17, 2014, NOAA (National Oceanic and Atmospheric Administration) issued an Endangered Species Act (ESA) Section 7(a)(2) Supplemental Biological Opinion (BiOp) for consultation on remand of the effects of the operation and maintenance of the Federal Columbia River Power System (FCRPS) on certain species listed as threatened or endangered under the ESA. The 2014 Supplemental BiOp supplements NOAA's 2008 FCRPS BiOp and Reasonable and Prudent Alternative (RPA), as amended by NOAA's 2010 Supplemental FCRPS BiOp.

This document records my decision on behalf of Bonneville Power Administration (BPA) to implement the 2008 FCRPS BiOp and RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps (collectively, FCRPS BiOp and RPA), in collaboration with the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (Reclamation). This decision document complies with regulations governing ESA consultations, which provide that "[f]ollowing issuance of a biological opinion, the Federal agency shall determine whether and in what manner to proceed with the action in light of its [ESA] section 7 obligations and [NOAA's] biological opinion."[1]

As described in further detail below, I conclude that implementation of the FCRPS BiOp and RPA is not likely to jeopardize the continued existence of listed species or destroy or adversely modify their critical habitat. I also conclude that BPA has the authority and discretion to implement the FCRPS BiOp and RPA in cooperation with the other Action Agencies. BPA therefore commits to implement the BiOp and RPA through 2018, including abiding by the terms and conditions in: (1) the 2008 FCRPS BiOp's Incidental Take Statement for salmon and steelhead, as amended by the 2010 and 2014 Supplemental Incidental Take Statements for salmon and steelhead; and (2) the 2014 Supplemental FCRPS BiOp's Incidental Take Statement for southern DPS eulachon.

The 2014 Supplemental FCRPS BiOp builds upon the 2010 Supplemental FCRPS BiOp, which in turn builds upon the 2008 FCRPS BiOp. Therefore, this 2014 Record of Decision (ROD) builds upon and incorporates by reference BPA's 2008 and 2010 RODs and 2011 Amended ROD respecting implementation of NOAA's 2008 and 2010 Supplemental FCRPS BiOps, to the extent those RODs are not inconsistent with this document.[2]

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[1] 50 C.F.R. § 402.15(a).

[2] *See* Attachments A-C.

II. Background

The Corps, Reclamation, and BPA are the three federal "Action Agencies" with responsibilities for the coordinated operation and maintenance of the FCRPS and the implementation of NOAA's 2008 FCRPS BiOp and 2010 Supplemental BiOp.

In August 2007, the Action Agencies submitted two documents to NOAA: a Biological Assessment (BA), including an extensive package of proposed actions to address effects of the operation and maintenance of the FCRPS on listed salmon and steelhead and designated critical habitat,[3] and a Comprehensive Analysis (CA). The Action Agencies developed the CA in response to a previous ruling by the United States District Court for the District of Oregon that NOAA develop a single integrated CA evaluating the effects on the salmon and steelhead lifecycle from the operations of the separate Upper Snake and FCRPS water management systems.[4] Subsequently, NOAA developed a Supplemental Comprehensive Analysis (SCA), in which NOAA updated the analysis with the most recent available scientific data and information and additionally incorporated impacts from harvest in the lifecycle analysis.[5]

In May 2008, NOAA issued three separate BiOps for: (1) the operation and maintenance of the FCRPS (the FCRPS BiOp); (2) Reclamation's operation and maintenance of the Upper Snake projects; and (3) the *United States v. Oregon* Management Agreement for harvest of upper Columbia River fish runs.[6] Each of these three BiOps are tiered off of the common analysis found in the SCA, which comprehensively analyzes the combined effects of these actions on the listed species and their designated critical habitat.

The 2008 FCRPS BiOp included a recommended RPA that NOAA concluded was likely to avoid jeopardizing the continued existence of the 13 listed salmon and steelhead species and

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[3] In separate correspondence, the Action Agencies also consulted with NOAA on the effects of the operation and maintenance of the FCRPS on Southern Resident Killer Whales and Green Sturgeon of the Southern DPS.

[4] *American Rivers v. NOAA Fisheries*, No. CV-04-00061-RE (D. Or.), Opinion and Order of Remand, Sept. 26, 2006, at 8.

[5] NOAA Fisheries. May 5, 2008. Supplemental Comprehensive Analysis of the Federal Columbia River Power System and Mainstem Effects of the Upper Snake and Other Tributary Actions. 882 pp.

[6] This management agreement was negotiated among the States of Oregon, Idaho, and Washington, the United States, the Shoshone Bannock Tribes, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, and the Confederated Tribes and Bands of the Yakama Nation, under the continuing jurisdiction of the District of Oregon in Civil No. 68-513-KI (D.Or.).

destroying or adversely modifying designated critical habitat.[7] The RPA incorporated and improved upon the actions proposed by the Action Agencies in the 2007 BA. It consists of a comprehensive set of "All H" strategies to minimize the adverse effects from the operation of the FCRPS. For each "All H" strategy (hydro, habitat, hatcheries, and predator management), it identifies concrete actions to be implemented through an adaptive management framework by 2018, and it establishes measurable performance standards and targets that guide and inform RPA implementation. BPA subsequently adopted NOAA's 2008 BiOp and RPA in its August 2008 ROD.[8]

After NOAA issued the 2008 BiOp, the Obama Administration, including senior leadership from the Departments of Commerce, Army, Interior, and Energy, as well as White House Council on Environmental Quality, conducted an extensive review of the scientific bases of the 2008 BiOp and underlying legal issues. This review led to the development of an Adaptive Management Implementation Plan (AMIP), which "enhanced and strengthened implementation of activities, research, and contingencies within the RPA's adaptive management provisions" and "called for a more precautionary approach to address uncertainties about the future condition of affected salmon and steelhead, particularly out of concern for how climate change may affect these species and their habitat."[9] NOAA concluded that the 2008 BiOp, as implemented through the AMIP and its enhanced and accelerated mitigation and research, monitoring, and evaluation (RM&E) actions, satisfies the requirements of the ESA.

In May 2010, NOAA issued a supplemental BiOp that formally incorporated the AMIP into the FCRPS BiOp and strengthened the existing adaptive management provisions in the RPA. The 2010 BiOp also supplemented the FCRPS BiOp with new science and confirmed NOAA's determination that the operation of the FCRPS through 2018 complies with the standards of Section 7(a)(2) of the ESA. BPA subsequently adopted NOAA's 2010 BiOp in its June 2010 ROD.[10]

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[7] In the 2008 BiOp, NOAA also considered the effects of the operation and maintenance of the FCRPS on Southern Resident Killer Whales and Green Sturgeon of the Southern DPS.

[8] Bonneville Power Administration. August 12, 2008. Record of Decision following the May 2008 NOAA Fisheries FCRPS Biological Opinion on Operation of the Federal Columbia River Power System, 11 U.S. Bureau of Reclamation Projects in the Columbia Basin, and ESA Section 10 Permit for Juvenile Fish Transportation Program.

[9] NOAA's National Marine Fisheries Service, Northwest Region, Supplemental Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program, May 20, 2010, Section 1.2.

[10] Bonneville Power Administration. June 11, 2010. Record of Decision following the May 20, 2010 NOAA Fisheries Supplemental Biological Opinion to the May 2008 FCRPS Biological Opinion for Operation of the Federal Columbia River Power System, 11 U.S. Bureau of Reclamation Projects in the Columbia Basin, and ESA Section 10 Permit for Juvenile Fish Transportation Program.

In August 2011, the District Court found that the 2008/2010 BiOp and RPA contains positive mitigation measures that provide adequate protection to the listed species through 2013, and it held that the BiOp shall remain in place and be implemented through December 31, 2013. During this time, the Court also ordered that spring and summer spill operations be implemented in a manner consistent with prior orders that adopted the Corps' annual Fish Operations Plan. The Court, however, remanded the BiOp to NOAA to reconsider the sufficiency of habitat mitigation actions beyond 2013, and it ordered NOAA to produce a new or supplemental BiOp by January 1, 2014.[11] In light of the court remand order, BPA issued a 2011 Amendment to its 2010 ROD that revises the temporal scope of the 2010 ROD to implement the 2008 FCRPS BiOp RPA, as amended by the 2010 Supplemental FCRPS BiOp, through 2013 rather than 2018, and thereby "avoid reliance on post-2013 habitat measures" that the United States District Court for the District of Oregon rejected in *National Wildlife Federation v. National Marine Fisheries Service*, 829 F.Supp.2d 1117 (D.Or. 2011).[12]

In accordance with the District Court's remand order, NOAA and the Action Agencies have continued longstanding collaboration with the regional sovereign entities, and the Action Agencies have continued to implement the RPA in concert with States, Tribes, and other regional parties. During this period, the Action Agencies have prepared 2010 and 2011 Annual Progress Reports, a 2013 Comprehensive Evaluation describing progress in implementing the RPA provisions for the period 2008-2012 and a 2014-2018 Implementation Plan describing the RPA actions that will be implemented through 2018 to achieve BiOp objectives. Together, and combined with the 2007 FCRPS BA, CA, and SCA, these documents presented NOAA with the information needed to develop and issue the 2014 supplemental FCRPS BiOp.

On January 17, 2014, NOAA issued its 2014 Supplemental FCRPS BiOp and Supplemental Incidental Take Statement.

[11] *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 839 F.Supp.2d 1117 (D. Or. 2011). By order dated November 8, 2013, the remand deadline was subsequently extended to January 24, 2014.

[12] Bonneville Power Administration. December 15, 2011. 2011 Amendment to 2010 Record of Decision following the May 20, 2010, NOAA Fisheries Supplemental Biological Opinion to the May 2008 FCRPS Biological Opinion for Management and Operation of the Federal Columbia River Power System, 11 U.S. Bureau of Reclamation Projects in the Columbia Basin, and ESA Section 10 Permit for Juvenile Fish Transportation Program, p.3-4.

III. Reasons for Decision

A. BPA Reviewed and Concurs with NOAA's Reasoning and Determinations in the 2014 Supplemental BiOp

Based on its review of new scientific information, NOAA concluded in the 2014 Supplemental FCRPS BiOp that the operation of the FCRPS, through the implementation of the 2008 BiOp's RPA, as amended by the 2010 and 2014 Supplemental BiOps, is not likely to jeopardize the continued existence of listed species of salmon and steelhead covered in this consultation or destroy or adversely modify their critical habitat. (Sections 4.1, 4.2, 4.3 of the 2014 Supplemental BiOp)

Operation of the FCRPS affects 13 listed species of salmon and steelhead, which are referred to as Evolutionarily Significant Units (ESUs) and Distinct Population Segments (DPSs). NOAA defines a DPS as

> a listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NOAA Fisheries policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.

(2014 Supplemental BiOp, Terms and Definitions, p.23.) Similarly, NOAA defines an ESU as

> [a] group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species. Equivalent to a distinct population segment and treated as a species under the Endangered Species Act.

(2014 Supplemental BiOp, Terms and Definitions, p.24.)

NOAA's BiOp addresses the impacts of the FCRPS RPA on listed ESUs and DPSs of salmon and steelhead. Recovery planning processes subdivide ESUs and DPSs into Major Population Groups (MPGs), and MPGs are further subdivided into individual populations, which generally correlate with the tributary reach where spawning occurs. Consistent with this recovery planning methodology, in the 2008 FCRPS BiOp, as supplemented in 2010 and 2014, NOAA considered both qualitative and quantitative information at the population, MPG and ESU/DPS levels and used this information to determine whether implementation of the RPA is likely to

jeopardize the listed ESUs and DPSs or destroy or adversely modify their critical habitat.[13] After reviewing the RPA's prospective actions aggregated with the environmental baseline and cumulative effects, the 2014 Supplemental BiOp concluded that the listed species are likely to survive with an adequate potential for recovery and therefore the RPA is not likely to jeopardize the listed species or adversely modify their critical habitat.

1. Modifications to the RPA

As the 2014 Supplemental BiOp supplements without replacing the 2008 and 2010 Supplemental BiOps, all Actions in the 2008 BiOp's RPA (as amended by the 2010 Supplemental BiOp) remain in effect through 2018, to the extent not otherwise modified by the 2014 Supplemental BiOp. As described in Table 1.3-1 of the 2014 Supplemental FCRPS BiOp, NOAA has modified the 2008/2010 RPA in the following ways:

- Spill operations to improve juvenile passage (*RPA Action No. 29, Table 2, as discussed in Section 3.3.1.1 of the 2014 Supplemental FCRPS BiOp*)
- Juvenile fish transportation in the Columbia and Snake Rivers (*RPA Action No. 30, Tables 3 & 4, as discussed in Section 3.3.3.4 of the 2014 Supplemental FCRPS BiOp*)
- Configuration and Operational Plan Transport Strategy (*RPA Action No. 31, as discussed in Section 3.3.3.4 of the 2014 Supplemental FCRPS BiOp*)
- Fish Passage Plan (*RPA Action 32, as discussed in Section 3.3.3.4 of the 2014 Supplemental FCRPS BiOp*)
- Pile Dike Removal Program (*RPA Action 38, as discussed in Section 3.2.3 of the 2014 Supplemental FCRPS BiOp*)
- Double-crested cormorant predation reduction (*RPA Action 46, as discussed in Section 3.5.2 of the 2014 Supplemental FCRPS BiOp*)
- Northern Pikeminnow Management Program (*RPA Action 43, as discussed in Section 3.5.1 of the 2014 Supplemental FCRPS BiOp*)

[13] As NOAA indicated in its July 16, 2006 jeopardy standard memorandum, "Because of the uncertainty attendant to any metric regarding the prospects for recovery and the difficulty in extrapolating from the population level on which those metrics are based, no one metric will be used to assess an ESU's potential for recovery. Instead, NOAA will consider a number of metrics, including those generated in the recovery planning process, along with other qualitative biological information and apply its best professional judgment as to an ESU's prospects for recovery."

BPA has reviewed each of the foregoing RPA modifications and concurs that Action Agency implementation of the FCRPS RPA, as modified, is economically and technologically feasible and that BPA can continue to implement its portion of this modified RPA in a manner consistent with the intended purpose of the operation of the FCRPS and consistent with BPA's legal authority and jurisdiction.[14]

2. Additional Species Addressed in the Remand Consultation

NOAA also reviewed new scientific information regarding the effects of implementing the RPA, as modified, on the listed Southern Resident Killer Whale DPS and the listed Southern Resident DPS of North American Green Sturgeon and reaffirmed its concurrence with the Action Agencies' determination that the RPA "may affect, but is not likely to adversely affect" the Southern Resident Killer Whale DPS and the Southern Resident DPS of North American Green Sturgeon. NOAA also concurred in the Action Agencies' determination that implementation of the RPA "may affect, but is not likely to adversely affect" designated critical habitat for North American Green Sturgeon. (Sections 5.3, 6.2.3 of the 2014 Supplemental BiOp)

During the remand period, the Action Agencies developed and submitted a Biological Assessment on the effects of implementing the 2008 RPA, as amended by the 2010 Supplemental BiOp, on southern DPS eulachon and critical habitat. The Action Agencies concluded the RPA "may affect, but is not likely to adversely affect" this listed species and "may affect, but is not likely to adversely affect" its designated critical habitat. Upon review of the Biological Assessment, NOAA did not concur with the Action Agencies' determinations and instead developed a formal BiOp that is included in the 2014 Supplemental BiOp. NOAA concluded that the 2008 RPA, as amended by the 2010 and 2014 Supplemental BiOps, is not likely to jeopardize the continued existence of southern DPS eulachon or result in the destruction or adverse modification of its designated critical habitat. (Section 7.7 of the 2014 Supplemental BiOp)

During implementation of the 2008 FCRPS BiOp RPA, as amended by the 2010 Supplemental FCRPS BiOp, and re-initiation of formal consultation leading to the 2014 Supplemental FCRPS BiOp, BPA has provided information and analysis to NOAA and reviewed NOAA's analyses and reasoning, as well as the new information considered by NOAA during the remand consultation. BPA is not aware of any additional information, not considered by NOAA in formulating its BiOp, which calls into question NOAA's findings and conclusions in the 2014 Supplemental

[14] *See* 50 C.F.R. § 402.02 (definition of "Reasonable and prudent alternatives").

FCRPS BiOp.[15] Finally, NOAA released a draft BiOp for public comment in September 2013 and addressed these comments in its January 17, 2014 memorandum entitled "NOAA Fisheries Responses to Comments from the Sovereign Review of the 2013 Draft Supplemental Biological Opinion" as well as in the final 2014 Supplemental FCRPS BiOp. These documents present a reasoned consideration of diverse views and explain the approach taken in the 2014 Supplemental FCRPS BiOp. Based on all of the foregoing, and for the reasons discussed in further detail in Section III(B), below, BPA concurs with NOAA's conclusions that implementation of the RPA, as amended by the 2014 Supplemental FCRPS BiOp, is not likely to jeopardize the continued existence of listed salmon, steelhead, or eulachon covered in this consultation or destroy or adversely modify their critical habitat.[16]

BPA has also reviewed and concurs with NOAA's determination that the terms and conditions in the 2014 Supplemental Incidental Take Statement for salmon and steelhead and the 2014 Incidental Take Statement for southern DPS eulachon minimize the impact of incidental take of these listed species associated with implementation of the FCRPS BiOp and RPA.[17] BPA further concludes that the terms and conditions involve only minor changes to the proposed RPA contained in the Action Agencies' 2007 Biological Assessment and do not alter its basic design, location, scope, duration or timing.[18]

B. BPA Concludes Implementation of the RPA is Not Likely to Jeopardize Listed Species or Result in Destruction or Adverse Modification of their Designated Critical Habitat

Section 7(a)(2) of the Endangered Species Act requires federal agencies to ensure that the actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.[19] In an ESA consultation in which the underlying proposed action is likely to cause jeopardy or adverse modification, NOAA must suggest a Reasonable and Prudent Alternative (RPA) action that "can be implemented in a manner consistent with the intended purpose of the action[] . . . [and] with the scope of the Federal agency's legal authority and jurisdiction, . . . is economically and

[15] Subsequent to NOAA's issuance of the 2014 Supplemental FCRPS BiOp, the ISAB released two reports: 1) Review of the Proposed Spill Experiment, and 2) Review of the Expert Regional Technical Group (ERTG) Process for Columbia River Estuary Habitat Restoration. Although this constitutes new information, it is consistent with or supports NOAA's findings and conclusions in the 2014 Supplemental FCRPS BiOp.

[16] *See* ESA Section 7(b)(3)(A), *codified at* 16 U.S.C. § 1536(b)(3)(A).

[17] *See* 50 C.F.R. § 402.14(i)(1)(ii) , (iv).

[18] *See* 50 C.F.R. § 402.14(i)(2).

[19] 16 U.S.C. § 1536(a)(2).

technologically feasible, and . . . avoid[s] the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat."[20] In light of the FCRPS consultation history, the Action Agencies developed the current FCRPS BiOp RPA collaboratively with NOAA.

To mitigate for the effects of the operation of the FCRPS on listed species, the RPA incorporates an "All-H" approach, which consists of onsite hydrosystem configuration and operational adjustments combined with offsite habitat improvement, hatchery reform and predation reduction measures, as well as research, monitoring, evaluation, and adaptive management. The RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, establishes objectively measurable performance standards and targets, which serve as substantive benchmarks of sufficient mitigation for listed species, and a specific timeline for implementing those mitigation actions. The RPA also requires the Action Agencies to submit regular reports to NOAA on implementation progress, to conduct ongoing research, monitoring, and evaluation of the biological effectiveness of mitigation actions, and to manage implementation of the RPA adaptively as new information about mitigation action effectiveness emerges. All of these aspects of the RPA facilitate transparency and Action Agency accountability for fulfilling BiOp commitments and, ultimately, the RPA meets the Action Agencies' ESA responsibility to ensure operation of the FCRPS, including implementation of the RPA's mitigation actions, is not likely to jeopardize the continued existence of listed species and is not likely to destroy or adversely modify critical habitat.[21] In other words, the RPA does not reduce appreciably the likelihoods of the listed species' survival and recovery.

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[20] 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.02 (defining "Reasonable and prudent alternative[]").

[21] In 2011, the United States District Court for the District of Oregon remanded the 2010 Supplemental FCRPS BiOp with instructions to continue implementing the BiOp and RPA through 2013 but to develop a new or supplemental BiOp identifying specific habitat mitigation actions for the period 2014-2018. *National Wildlife Federation v. National Marine Fisheries Service*, 839 F.Supp.2d 1117, 1131-1132 (D.Or. 2011). In the 2008 BiOp and 2010 Supplemental BiOp, NOAA had concluded that implementation of the RPA through 2018 avoided the likelihood of jeopardy or adverse modification. Those BiOps relied on previous Action Agency Implementation Plans that had identified specific mitigation actions for implementation through 2013, including habitat improvement actions, with the understanding that the Action Agencies would develop additional Implementation Plan going forward, per the schedule in the RPA that would identify additional habitat improvement actions for implementation during the period 2014-2018. On review, the Court held that NOAA's reliance for its jeopardy and adverse modification determinations on the anticipated beneficial effects of post-2013 habitat actions was unreasonable because the effects of "unidentified" projects were "not reasonably certain to occur." *Id.* at 1125-1126. Accordingly, in their 2014-2018 Implementation Plan, the Action Agencies have identified lists of specific tributary and estuary habitat improvement actions for implementation during the period 2014-2018 and the biological benefits of implementing such actions under the habitat RPA actions. In its 2014 Supplemental FCRPS BiOp, NOAA has determined, and BPA concurs, that the habitat RPA actions, including the lists of habitat actions identified under the RPA, comply with the District Court's remand order directing NOAA to rely only on the beneficial effects of habitat mitigation actions that are "reasonably certain to occur".

1. The Action Agencies Have Successfully Implemented the RPA Actions and are on Track to Complete Implementation of the RPA Actions by 2018

As Documented in the 2013 Comprehensive Evaluation and 2014-2018 Implementation Plan, the Action Agencies have demonstrated significant progress in implementing RPA actions and, especially with respect to habitat, have expanded their capacity to implement more projects over a larger area. This progress is described in detail in the 2013 Comprehensive Evaluation and includes improvements to bypass systems at Lower Monumental and McNary dams, completion of a spill wall that has been shown to increase juvenile fish survival at The Dalles Dam and the continued success of surface passage systems at all federal dams on the lower Snake and Columbia Rivers. Halfway through the BiOp term, the Action Agencies and their partners have already met or exceeded habitat improvement goals for more than half the covered salmon and steelhead populations. This includes improvements to more than 200 miles of streams and more than 6,800 acres of riparian habitat and improved access to more than 2,000 miles of spawning and rearing habitat that was previously blocked or difficult for fish to reach. Habitat improvements in the Columbia River estuary have also accelerated, with almost 4,000 acres of estuary floodplain protected and restored. Further, an extensive program of research, monitoring and evaluation is underway and preliminary results indicate that actions under the BiOp are providing benefits for fish. Based on the additional actions underway and outlined in the 2014-2018 Implementation Plan, the best available scientific data and commercial information demonstrates that the Action Agencies will achieve full implementation of the RPA by 2018. Further evidence of implementation progress is discussed in the following sections.

2. RM&E Demonstrates that Hydrosystem Operations Under the RPA Benefit the Listed Species

The 2008 BiOp and RPA call for improving juvenile and adult fish passage survival through the FCRPS. Operations under the BiOp have provided flow augmentation from storage reservoirs, which has increased water velocity and smolt migration speed, reducing travel time through the system of dams and thereby reducing exposure to predators. Monitoring results and performance tests indicate that the new configuration and operation of dams have improved juvenile fish survival through the FCRPS to levels roughly comparable to those realized decades ago, when fewer dams were in place. Annual estimates indicate an upward trend in survival of juvenile steelhead and yearling Chinook salmon migrating through the Snake and Columbia rivers over the last two decades. Analyses indicate that this is a result of collective management actions implemented at individual dams and system-wide. Results of performance testing based on the best available science indicate that overall juvenile fish survival using the BiOp spill program is now on track to meet BiOp survival performance standards for dam passage (96% and 93%, for spring and summer migrants, respectively).

The 2014 Supplemental BiOp continues the approach taken in the 2008 BiOp and RPA. Spill operations are finely tuned and tested to the unique characteristics of each dam, balancing adult and juvenile fish passage needs, and are a foundational element in the federal strategy to pass juvenile salmon and steelhead safely through federal hydro projects on the lower Columbia and Snake rivers. Hydrosystem operations combine scientifically-designed spill operations with surface passage and other structural changes (such as bypass outfall improvements) to increase juvenile fish survival beyond what conventional spill alone can achieve. As described in the Action Agencies 2014-2018 Implementation Plan, improvements and testing are scheduled to be completed by 2018. The review of Performance Standard test results will follow the steps outlined in the FCRPS Juvenile Dam Passage Performance Standard Testing and Metrics paper.[22]

In recent Comparative Survival Study (CSS) Annual Reports, Tuomikoski et al. (2011, 2012, 2013) hypothesize that substantially increasing spill levels (which reduce exposure of juveniles to juvenile bypass systems and turbines) would substantially increase both inriver smolt survival and smolt to adult return (SAR) rates (ocean survival). In comments on the Implementation Plan and the Draft BiOp, several parties have recommended that the region design and implement a large-scale operational study, increasing spill to 125% Total Dissolved Gas (TDG) levels to evaluate this hypothesis, and that NOAA amend the FCRPS BiOp to include SAR as a BiOp hydro performance standard. (Section 3.3.3.5 of 2014 Supplemental BiOp)

In the 2014 Supplemental BiOp, NOAA did not adopt SAR as a hydro performance standard (see Section 3.3.3) because most of the mortality in this life stage occurs in the estuary and ocean, outside of the FCRPS. The degree to which mortality in the estuary and ocean is caused by the prior experience of juveniles passing through the FCRPS (*i.e.*, delayed or latent mortality) is unknown and hypotheses regarding the magnitude of this effect vary greatly (*e.g.*, ISAB 2007a).

The proposed spill test would depart significantly from what NOAA evaluated in the 2008 BiOp and called for in the 2014 Supplemental BiOp. The RPA's approach to improve juvenile survival (by making structural improvements at the dams combined with spill tailored for each unique dam) is showing positive results as expected in the 2008 BiOp. The proposed spill test is not biologically justified and would change course and significantly alter dam operations part way through implementation of the BiOp's comprehensive plan to improve juvenile survival. NOAA did not amend the RPA to adopt the proposed spill test in the 2014 Supplemental BiOp, noting that "several substantial weaknesses in the analysis exist that would need to be resolved prior to further consideration of any operational study of this magnitude." BPA concurs with these findings. (Section 3.3.3.5 of 2014 Supplemental BiOp)

[22] Federal Columbia River Power System Juvenile Dam Passage Performance Standard and Metrics, August 2012, *at* http://www.salmonrecovery.gov/Files/BiologicalOpinions/2012/Performancestandardspaper.pdf.

The Northwest Power and Conservation Council's Independent Scientific Advisory Board independently reviewed the proposed spill test in February 2014 and, like NOAA, concluded that the proposal lacks sufficient details and analysis. The ISAB noted in its report (ISAB 2014-2) that the proposal involves significant uncertainties and risks of unintended consequences such as adverse effects of dissolved gas, increased delay of juvenile fish, increased predation and fallback of adult salmon and steelhead. Given its shortcomings, the test may not produce enough information to justify its cost, the ISAB said. The ISAB also called for further scrutiny of the analyses and models used to justify the test, noting that they depend heavily on correlations "which do not by themselves determine cause and effect." In addition, the ISAB indicated it is unlikely that spill could be isolated as the cause of changes in SARs given the confounding variables such as ocean conditions that also affect returns. BPA has reviewed and agrees with the NOAA and ISAB conclusions that the spill test is not justified.

In addition, increased spill, without being carefully calibrated at each dam, can have detrimental effects such as: elevating dissolved gas beyond the current CWA standards and to levels that can harm fish (See Section D3 below); delaying adult migration timing by affecting hydraulic conditions; increasing the number of adults that fall back over some dams, requiring fish to ascend ladders a second time; creating eddies below dams that trap juvenile fish, exposing them to predators by delaying downstream egress; and drawing juveniles from surface passage routes that are generally safer and faster.

The 2008 FCRPS BiOp RPA contained a provision to transition from spring to summer spill operations when subyearling Chinook juveniles exceed 50% of the collection for a 3-day period for each Snake River project after June 1. Some regional fishery co-managers objected to this criterion, however, because it was largely influenced by hatchery-released summer migrants. To address this concern, NOAA included a new criterion in the 2014 Supplemental BiOp so that the transition will be based on the estimated 95% passage date of wild spring migrating smolts (or in the case of sockeye, combined hatchery and wild smolts). Like the 2008 BiOp, the 2014 Supplemental BiOp also allows the use of Snake River fall Chinook salmon juvenile abundance triggers to end spill at the Snake River dams in August, which is a change from operations directed by court orders in 2011 and earlier. These changes are not expected to result in significant changes in survival from what has been observed since 2008. (See Federal Columbia River Power System Improvements and Operations Under the Endangered Species Act – A Progress Report.) The differences between spring and summer spill levels at the Snake River dams (with the exception of Lower Monumental Dam) are generally very small (0 to 2 kcfs); the differential effect resulting from the changes in spill level are likely small (survival rates between the two operations are likely to be very similar); and the proportion of SR spring/summer Chinook salmon, fall Chinook salmon, sockeye salmon or steelhead smolts likely to be affected by the change in operation are small (less than 5% for spring migrating fish affected by the spring-to-summer spill transition and less than 1% for summer migrating fall Chinook salmon affected by ending spill prior to August 31).

Juvenile survival through the FCRPS represents only one piece of the picture. The 2014 Supplemental BiOp continues to call for barge transportation to move juvenile fish safely past the dams. Broad improvements in the survival of juvenile salmon through the FCRPS have reduced, but not eliminated, the relative benefit of barge transportation. Recent analyses of adult returns indicates that during most of the year, spring-migrating Snake River Chinook salmon and steelhead that are transported as juveniles return at higher rates as adults than their counterparts that migrated through the FCRPS. The ISAB identified a list of uncertainties regarding the benefits of transportation and recommended a strategy to spread the risk between transport and inriver migration. The 2014 Supplemental BiOp clarifies that the goal is to transport 50% of the fish to implement this spread-the-risk strategy.

3. The Action Agencies Have Developed a Reliable Program for RPA Implementation

Halfway through the term of what was originally designed as a ten-year BiOp, the Action Agencies have developed a reliable program that demonstrates the likelihood that the RPA implementation, as described in the 2014-2018 Implementation Plan, will achieve the FCRPS BiOp targets, and, thereby, not reduce appreciably the likelihoods of the listed species' survival and recovery. Cornerstones of this program include a mature adaptive management process that incorporates best available science as it evolves, extensive regional collaboration and consensus regarding implementation methodology, and sophisticated tracking processes for project funding and implementation.

a. The Action Agencies Manage Implementation Adaptively as New Information Becomes Available through Research, Monitoring, and Evaluation (RM&E)

The RPA includes an adaptive management component, under which the Action Agencies adjust implementation actions in response to new information and study results obtained through an extensive program of RM&E. This flexible framework helps ensure the Action Agencies incorporate ongoing scientific and technical advances into the selection and implementation of mitigation actions, applying the results of the latest research and best available science to adjust and refine strategies and actions to maximize benefits for listed species and allowing for course corrections to achieve the BiOp's performance standards and targets. Halfway through the term of what was originally a ten-year BiOp, the Action Agencies have developed and refined adaptive management of the RPA, with a documented track record of adjusting program implementation to achieve results and a detailed plan in the 2014-2018 Implementation Plan to continue this process through the expiration of the BiOp.

b. The RPA Continues to Benefit from Ongoing Dialogue and Collaboration Among the Action Agencies, States, and Tribes, Including Support from the Columbia Basin Fish Accords

The FCRPS BiOp and RPA were developed with extensive regional collaboration, and RPA implementation continues to benefit from the significant regional and scientific consensus that is an outgrowth of this collaborative effort. Regional forums include the Regional Implementation Oversight Group, which consists of senior policy representatives from five federal agencies, four states, and nine tribes and serves as a policy forum for interagency discussion and coordination of actions to benefit salmon and steelhead in the Columbia River basin, and the System Configuration Team and Technical Management Team, which consist of technical representatives from regional sovereigns and assists in prioritizing dam configuration actions and making in-season recommendations on dam and reservoir operations, respectively. To inform the Action Agencies' implementation of RPA actions related to habitat, the Action Agencies work closely with states, tribes, and local experts throughout the Pacific Northwest who are familiar with local tributary watersheds and the estuary to identify, evaluate, develop and implement habitat actions. Related processes, such as the Northwest Power and Conservation Council's Fish and Wildlife Program, help inform and guide fish and wildlife improvements in the Basin. Finally, the memoranda of agreement formed with states and tribes (referred to collectively as the Columbia Basin Fish Accords) continue to support BiOp implementation, securing over $900 million in BPA funding for habitat restoration and protection projects and other actions directly benefiting listed and other species in the Columbia River Basin over a period of ten years.

c. The Action Agencies Use Best Available Science to Implement the Tributary and Estuary Habitat Programs, Which Includes Reliance on Expert Judgment

The 2014 Supplemental BiOp supports a rigorous system for reviewing the benefits of habitat improvement programs in the tributaries and estuaries based on the best available science and expert judgment. This system draws on recent research and local expertise to assure that the Action Agencies undertake habitat projects that benefit listed salmon and steelhead and that the projects deliver the expected benefits by addressing factors limiting survival, called limiting factors.

i. Tributary Habitat Expert Panels

The approaches in the tributaries and estuary differ slightly, although many of the principles are the same. In the tributaries, the Action Agencies convene panels of experts with knowledge of local habitat to review prospective and completed projects. This approach was designed during development of the BiOp by a Habitat Collaboration Workgroup (HCW), which reviewed the latest science and biological modeling approaches. Several months of discussion by the HCW

led to a structured process for estimating improvements in habitat quality and resulting survival benefits by combining the best available science with the professional judgment of the expert panels. The Action Agencies provide the experts with a large range of detailed habitat information and research results to draw upon. The information includes subbasin plans developed for the Northwest Power and Conservation Council's Fish and Wildlife Program, recovery plans for listed species, reach assessments completed by Reclamation, relevant research on the relationship between fish survival and habitat condition and the latest results of extensive research, monitoring and evaluation efforts under the BiOp. The experts apply this information in conjunction with their own expertise to estimate, in advance, the degree to which habitat projects alleviate limiting factors. Following completion of each project, the panels review the results as well as any relevant new information or research to confirm the project's benefits or adjust their earlier estimate. The Action Agencies then use a mathematical procedure described in Section 3.1.1 of the 2014 Supplemental BiOp to convert the changes in limiting factors as estimated by the expert panels into a specific percentage of habitat quality improvement, the BiOp's yardstick for measuring habitat benefits. Habitat quality improvements represent survival improvements as called for by the BiOp.[23] The 2014 Supplemental BiOp reviewed this approach and confirmed that it "represents a cause-and-effect chain of events that links the completion of habitat improvement actions to changes in habitat functions." (Section 3.1.1.6.3 of 2014 Supplemental BiOp)

The inclusion of expert judgment in this process is warranted given that detailed empirical information regarding habitat conditions is not available for all of the areas where habitat improvements are taking place. The expert panels draw on what empirical information is available and the RM&E program under the BiOp is rapidly developing additional information that is also available to the panels. In the 2014 Supplemental BiOp, NOAA concluded that the approach used to estimate the benefits of habitat improvements "is based on the best available scientific information from fish and habitat experts and on general empirical relationships between habitat quality and salmonid survival[]" and that the approach "represents the best available scientific information that can be consistently applied over the larger Columbia basin to estimate the survival response of salmonids to habitat mitigation actions." (Section 3.1.1.9 of 2014 Supplemental BiOp) BPA concurs with NOAA's evaluation and conclusions.

The Action Agencies have accelerated their habitat improvement program to meet BiOp targets and have developed detailed plans for implementation of tributary habitat actions through 2018. The Action Agencies have also used adaptive management to adjust strategies as needed to ensure that the habitat improvement actions deliver the expected benefits. These adjustments include improved stakeholder engagement and support for actions that target key

[23] For further details, see Science and the evaluation of habitat improvement projects in Columbia River tributaries, March 2013.

limiting factors and have helped to enhance local capacity to implement those actions. The Action Agencies have also expanded their relationships in planning, implementation, monitoring, and evaluation with regional partners, and BPA agrees with NOAA's finding in the 2014 Supplemental BiOp that these developments "have enhanced the ability of the Action Agencies and regional partners to plan, develop, prioritize, implement, monitor, and evaluate habitat improvement actions that target the most important factors limiting the growth and survival of anadromous fish in the locations where they will yield the most benefit." (Section 3.1.2.2.5 of 2014 Supplemental BiOp)

ii. Estuary Habitat Expert Regional Technical Group

The method for evaluating the benefits of habitat improvement projects in the estuary is similar to that in the tributaries in that it also combines expert judgment with the latest science on the way salmon and steelhead use estuary habitat. In this case the expert panel, called the Expert Regional Technical Group (ERTG), includes scientists with expertise in habitat rehabilitation and estuarine science. The ERTG scores prospective habitat projects on three factors with the potential to influence fish survival: the certainty of the project's success, its accessibility to fish, and the capacity of the habitat to support fish. The ERTG developed a standard algorithm to convert the scores into Salmon Benefit Units (SBUs), a gauge of improved fish survival, based on established scientific principles. The standardized process provides for increased objectivity, consistency, repeatability, and transparency in gauging the benefits of habitat improvements in the estuary.[24] As stated in the 2014 Supplemental BiOp, the "ERTG method combines quantitative metrics with professional judgment, which is applied within a documented process by a group of scientists who are experts in the subject matter." BPA agrees with NOAA's conclusion in the 2014 Supplemental BiOp that "[t]his method for determining the efficacy of estuary habitat actions uses the best science available."

In a review of the ERTG Process in early 2014 (ISAB 2014-1), the ISAB recognized the scientific qualifications of ERTG members and noted the advantage of the ERTG process in providing "structured and transparent decision making." But the ISAB also identified opportunities for improvement in the ERTG process through the use of improved data on how salmon and steelhead use estuary habitat. Indeed, the ERTG process was designed to combine expert judgment with the latest science in light of the limited empirical data available on salmon and steelhead use of estuary habitat at the time. The 2008/2010 BiOp and the 2014 Supplemental BiOp expect that the Action Agencies will incorporate the results of RM&E in the estuary as well as science recommendations, such as those from the ISAB, through adaptive management to strengthen the ERTG process. The ISAB review noted that the Columbia Estuary Ecosystem

[24] For further details see Benefits of Habitat Improvements in the Lower Columbia River and Estuary: Results of Research, Monitoring, and Evaluation.

Restoration Program (CEERP) strategy developed by the Corps and BPA includes improving estimates of salmon density and addressing uncertainties in the ERTG process, "and these efforts are likely to lead to future improvements in the ERTG Scoring Criteria." The ISAB conclusions generally support NOAA's finding that the ERTG process incorporates the best science available and the ISAB results will inform the ERTG process through adaptive management.

The estuary habitat program has expanded in concert with emerging science to pursue additional habitat projects that are designed to provide greater benefit to fish, based on research and ERTG advice. For instance, the Action Agencies have sought out projects that improve larger, intact areas of habitat close to the mainstem, because research indicates that such projects provide proportionally greater benefits for fish. In the 2014 Supplemental BiOp, NOAA finds that the Action Agencies have now demonstrated the ability to implement such larger projects and that the Agencies have outlined a credible strategy for achieving SBU targets by 2018. BPA agrees with NOAA's conclusion that "the estuary habitat mitigation measures are likely to be effective and, when combined with the remaining actions set forth in the RPA, are likely to avoid jeopardizing the continued existence of the listed species or the destruction or adverse modification of designated critical habitat." (Section 3.2.2.3 of the 2014 Supplemental BiOp)

d. BPA Has Sufficient Management Systems to Track and Assure Progress in the Habitat Improvement Programs

In recent years BPA has invested in the development of computerized management systems, called Pisces and Taurus, to facilitate tracking of funds and project completion and to ensure that funded projects address the specific limiting factors identified by expert panels. The system provides additional accountability and transparency in the use of funds, which in turn yields increased confidence that the work funded by BPA is directly related to actions that will improve the conditions of limiting factors. Most of the information is publicly accessible through the website www.cbfish.org, which is the public portal for the Taurus system. The additional detail provided by these systems also provide for more effective "roll-up" of all habitat improvement metrics, improving BPA's ability to track and report progress toward BiOp goals. NOAA found that the systems provide "additional accountability and transparency in implementation." (Section 3.1.2.2 of the 2014 Supplemental BiOp)

4. The RPA Habitat Actions Are Designed to Account for the Anticipated Future Effects of Climate Change

In the 2014 Supplemental BiOp, NOAA reviewed new scientific information pertaining to climate change since the 2008 BiOp and 2010 Supplemental BiOp, and compared that information to the 2008 BiOp's analytical assumptions. BPA has reviewed this new information as well and agrees with NOAA's finding that the types of monitoring and adaptation actions

implemented through the RPA are consistent with the types of adaptation in scientific literature (*e.g.*, riparian restoration to reduce stream temperatures). Based on this review of new scientific information, BPA agrees with NOAA's conclusion in the 2014 Supplemental BiOp that new information on the likely effects of climate change is consistent with the information considered in the 2008 BiOp and 2010 Supplemental BiOp. (Section 2.1.4.6 and Appendix D of the 2014 Supplemental BiOp)

Based on this review, BPA concludes that implementation of the 2008 FCRPS BiOp RPA, as amended by the 2010 and 2014 Supplemental BiOps, ensures that operation of the FCRPS is not likely to jeopardize the continued existence of listed species or destroy or aversely modify their critical habitat.[25]

C. The Action Agencies Will Engage in ESA Consultation for Post-2018 Operation and Maintenance of the FCRPS

The current consultation in the 2014 Supplemental BiOp encompasses operation of the FCRPS for the period 2014-2018. This decision to implement the FCRPS BiOp and RPA is therefore a decision to implement RPA Actions through 2018. The Action Agencies intend to initiate consultation with NOAA prior to the expiration of the 2014 Supplemental BiOp with respect to system operations and any related mitigation actions for 2019 and beyond. As the next consultation will commence before the current FCRPS BiOp and RPA is fully implemented, the Action Agencies and NOAA will consider adjustments in the timing and content of remaining implementation plans, annual progress reports and comprehensive evaluations called for in the current RPA. BPA concurs with NOAA's findings and conclusions in the 2014 Supplemental BiOp that "[s]uch flexibility and modifications are inherent in the RPA and consistent with the purposes served by RPA Actions 1-3, as the modifications would continue to provide NOAA with a comprehensive assessment of both past and planned implementation of the RPA" and that "such flexibility or modifications would be appropriate and consistent with the purposes and policies of ESA Section 7." (Section 1.3 of the 2014 Supplemental FCRPS BiOp)

D. BPA Concludes Implementation of the RPA is Consistent with Other Federal Laws and Responsibilities

1. National Environmental Policy Act (NEPA)

BPA's ROD to implement the 2008 FCRPS BiOp describes how several existing BPA programmatic NEPA documents provide the environmental analysis of the effects of implementing BPA's activities described in the 2008 BiOp, plus the terms and conditions of the

[25] *See* ESA Section 7(a)(2), *codified at* 16 U.S.C. § 1536(a)(2).

BiOp's Incidental Take Statement. These existing NEPA documents include the System Operation Review Environmental Impact Statement (EIS), Wildlife Mitigation Program EIS, Watershed Management Program EIS, Fish and Wildlife Implementation Plan EIS, and associated RODs. BPA therefore relied on these NEPA documents to implement the 2008 BiOp, RPA, and terms and conditions of the 2008 BiOp's Incidental Take Statement for salmon and steelhead, as well as the 2010 Supplemental FCRPS BiOp and terms and conditions of the 2010 Supplemental Incidental Take Statement for salmon and steelhead.

BPA continues to rely on these NEPA documents for its decision to implement the 2008 BiOp RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, the terms and conditions of the 2014 Supplemental Incidental Take Statement for salmon and steelhead, and the terms and conditions of the 2014 Incidental Take Statement for southern DPS eulachon, because these NEPA documents also provide the environmental analysis for the types of BPA activities identified in the 2014 Supplemental BiOp and included incidental take statements. For BiOp actions that are within the scope of these existing NEPA documents, BPA will determine whether the environmental effects of the actions are adequately covered by the existing NEPA documents and no further NEPA documentation is necessary, or whether it will prepare additional NEPA documentation. To the extent that long-term implementation of the BiOp identifies proposed actions in the future that are not covered by BPA's existing NEPA analyses, BPA will conduct additional environmental analyses, including any necessary NEPA documentation, as appropriate. In preparing its NEPA analyses, BPA also integrates other related and applicable environmental laws.

2. Northwest Power Act

a. Equitable Treatment

The Pacific Northwest Electric Power Planning and Conservation Act, *codified at* 16 U.S.C. §§ 839-839h (commonly known as the Northwest Power Act), requires that Bonneville exercise its FCRPS management responsibilities "in a manner that provides equitable treatment for . . . fish and wildlife with the other purposes for which such system and facilities are managed and operated."[26] The Northwest Power and Conservation Council has described equitable treatment as "meet[ing] the needs of salmon with a level of certainty comparable to that accorded the other operational purposes."[27] As described in the 2010 BPA ROD, BPA has historically provided equitable treatment on a system-wide basis primarily by implementing the Northwest Power and Conservation Council's Fish and Wildlife Program integrated with

[26] 16 U.S.C. § 839b(h)(11(A)(i). The Action Agencies operate the FCRPS to fulfill multiple purposes, such as flood control, fish mitigation, irrigation, and power production.

[27] Council Program 1992, Vol. II, p.9, *at* http://www.nwcouncil.org/media/63830/2_1_Intro.pdf.

relevant BiOps related to FCRPS operations. Implementation of the 2008 FCRPS BiOp's RPA, as amended through the 2010 and 2014 Supplemental FCRPS BiOps, continues this approach, and expands upon BPA's commitments to benefit fish and wildlife. Implementation of the 2008 FCRPS BiOp, as amended by the 2010 and 2014 Supplemental BiOps, therefore furthers BPA's contribution to manage the FCRPS equitably for both fish and power.

b. Protect, Mitigate, and Enhance Fish and Wildlife Consistent with the Northwest Power and Conservation Council's Power Plan and Fish and Wildlife Program

The Northwest Power Act also directs BPA to use its Bonneville Fund and authorities to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the FCRPS, in a manner consistent with the Northwest Power and Conservation Council's Power Plan and Fish and Wildlife Program, and the purposes of the Act, which include providing an adequate, efficient, economical, and reliable power supply.[28]

The Action Agencies' and NOAA's data and analysis supporting the 2008 FCRPS BiOp and the 2010 and 2014 Supplemental FCRPS BiOps show that implementing the RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, will provide measurable benefits for fish and marine species and will thus also help fulfill BPA's responsibilities under the Northwest Power Act to protect, mitigate, and enhance fish and wildlife. In particular, implementing the RPA remains consistent with the Northwest Power and Conservation Council's program and helps fulfill BPA's responsibilities under the Northwest Power Act because it:

- complements the existing and future activities of the Federal and the region's state and tribal fish and wildlife agencies (*e.g.*, the Lower Snake River Compensation Plan);[29]
- is based on and supported by the best available scientific knowledge, as evidenced, for example, by the CE;[30]
- is consistent with Indian tribes' rights (*e.g.*, Accords with three lower river treaty tribes, CRITFC, Shoshone Bannock, Colville, and Kalispel tribes);[31]
- provides for improved anadromous fish survival throughout the FCRPS;[32] and

[28] 16 U.S.C. § 839b(2), (h)(10)(A).

[29] *Cf.*, 16 U.S.C. § 839b(h)(6)(A).

[30] *Cf.*, 16 U.S.C. § 839b(h)(6)(B).

[31] *Cf.*, 16 U.S.C. § 839b(h)(6)(D).

[32] *Cf.*, 16 U.S.C. § 839b(h)(6)(E)(i).

- provides flows of sufficient quality and quantity between FCRPS facilities to improve production, migration, and survival of listed and unlisted anadromous fish, thus achieving sound biological objectives.[33]

As described in the 2008 BPA ROD, BPA generally seeks to fulfill its ESA obligations through projects reviewed by the Independent Scientific Review Panel and recommended by the Northwest Power and Conservation Council. Furthermore, the foundational elements of the 2008 FCRPS RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, namely, the RPA's flow, spill, transportation, configuration, habitat improvement, hatchery, and RM&E actions, either originated with the Northwest Power and Conservation Council's Fish and Wildlife Program or build on program measures addressing the same issues. BPA thus continues integrating its ESA activities with the Northwest Power and Conservation Council's program and processes and taking the Fish and Wildlife Program into consideration at each relevant decision point.

c. Adequate, Efficient, Economical, and Reliable Power Supply

As discussed in the 2008 and 2010 BPA RODs, implementation of the 2008 FCRPS BiOp RPA, as amended by the 2010 Supplemental FCRPS BiOp, posed significant challenges to BPA's ability to meet its responsibilities under the Northwest Power Act for fish and wildlife while also maintaining an adequate, efficient, economical, and reliable power supply. In summary, those RPA actions that reduce federal hydrosystem flexibility and output can increase the cost of electricity for BPA ratepayers,[34] reduce system capability available to address fluctuations in power needs, and limit the system's ability to integrate other renewable resources such as wind power. The 2014 Supplemental FCRPS BiOp does not significantly increase or decrease those challenges. As a result, the challenges and costs of operations to benefit fish remain as described in the 2008 and 2010 BPA RODs. These include direct costs of approximately $100 million annually associated with implementation of the FCRPS BiOp and Columbia Basin Fish Accords, as well as an estimated reduction in federal hydrosystem production by about 1000 annual average megawatts of electricity when compared to an operation without changes to benefit fish and constraints to the flexible operation of the hydrosystem. (Currently, the total average annual energy produced by the 14 FCRPS projects is approximately 8500 average annual megawatts. [source: BPA 2013 White Book])

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[33] *Cf.*, 16 U.S.C. § 839b(h)(6)(E)(ii).

[34] *See* Northwest Power and Conservation Council, 2012 Columbia River Mitigation Fish and Wildlife Program Costs Report: 12th Annual Report to the Governors, *at* http://www.nwcouncil.org/media/6867139/2013-04.pdf.

Implementation of the 2008 FCRPS RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, continues to balance appropriately between – and thereby remain consistent with – the various conflicting Northwest Power Act responsibilities, but calls for substantial additional spill by some parties in the region could upend this balance.

As discussed above in Section III(B)(2), during the consultation on remand resulting in the development of the 2014 Supplemental FCRPS BiOp, some public commenters proposed a "spill test" in their comments on the draft BiOp and the Action Agencies' supporting documents. The 2014 Supplemental FCRPS BiOp retains the 2008 BiOp's performance-based approach to achieve effective fish passage. Under this approach structural improvements at the dams are combined with spill levels which are adjusted and tailored to achieve the prescribed juvenile dams passage survival performance standards at each dam. Higher spill levels may not be necessary to achieve the BiOp performance standard but would certainly reduce hydrosystem output. To the extent the proposed "spill test" would further reduce generation of the hydrosystem or restrict its flexibility in meeting load, it would escalate the costs and intensify the challenges of maintaining an adequate, effective, economical, and reliable power supply. For example, maintaining the high spill levels – with no room between required spill and total dissolved gas limits – as suggested in the spill test would reduce flexibility in operations, likely limiting the hydro system's ability to integrate variable resources, and would likely impact transmission system reliability. As a result, new resources would be needed to provide balancing services for both existing and future variable renewable resources which would likely increase the cost to provide these resources.

This would be particularly problematic given the questionable biological benefit to listed and other aquatic species discussed above and BPA's obligation under the Northwest Power Act to balance fish mitigation, protection, and enhancement with an adequate, effective, economical, and reliable power supply.

d. In Lieu Provision

Under Section 4(h)(10)(A) of the Northwest Power Act, Congress expressly limited BPA's authority to provide protection, mitigation, and enhancement in the in-lieu provision, which states: "Expenditures of the Administrator pursuant to this paragraph shall be in addition to, and not in lieu of, other expenditures authorized or required from other entities under other agreements or provisions of law."[35] As explained by the House of Representatives' Interior Committee, "other fisheries efforts outside this Act . . . are expected to continue and to be

[35] 16 U.S.C. § 839b(h)(10)(A).

funded separately."[36] Thus, if another entity is authorized or required under other agreements or provisions of law to undertake an activity, BPA cannot fund the activity under the authority of section 4(h)(10)(A) unless BPA's funding is in addition to, not in lieu of that other entity's funding. The in-lieu provision helps ensure that BPA's funding for fish and wildlife protection, mitigation, and enhancement under section 4(h)(10)(A) supplements ongoing and future mitigation conducted by others rather than simply supplanting other efforts outside of the Northwest Power Act.

As it implements measures in the 2008 FCRPS BiOp RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, BPA will continue to comply with the in-lieu provision by taking several steps:

- For mitigation operations and maintenance and capital facilities costs at FCRPS dams and related hatcheries, BPA pays only the costs allocated to the power purpose of each dam, thus ensuring ratepayers do not fund mitigation for other project purposes or their beneficiaries.
- For offsite mitigation that BPA funds directly, also called "enhancement" in the Northwest Power Act,[37] BPA annually recoups from the U.S. Treasury an amount equal to the share allocable to the non-power purposes of the FCRPS dams, that is, the share other agencies would have had to secure through appropriations to cover the non-power costs.
- For their Columbia Basin Fish Accord projects, the Umatilla, Warm Springs, and Yakama tribes, and CRITFC have certified that the projects they implement are not authorized or required to be funded by any other entity.
- When the Northwest Power and Conservation Council made program-wide recommendations for fiscal years 2007-2009, BPA conducted extensive in lieu reviews of each project. Those recommendations, along with Columbia Basin Fish Accord projects, established the core of BPA's current portfolio of mitigation projects.[38]
- On an ongoing basis, BPA continues to examine projects for in lieu conflicts when considering whether to fund them initially or renew or expand them.

[36] H.R. Rep. No. 976, 96th Cong., 2d Sess., pt. 2, at 45. *See also* 126 Cong. Rec. H9846 (daily ed. Sept. 29, 1980) (Rep. Lujan: section 4(h)(10(A) would "insure that the program will not call for measures already being implemented to protect, mitigate, and enhance fish and wildlife").

[37] *See* 16 U.S.C. § 839b(h)(8)(A).

[38] *See* Bonneville Power Administration, Integrated Fish and Wildlife Program, FY 07-09 Fish and Wildlife Proposals Final In Lieu Ratings, *at* http://efw.bpa.gov/IntegratedFWP/docs/2007/FY07-09_FW_Final_in_lieu_ratings.pdf.

3. Clean Water Act

As described in the 2008 and 2010 BPA RODs, in developing the proposed RPA for the 2008 BiOp, the Action Agencies considered the respective ecological objectives of the ESA and the Federal Water Pollution Control Act, *codified generally as* 33 U.S.C. §§ 1251-1387 (commonly known as the Clean Water Act or CWA). The Action Agencies harmonize federal dams to be consistent with both ESA requirements, determined by NOAA and U.S. Fish and Wildlife Service, and water quality standards established under the Clean Water Act.

The U.S. Environmental Protection Agency (EPA) has delegated authority to the states of Washington and Oregon to set Total Dissolved Gas (TDG) levels under the CWA. Currently, the states apply the biologically-based national EPA criterion of 110% TDG as their state water quality standards. The 2014 FCRPS Supplemental BiOp includes flow augmentation and specific spill operations for fish passage to benefit ESA-listed fish at the Corps' mainstem Columbia and Snake River projects. The spill operations can sometimes generate TDG levels in excess of the 110%. The Corps is responsible for obtaining "waivers" from Oregon and Washington for generating TDG for a 12-hour average up to 120% at the project tailrace. Washington has an additional limit of 115% for a 12-hour average at the project forebay when conducting operations to benefit ESA-listed fish. Therefore, the Action Agencies plan FCRPS operations to comply with applicable state water quality standards and waivers and minimize excess TDG to the extent practicable.

Under the 2008 BiOp RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, the Action Agencies will continue to implement actions designed to improve water quality that will benefit ESA-listed species, such as reducing TDG and water temperature.

4. Magnuson-Stevens Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Section 305, NOAA makes conservation recommendations to mitigate adverse effects on essential fish habitat (EFH) of species regulated under federal fishery management plans. As part of the 2008 FCRPS BiOp, NOAA considered EFH designated by the Pacific Fisheries Management Council for Chinook and Coho salmon, groundfish, and coastal pelagic species. (2008 FCRPs BiOp, Section 15.2, p.15-4) The 2010 Supplemental FCRPS BiOp and 2014 Supplemental FCRPS BiOp do not amend NOAA's conservation recommendations. As one of the Action Agencies, BPA will continue to implement the 2008 BiOp RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, and thereby also implement NOAA's MSA conservation recommendations.

5. Tribal Treaty and Trust Responsibilities

BPA's ROD to implement the 2008 BiOp RPA describes how that decision furthers BPA's tribal treaty and trust responsibilities. BPA's commitment to implement the RPA in the 2008 FCRPS BiOp, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, continues action that helps fulfill the Federal tribal treaty and trust responsibilities. By implementing the RPA BPA avoids the likelihood of jeopardizing listed fish or destroying or adversely modifying their designated critical habitat, thus helping preserve the region's fisheries. BPA has also engaged tribes during the remand collaboration and made the extensive commitments to tribes through the ten-year Columbia Basin Fish Accords, both of which help tribes exercise their rights as co-managers of the fisheries in coordination with other resource managers in the region.

IV. Decision

It is my decision that BPA has the authority and discretion and will, in cooperation with the other Action Agencies, to implement the 2008 FCRPS BiOp and RPA, as amended by the 2010 and 2014 Supplemental FCRPS BiOps, through 2018. This decision includes a commitment to abide by the terms and conditions in: (1) the 2008 FCRPS BiOp's Incidental Take Statement for salmon and steelhead, as amended by the 2010 and 2014 Supplemental Incidental Take Statements for salmon and steelhead; and (2) the 2014 Supplemental FCRPS BiOp's Incidental Take Statement for southern DPS eulachon.

This decision is based on review and consideration of multiple sources, including: the 2008 FCRPS BiOp and supporting documents; the 2008 BPA ROD; the AMIP; the 2010 Supplemental FCRPS BiOp and supporting documents; the 2010 BPA ROD; the 2011 Amended BPA ROD; implementation of the 2008 BiOp and RPA as amended by the 2010 Supplemental BiOp; the 2014 Supplemental BiOp and supporting documents, analysis, and new information; collaboration with and comments from federal and state agencies and tribes and interested persons and entities provided on documents such as the 2013 Comprehensive Evaluation; the 2014-2018 Implementation Plan; the Annual Progress Reports and annual Fish Operations Plans; and the information provided by parties to *National Wildlife Federation v. National Marine Fisheries Service* contained in pleadings, including motions, briefs, and declarations, and the full administrative record for this decision on file with BPA.

Implementation of the FCRPS BiOp and RPA requires a significant commitment of resources from the region's ratepayers, including spill and flow augmentation, repayment to the Treasury for configuration improvements, extensive support for RM&E of the system and off-site measures, and new actions within our already extensive off-site mitigation program. These actions, taken together, will meet BPA's responsibilities under the ESA to ensure operation of the FCRPS is not likely to jeopardize the continued existence of listed species that are the subject of this consultation, reduce appreciably the likelihoods of both survival and recovery, or

result in the destruction or adverse modification of their designated critical habitat. These actions also further BPA's commitment to meet its responsibilities under the Northwest Power Act to protect species, and they are consistent with BPA's multiple statutory authorities.

Issued in Portland, Oregon, this _27th___ day of __February _____ 2014.

BONNEVILLE POWER ADMINISTRATION

By: ____/s/ Elliot E. Mainzer_____
Elliot E. Mainzer
Administrator and Chief Executive Officer

Attachments:

A – BPA 2008 ROD Following the 2008 FCRPS BiOP
B – BPA 2010 Supplemental ROD Following the 2010 FCRPS Supplemental BiOp
C – BPA 2011 Supplemental ROD Following the 2011 Court Remand Order

Attachment A

BONNEVILLE POWER ADMINISTRATION

RECORD OF DECISION

following the

MAY 2008 NOAA FISHERIES
FCRPS BIOLOGICAL OPINION

on

OPERATION

of the

FEDERAL COLUMBIA RIVER POWER SYSTEM,

11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,

and

ESA SECTION 10 PERMIT FOR JUVENILE FISH TRANSPORTATION
PROGRAM

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ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

Action Agencies	U. S Department of the Interior Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers, Bonneville Power Administration, the agencies responsible for management and operation of federal hydroelectric projects in the Columbia and Upper Snake Rivers
Adaptive Management	The process of adjusting management actions and/or directions based on new information.
Anadromous Fish	Species that are hatched in freshwater migrate to and mature in salt water and return to freshwater to spawn.
BA	Biological Assessment
Biological Assessment	The Action Agencies' analysis of impacts of their proposed actions on species listed and proposed to be listed under the ESA. The Action Agencies produced biological assessments on projects in the Federal Columbia River Power System in the Columbia River and on projects in the Upper Snake River. See definition at 50 C.F.R. 402.02.
Biological Opinion	A document expressing NOAA Fisheries' opinion regarding whether and how a proposed action avoids jeopardy to listed species and the destruction or adverse modification of their critical habitat. See 50 C.F.R. § 402.02
BiOp	biological opinion
BPA	Bonneville Power Administration
Columbia Basin Accords	Agreements signed by the Action Agencies, four tribes, and two states to support the 2008 FCRPS BiOp and provide additional benefits to fish.
Comprehensive Analysis (CA)	The analysis conducted by the Action Agencies to assess impacts of proposed operation of major projects in the Federal Columbia River Power System (FCRPS). The CA provides the basis underlying the biological assessments on the FCRPS and Upper Snake projects.
Corps	U.S. Army Corps of Engineers
CRITFC	Columbia River Intertribal Fish Commission
Cumulative Effects	Effects of future State or private activities, not involving federal activities, that are reasonably certain to occur. See definition at 50 C.F.R. 402.02.
EFH	Essential fish habitat under the Magnuson Stevens Fisheries Management Act
EIS	environmental impact statement

Environmental Baseline	Past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private aactions which are contemporaneous with the consultation in process. See definition at 50 C.F.R. 402.02.
ESA	Endangered Species Act, 16 U.S.C. 1531 et seq.
ESA Recovery Plan	A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.
ESU	Evolutionarily Significant Unit
Evolutionarily significant unit (ESU)	A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other specific units and (2) represents an important component of the evolutionary legacy of the species.
FCRPS	Federal Columbia River Power System
Federal Caucus	Eight agencies operating in the Columbia River Basin that have natural resource responsibilities related to the Endangered Species Act (ESA). Through the Federal Caucus, these agencies coordinate their activities.
ICTRT	Interior Columbia Basin Technical Recovery Team
Jeopardize	to reduce appreciably the likelihoods of survival and recovery of a species listed as threatened or endangered under the ESA. See 50 C.F.R. § 402.02 (definition of "jeopardize")
Multipurpose Facilities	The Columbia River and the reservoir system are used for many purposes or uses. Projects that were authorized to serve a variety of purposes are referred to as "multipurpose."
NEPA	National Environmental Policy Act
NOAA Fisheries	National Marine Fisheries Service, an agency within NOAA
NW Power and Conservation Council	Pacific Northwest Electric Power and Conservation Planning Council, created under the Pacific Northwest Electric Power Planning and Conservation Act, which develops which develops power plans and a fish and

	wildlife programs to guide activities by the Bonneville Power Administration and other federal and nonfederal entities in the Pacific Northwest.
Prospective Actions	The four federal agency actions reviewed by NOAA's 2008 Supplemental Comprehensive Analysis and 2008 BiOps: operation and configuration of FCRPS projects, operation and configuration of Reclamation Upper Snake Projects, a permit to the Corps of Engineers to transport fish, and the United States v. Oregon Harvest Management Agreement (collectively described as the "Prospective Actions").
Reasonable and Prudent Alternative (RPA)	Recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the purposes of the action, that is consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that NOAA Fisheries believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat. See definition at 50 C.F.R. § 402.02.
Reclamation	U.S. Bureau of Reclamation
Recovery	Improvement in the status of a species to the point at which listing under the ESA is no longer appropriate.
ROD	Record of decision.
RPA	Reasonable and Prudent Alternative
Spill	Water released from a dam over the spillway instead of being directed through the turbines.
Supplemental Comprehensive Analysis	An analysis by NOAA Fisheries of the effects of three actions in the context of the environmental baseline and cumulative effects. The SCA provides the analysis underlying the evaluations in NOAA Fisheries' BiOps on operation of FCRPS projects, operation of Upper Snake River projects, and harvest activities under U.S. v. Oregon.
U.S. v. Oregon	Litigation under which federal, state, and tribal parties resolve differences respecting harvest levels of anadromous fish.

BONNEVILLE POWER ADMINISTRATION
RECORD OF DECISION
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MAY 2008 NOAA FISHERIES FCRPS BIOLOGICAL OPINION
on
OPERATION
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FEDERAL COLUMBIA RIVER POWER SYSTEM,
11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,
and
ESA SECTION 10 PERMIT FOR JUVENILE FISH TRANSPORTATION PROGRAM

I. Summary

This document records the Bonneville Power Administration's (BPA) decision to implement the Reasonable and Prudent Alternative (RPA) FCRPS action recommended by the May 5, 2008, the National Marine Fisheries Service (NOAA Fisheries) Biological Opinion (BiOp) on Operation and Configuration of Major Projects in the Federal Columbia River Power System (FCRPS), plus the measures, terms, and conditions provided in the BiOp's Incidental Take Statement. BPA's decision, like the 2008 FCRPS BiOp and products and activities leading to this decision, responds to opinions and orders by the federal District Court of Oregon and Courts of Appeal for the Ninth Circuit in the National Wildlife Federation v. National Marine Fisheries Service litigation, where these courts found fault with NOAA's previous 2004 FCRPS BiOp. It also responds to the regulations on Endangered Species Act consultation, which provide, "following issuance of a biological opinion, the federal agency shall determine whether or in what manner to proceed with the action in light of its section 7 [of the Endangered Species Act (ESA)] obligations and the Service's [National Oceanic and Atmospheric Administration (NOAA)] biological opinion." 50 CFR § 402.15(a).

II. Background

A. BPA Authorities and Responsibilities

The U.S. Army Corps of Engineers (Corps), U.S. Bureau of Reclamation (Reclamation), and Bonneville Power Administration (BPA) (collectively termed the Action Agencies) are responsible for ensuring their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. The Corps and Reclamation are authorized by Congress to operate and maintain the

projects referenced, for purposes of this consultation, as the Federal Columbia River Power System (FCRPS)[1]

Congress authorized, and the Federal Government completed construction of, the FCRPS projects. Congress also directed the Corps and Reclamation to operate and maintain these projects for multiple purposes, including flood control throughout the Columbia River Basin, navigation in the Columbia and Snake rivers; hydropower generation to serve the Pacific Northwest, irrigation, fish and wildlife, municipal and industrial water supply, and recreation. BPA is responsible for the marketing and transmission of the power generated from these projects.

The Federal Columbia River Transmission System Act designated the Bonneville Administrator "as the marketing agent for all electric power generated by federal generating plants in the Pacific Northwest, constructed by . . . the Bureau of Reclamation or the United States Corps of Engineers. . . ." 16 U.S.C. § 838f. BPA has a duty to provide the Pacific Northwest with "an adequate, efficient, economical and reliable power supply," 16 U.S.C. § 839(2). BPA must set rates having regard to the recovery of its costs and "with a view to encouraging the widest possible diversified use of electric power at the lowest possible rates to consumers . . . ." 16 U.S.C. § 838g; see also 16 U.S.C. § 825s. Congress directed BPA to set its rates,16 U.S.C. §§ 825s, 838g, and fulfill its other Northwest Power Act mandates in a sound and businesslike manner. 16 U.S.C. § 839f(b).

The Northwest Power Act directs the Administrator to protect, mitigate, and enhance fish and wildlife affected by Columbia River basin federal hydroelectric projects from which BPA markets power, consistent with the fish and wildlife program developed by the Northwest Power and Conservation Council (Council). 16 U.S.C. § 839b(h)(10)(A). BPA undertakes significant offsite enhancement of habitat for fish and wildlife and funds extensive hatchery activities and research programs under the Northwest Power Act as a part of an integrated program of activities for ESA-listed and non-listed species in a manner consistent with the Council's Fish and Wildlife Program and the ESA.

With regard to management of the FCRPS, the Northwest Power Act also requires BPA to "protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, affected by such projects . . . in a manner that provides equitable treatment for such fish and wildlife with the other purposes for

[1] For purposes of the 2008 FCRPS BiOp, the FCRPS comprises 14 federal multipurpose hydropower projects. There are 12 projects operated and maintained by the Corps, which are: Bonneville, The Dalles, John Day, McNary, Chief Joseph, Albeni Falls, Libby, Ice Harbor, Lower Monumental, Little Goose, Lower Granite, and Dworshak dams. Reclamation operates and maintains the following two FCRPS projects: Hungry Horse Project and the Columbia Basin Project, which includes Grand Coulee Dam. The FCRPS consultation also includes the mainstem effects of other tributary projects in the Columbia Basin.

which such system and facilities are managed and operated." 16 U.S.C. § 839b(h)(11)(A)(i). BPA provides equitable treatment on a system-wide basis primarily by implementing an integrated fish and wildlife program and relevant Biological Opinions.

Under section 7(a)(2) of the Endangered Species Act, federal agencies must "insure that any action authorized, funded, or carried out by such agency. . .is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species." 16 U.S.C. § 1536(a)(2). If a federal action may affect a listed species or critical habitat, the federal agency consults with the appropriate fish and wildlife agency, which will render an opinion as to whether the proposed action is likely to jeopardize the continued existence of the species or to adversely modify critical habitat. This process led to the Comprehensive Analysis Biological Assessments by the Action Agencies, and the Supplemental Comprehensive Analysis and Biological Opinions by NOAA.

B. The FCRPS Action

The May 5, 2008 NOAA FCRPS BiOp recommends an action – a reasonable and prudent alternative – with some changes from the action proposed by the FCRPS Action Agencies in their August 2007 FCRPS Biological Assessment. NOAA sets forth its RPA in the Reasonable and Prudent Alternative Table appended to the 2008 FCRPS BiOp.

The BiOp refers to the Action Agencies' Biological Assessment for additional information relevant to the RPA. The Action Agencies describe their proposed RPA in section 2 of their FCRPS Biological Assessment, "Summary of the Proposed Reasonable and Prudent Alternative," and Appendix B to the Biological Assessment, "Description of the Proposed Reasonable and Prudent Alternative."

The NOAA FCRPS BiOp RPA also takes into account May 2, 2008 Memoranda of Agreements reached among the Action Agencies and Indian tribes and states. The Memoranda of Agreement, or Columbia Basin Fish Accords, are the result of extensive collaboration among the signatory parties.

C. Chronology of Principal Documents Relevant to Decision

For easy reference, a chronological list of principal documents leading to this decision follows. The descriptions are those appearing on the federal Caucus' Salmon Recovery website at http://www.salmonrecovery.gov/index.cfm. The federal Caucus is a group of eight agencies operating in the Columbia River Basin that have natural resource responsibilities related to the ESA.

2005, 2006, 2007, and 2008: Collaboration. Federal agencies, States, and Tribes meet to discuss and endeavor to resolve issues and provide input as the

Action Agencies develop their biological assessments and NOAA Fisheries develops its biological opinions.

September 6, 2007: Biological Assessments. The Action Agencies made available their August 31, 2008 Biological Assessments of proposed reasonable and prudent alternatives for operation and configuration of the federal Columbia River Power System and the Upper Snake projects, including a Comprehensive Analysis of the impacts of these actions proposed for listed Columbia River Basin salmon and steelhead.[2]

October 31, 2007: Draft Biological Opinions. NOAA Fisheries released draft Biological Opinions for the federal Columbia River Power System and the Upper Snake projects. In the NWF v. NMFS litigation, the Court set Jan. 4, 2008, as the deadline for close of comment to NOAA Fisheries on these draft BiOps.

April 2008: Action Agencies Submit Addenda to their Comprehensive Analysis. The Action Agencies submitted two supplements to their Comprehensive Analysis of the effects of FCRPS and Upper Snake Project actions. To address possible effects on additional listed species, one Addendum is an "Analysis of Effects on Listed Killer Whale and Green Sturgeon Distinct Population Segments." To address prospective conclusion of agreements with Columbia River tribes and two Pacific Northwest states, the other Addendum is an "Analysis of Effects on Listed Columbia River Basin Salmon and Steelhead Populations from Proposed Memorandum of Agreement Actions."

May 2, 2008: Columba Basin Fish Accords. A ceremony celebrated the signing of the Columbia Basin Fish Accords, ending years of divisiveness on fish issues. The Action Agencies, four Northwest tribes and two States signed agreements for 10 years of projects that will deliver specific biological results for fish.[3]

May 5, 2008: Final Biological Opinions. NOAA Fisheries issued final biological opinions and a Supplemental Comprehensive Analysis for the federal Columbia River Power System and the Upper Snake projects and Columbia River harvest under U.S. v. Oregon. NOAA Fisheries finds that, with the actions in the FCRPS Reasonable and Prudent Alternative, salmon and steelhead are on a trend to recovery. The agency noted that these new BiOps have broader support among tribes and states than ever before.[4] The documents at this site include an Executive Summary, an Issues Summary, and a May 2, 2008 Response to Comments on the Draft FCRPS BiOp. The Issues Summary and Response to

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[2] They are available at http://www.salmonrecovery.gov/biological_opinions/fcrps/ba-ca/index.cfm and http://www.salmonrecovery.gov/Biological_Opinions/FCRPS/2008_biop/action.cfm .

[3] The Accords are available at http://www.salmonrecovery.gov/Biological_Opinions/FCRPS/2008_biop/ColumbiaBasinFishAccords.cfm . See also the May 2, 2008, BPA Administrator's Record of Decision on these Accords, available at: http://www.bpa.gov/corporate/pubs/RODS/2008/.

[4] These BiOps are available at http://www.nwr.noaa.gov/Salmon-Hydropower/Columbia-Snake-Basin/final-BOs.cfm.

Comments describe how the 2008 FCRPS BiOp took into account the comments filed by litigants on the draft BiOps.

III. Reasons for Decision

A. In their Biological Assessment and Comprehensive Analysis the Action Agencies Conclude the FCRPS Action Does Not Jeopardize Listed Species and Does Not Result in the Destruction or Adverse Modification of their Critical Habitat.

The Action Agencies' Comprehensive Analysis reviews two actions: operation of projects in the FCRPS by the Corps of Engineers, Bureau of Reclamation, and BPA, and operation and management of reclamation projects in the Upper Snake River by the Bureau of Reclamation. The combined analysis responds to direction by the district court to ensure a "comprehensive analysis" of the effects of both actions on listed species and their critical habitat. Comprehensive Analysis, p. 1-1.

The Action Agencies' Biological Assessment and Comprehensive Analysis (CA) uses a life-cycle, aggregate, analytical approach.

> The analytical approach described in this chapter considers the biological requirements for survival and recovery of the listed species, and evaluates whether the species are likely to survive and be placed on a trend toward recovery after considering the effects of the federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) and the Upper Snake River Proposed Actions (PA) aggregated with the environmental baseline and cumulative effects. As such, it is a lifecycle survival analysis that necessarily considers all mortality factors affecting the listed species, as well as all actions that have an impact on the species' survival, productivity, and population growth rates.

CA at 3-1. The analysis for each ESU takes into consideration the unique facts and status applicable to that ESU. Based upon this analysis, the CA concludes that the FCRPS action meets or exceeds the objectives of doing no harm and contributing to recovery. CA at 4-16. The CA also concludes that the primary constituent elements of listed species' designated critical habitat are expected to function adequately to serve their conservation role. CA at 1-3 — 1-4. Consequently, the Comprehensive Analysis shows that the RPA proposed by the Action Agencies avoids jeopardizing listed species and destroying or adversely modifying their critical habitat.

In addition to its aggregated lifecycle analysis, the CA also considers the Conceptual Framework developed during the FCRPS BiOp Remand's Collaboration Process among the sovereigns. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior

Columbia River Basin salmonid populations for which adequate data was available.[5] The Conceptual Framework provides the Collaboration parties' view of the relative magnitude of mortality caused by past and continued FCRPS activities, and correspondingly an estimate of the appropriate contribution of the FCRPS and other actions toward long-term recovery of the listed ESUs.[6] It provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. Id.

In the CA, the Action Agencies compare the expected effects of the proposed RPA to the level of effort needed to achieve the goals set by the Remand Collaboration in the Conceptual Framework. This comparison provides one means of assessing the degree to which the proposed RPA will advance a species' prospects for recovery. The CA concludes that the proposed RPA reaches or exceeds the Conceptual Framework's goals for the FCRPS for all Interior Columbia species for which adequate data is available to support the analysis.

As will be noted in the following section, NOAA's 2008 FCRPS BiOp recommends an RPA with some changes from the RPA proposed in the Action Agencies' Biological Assessment. The 2008 BiOp also updates biological information and modeling to use new and revised estimates of impacts on salmonid survival. These changes in the RPA provide additional benefits to listed fish, and the updates to biological information are consistent with the Action Agencies' own analysis. Consequently, because the Action Agencies' CA has continued validity and reaches its conclusion without taking into account these additional benefits, the CA provides support in addition to the 2008 BiOp for BPA's conclusion that NOAA's recommended RPA also avoids jeopardizing listed species and the destruction or adverse modification of critical habitat.

As is also noted in the following section, NOAA's final FCRPS BiOp takes into account comments filed by NWF v. NMFS litigants on the draft 2008 FCRPS BiOp. BPA has reviewed these comments and NOAA's responses. The comments do not undermine the CA as a basis for concluding that the RPA to be undertaken by the Action Agencies avoids jeopardizing listed species and the destruction or adverse modification of critical habitat. BPA continues to rely on the BA and CA as a basis for concluding that the RPA as recommended in the 2008 FCRPS BiOp avoids jeopardizing listed species and the destruction or adverse modification of their critical habitat.

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[5] The Interior Columbia River Basin species addressed by the Conceptual Framework are Snake River Fall Chinook Salmon, Snake River Spring and Summer Chinook Salmon, Upper Columbia River Spring Chinook Salmon, Upper Columbia River Steelhead, and Middle Columbia River Steelhead. The two Interior Columbia River Basin species for which adequate scientific data is not available are Snake River Sockeye and Snake River Steelhead. The Conceptual Framework did not address Lower Columbia River and Willamette River species.

[6] Comprehensive Analysis, § 3.1.3.2, "Comparison to the Remand Collaboration's Conceptual Framework," pp. 3-9 – 3-10 and corresponding sections for each listed species, e.g. § 4.3.5, p 4 15, for Snake River Fall Chinook.

B. In its Supplemental Comprehensive Analysis and FCRPS BiOp, NOAA Concludes that the FCRPS Action Does Not Jeopardize Listed Species and Does Not Result in the Destruction or Adverse Modification of their Critical Habitat.

NOAA's 2008 Supplemental Comprehensive Analysis (SCA) assesses the effects of four proposed actions – operation and configuration of FCRPS projects, operation and configuration of Reclamation Upper Snake Projects, a permit to the Corps of Engineers to transport fish, and the United States v. Oregon Harvest Management Agreement (collectively described as the "Prospective Actions"). FCRPS BiOp, p. 1-10. Based on the SCA, NOAA issued BiOps on these actions. The FCRPS BiOp and SCA provide a comprehensive, reasoned consideration of why the FCRPS action does not jeopardize listed species and does not destroy or adversely modify critical habitat.

NOAA's Supplemental Comprehensive Analysis uses an analytic approach and methods like those in the Action Agencies' CA, updated information regarding species status, and new modeling estimates and analysis to inform the BiOp's conclusions. This aggregated lifecycle analysis incorporates and considers all sources of salmonid mortality and assesses the effects of the Prospective Actions with the environmental baseline and the anticipated future state and private actions, or cumulative effects, on the listed salmon and steelhead; and analyzes whether, with these aggregate effects, listed species have a sufficiently low risk of extinction and an adequate potential for recovery.

The SCA concludes that the Prospective Actions provide sufficient benefits so that they will improve, not degrade, the status of listed species, so that, under the aggregate analysis, listed species are expected to survive with an adequate potential for recovery. Consequently, the Prospective Actions avoid jeopardizing the listed species. The SCA also concludes that the Prospective Actions will improve habitat so that critical habitat will retain its current ability for Primary Constituent Elements (PCEs) to become functionally established and to serve its conservation role for the species. Consequently, the Prospective Actions avoid destruction or adverse modification of designated critical habitat.

In its 2008 BiOp and SCA analysis NOAA uses the same conceptual approach it used in its 1995 and 2000 BiOps. But the 2008 analysis uses a much expanded set of data and a wider variety of metrics than the earlier BiOps. These metrics take advantage of the relative strengths of each to form a more complete picture of the present and future status of the listed species.

While the 2000 BiOp placed its primary emphasis on extinction risk estimates over a 100 year timeframe, the SCA and 2008 BiOp place their primary emphasis on risks over a 24 year timeframe. This was done in part because the precision of the risk estimate decreases with a longer time horizon. The available data for Columbia River basin salmonid populations is only sufficient to support reliable

risk estimates 5-10 years into the future. To illustrate this point, the 95% confidence intervals for a significant number of the 100 year risk estimates included in the 2008 BiOp are between 0% and 100%. Not only does this indicate the extreme unreliability of these long term estimates, it suggests that the 100 year modeling exercise itself is of limited value, since we do not need to conduct the modeling to know that the likelihood of extinction is between 0% and 100%. All such longer-term risk modeling – to the extent that it is based upon a paucity of data – suffers from the same shortcomings. See discussion in the SCA, Aggregate Analysis Appendix, Attachment 1, p. 9.

NOAA and the Action Agencies also chose to place their primary emphasis on 24 year risk estimates because "the main purpose of the metric is to inform our judgment regarding the ability of the species to survive while actions to promote recovery are implemented under the prospective Actions and other processes." FCRPS BiOp at 7-18.

NOAA also considered listed species' potential for recovery:

> An adequate potential for recovery is evident when the listed species is on a trend toward eventual recovery. The adequacy of the recovery potential is sensitive to the present obstacles for planning or achieving recovery, as well as to the extent of influence the agency's actions can have on recovery potential considering the action's duration and magnitude of adverse effects on the listed species. Thus, in some clearly articulated circumstances, a resulting recovery potential will be adequate where limiting factors are reduced or protective mechanisms are implemented, as with safety net hatcheries, to position the species for eventual progress to recovery.

FCRPS BiOp at 1-12 – 1-13.

The 2008 FCRPS BiOp recommends an RPA with modifications to but largely based upon the RPA proposed in the Action Agencies' Biological Assessment. 2008 FCRPS BiOp, "Reasonable and Prudent Alternative Table" Appendix.[7] This is the action that BPA, with the other Action Agencies, will implement.

[7] This RPA includes two measures added by a clarifying June 27, 2008, letter from Gregory K. Delwiche, Vice President, Environment, Fish and Wildlife, BPA, to Bruce Suzimoto, NOAA Fisheries. With regard to Action item 50 of the RPA, the letter states, "The implementation section of this RPA Action [No. 50] on page 69 of the RPA Table notes that 'Specific projects for implementation in the 2007-2009 period are identified in the FCRPS BA Attachment B.2.6-1, Table 8.' We would like to further note our mutual understanding that in addition to the projects identified in Table 8, Fish and Wildlife Program project 199902000-Analyze Persistence/Dynamics (limited to adult Chinook monitoring) and project 198902401-Evaluate Umatilla Juvenile Outmigration (limited to adult, SAR, and smolt production monitoring of steelhead) will be implemented as part of this RPA during this 2007 to 2009 period."

NOAA completed its review only after extensive collaboration with Pacific Northwest states and tribes, meetings with all interested entities, and comments on draft BiOps. NOAA's analysis takes into account comments by NWF. v. NMFS litigants. After NOAA issued draft BiOps in November 2007, pursuant to court order, litigants submitted comments by January 4, 2008. NOAA reviewed these comments in its May 2, 2008, memorandum entitled, "Comments on the 2007 Draft FCRPS Biological Opinion." In addition, contemporaneous with the 2008 BiOps, NOAA produced a document entitled, "Issue Summaries of the FCRPS 2008 Biological Opinion. These documents describe a reasoned consideration of diverse views and explain the approach taken in the BiOps.

Together and independently, the Action Agencies' CA and Biological Assessments and NOAA's FCRPS SCA and BiOps demonstrate that the FCRPS action avoids jeopardizing listed species and the destruction or adverse modification of their critical habitat. The FCRPS BiOp also provides an incidental take statement, with additional measures and terms and conditions to further minimize incidental take. BPA will comply with these measures, terms, and conditions.

C. The FCRPS Action and BiOp Use Guidance from and Address Concerns Expressed by the NWF v. NMFS District and Appellate Courts.

The Court of Appeals held that an action should not further deteriorate the status of a listed species.

> To "jeopardize" — the action ESA prohibits — means to "expose to loss or injury" or to "imperil." Either of these implies causation, and thus some new risk of harm. Likewise, the suffix "-ize" in "jeopardize" indicates some active change of status: an agency may not "cause [a species] to be or to become" in a state of jeopardy or "subject [a species] to" jeopardy. American Heritage Dictionary of the English Language (4th ed.). Agency action can only "jeopardize" a species' existence if that agency action causes some deterioration in the species' pre-action condition.
>
> Even under the so-called aggregation approach NMFS challenges, then, an agency only "jeopardize[s]" a species if it causes some new jeopardy. An agency may still take action that removes a species from jeopardy entirely, or that lessens the degree of jeopardy. However, an agency may not take action that will tip a species from a state of precarious survival into a state of likely extinction. Likewise, even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm.

NWF v. NMFS, 524 F3d 917, 930 (9th Cir. 2008). Similarly, the regulations issued by NOAA and the U.S. Fish and Wildlife Service define "jeopardize" to mean "reduce appreciably" the likelihoods of survival and recovery of a listed

species. 50 C.F.R. § 402.02. The Court of Appeals also wrote that agencies should evaluate the additional effects caused by FCRPS operations in the context of the existence of dams and other elements in the environmental baseline. 524 F.3d at 930-31.

With regard to assessing the effects caused by FCRPS operations and the significance of those effects, the district court specified revisions for NOAA, and implicitly the Action Agencies, to make in their analysis. In his May 26, 2005 Opinion, Federal District Court Judge Redden found fault with the 2004 FCRPS BiOp. In his October 7, 2005, Opinion and Order of Remand of the 2004 BiOp, Judge Redden directed NOAA to:

> (1) Correct its improper segregation of the elements of the proposed action NOAA Fisheries deems to be nondiscretionary;
>
> (2) Correct its improper comparison, rather than aggregation, of the effects of the proposed action on the listed salmon and steelhead;
>
> (3) Correct its flawed determinations as to whether the proposed action destroys or adversely modifies critical habitat;
>
> (4) Correct its failure to consider the effects of the proposed action on both recovery and survival of the listed species in determining whether the proposed action is likely to jeopardize the continued existence of listed salmon and steelhead; and
>
> (5) Correct its past reliance on mitigation measures that are not reasonably certain to occur and/or have not undergone Section 7 consultation.

Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv., No. CV 01-640-RE, 2005 WL 2488447, at *5, 35 Envtl. L. Rep. (Envtl. Law Inst.) 20,209 (D. Or. Oct. 7, 2005).

NWF v. NMFS (9th Cir.) affirmed the district court's rejection of the 2004 BiOp.

> In sum, the district court correctly held that the 2004 BiOp's analysis was structurally flawed. It properly determined that the agency may not use a hypothetical "reference operation" in its jeopardy analysis to exclude from the proposed action's impacts the effects of related operations the agency deems "nondiscretionary." The district court also properly concluded that the 2004 BiOp impermissibly failed to incorporate degraded baseline conditions into its jeopardy analysis. Finally, the district court correctly determined that the 2004 BiOp was legally deficient because its jeopardy analysis did not adequately consider the proposed action's impacts on the listed species' chances of recovery.

524 F.3d at 933.

The jeopardy analyses used by BPA, as well as the other Action Agencies and NOAA Fisheries, respond to all points made by the appellate and district courts. They analyze the impact of all FCRPS operations and do not use a hypothetical operation or other approach that excludes "nondiscretionary" operations. They evaluate impacts caused by FCRPS operations in the context of degraded baseline conditions, including existence of the dams. They analyze the impacts of the proposed action on prospects for recovery. And, to the extent they rely upon actions by others, they rely only on other federal actions that have completed consultation and non-federal actions that are reasonably certain to occur.

With regard to impact on recovery, the appellate and district courts favorably view the 1995 and 2000 BiOps, which "plainly considered analysis of the listed species' prospects for recovery as essential to the jeopardy analysis, and included repeated reference to, and measurement of, the relevant species' chances to survive proposed operations 'with an adequate potential for recovery.'" 524 F.3d at 932-33. The jeopardy analyses used by BPA, as well as the other Action Agencies and NOAA Fisheries, likewise analyze how the FCRPS action affects each listed species' survival with an adequate potential for recovery. The analyses in the 2008 BiOp and Action Agency CA rely on widely used measures of population growth and productivity to reach their conclusions. One of those measures (lambda>1.0) is identical to one of the metrics used for the same purpose in the 2000 BiOp. The analyses reach conclusions respecting whether survival with an adequate potential for recovery exists.

The Court of Appeals also affirmed the district court's criticism of the 2004 BiOp's adverse modification analysis.

> We agree with the district court that NMFS's critical habitat determination was arbitrary and capricious because it (1) did not adequately consider the proposed action's short-term negative effects in the context of the affected species' life cycles and migration patterns, (2) relied on uncertain long-term improvements to critical habitat to offset certain short-term degradation, and (3) concluded that the species' critical habitat was sufficient for recovery without adequate information to make that determination.

524 F.3d at 934. In response, the NOAA and action agency analyses consider short-term negative impacts, rely only on improvements they themselves can implement or other improvements reasonably certain to occur, and use the best available science.

The District Court has provided directions in addition to those addressed by the Court of Appeals. In American Rivers, Inc. v. NOAA Fisheries, No. CV-04-0061-RE, 2006 WL 1455629, at *11, 63 Env't Rep. Cas. (BNA) 1009 (D. Or. May 23, 2006), the court reasoned that the Action Agencies needed to conduct a comprehensive analysis of both the action involving operation the FCRPS and operation of Reclamation's Upper Snake projects. In response, both the Action Agencies' BA and CA, and NOAA's 2008 BiOps and SCA conduct a comprehensive analysis of both actions, and do so in the context of the environmental baseline and cumulative effects.

In its October 7 Order, the District Court directed NOAA, the Bureau of Reclamation and Army Corps of Engineers to collaborate with the sovereign entities who are parties to this litigation to achieve develop items for the proposed actions, and to reach agreement or narrow disagreement on scientific and technical information. Serious collaboration among the sovereign entities produced a significant result: the proposed RPA, Biological Assessment and Comprehensive Analysis as well as the Columbia Basin Accords among the Action Agencies, four Indian Tribes and two States. The Accords reflect mutual agreement on many issues and measures and provide additional benefits for fish. See section III.D of this document.

The Court's October 7, 2005, Order also directed NOAA to correct flaws identified in the Court's Opinions and Orders issued on May 7, 2003 and May 26, 2005. The May 2005 Opinion and Order is the one affirmed by the Court of Appeals and addressed above in this section of BPA's ROD. The Court's May 2003 Opinion and Order ruled that the action area should include not only the area impacted by FCRPS operations but locations where the Action Agencies would conduct offsite mitigation habitat, harvest, and hatchery actions. In response, the action area includes these areas. The May 2003 Opinion also criticized the 2000 BiOp for relying in part on other federal actions that had not undergone consultation and non-federal mitigation actions that were not reasonably certain to occur. In response, the Action Agencies rely on actions that they themselves have power to undertake, other federal actions that have completed consultation, and non-federal actions that are reasonably certain to occur.

D. The Columbia Basin Fish Accords among the Action Agencies and Tribes and States Result from Collaboration Encouraged by the District Court and Provide Additional Benefits to Fish that the Action Agencies' and NOAA's Analyses Take into Account.

The BPA Administrator's Record of Decision on the 2008 Columbia Basin Fish Accords describes the process leading to these agreements. In its May 2005 opinion finding fault with the 2004 BiOp, the District Court ordered NOAA and the Action Agencies (Corps of Engineers, Bureau of Reclamation) to collaborate with sovereign states and tribes to develop items to include in the FCRPS proposed

action, clarify policy issues, and reach agreement or narrow the areas of disagreement on scientific and technical information.

The Fish Accords ROD describes the process leading to the agreements.

> Beginning in 2006 several of the sovereign parties began to explore the potential for resolving their mutual issues through negotiations. The parties recognized that years of litigation focused attention in the courtroom and directed attention away from the mutual work on the ground for the benefit of fish that all are engaged in. In addition, the litigation has been a tremendous drain on parties and their staffs, taking up time and resources that might be better spent working together.
>
> By the middle of 2007, negotiations were underway in earnest. The parties sought to resolve outstanding issues, to resolve litigation matters, and to set forth long-term mutual commitments between them for the benefit of fish and wildlife in the region. The parties sought to keep discussions confidential in order to be as candid as possible and to produce the best outcome.

Columbia Basin Fish Accords ROD, p. 3.

In May 2008 the Action Agencies (Corps of Engineers, Bureau of Reclamation, and BPA) reached agreements on fish measures with the following sovereigns.

- Confederated Tribes of the Umatilla Indian Reservation,
- Confederated Tribes of the Warm Springs Reservation,
- Confederated Tribes and Bands of the Yakama Nation, (as well as the Columbia River Inter-Tribal Fish Commission (CRITFC))
- the Confederated Tribes of the Colville Indian Reservation,
- the State of Idaho, and
- the State of Montana.

The BPA Administrator's Record of Decision describes the significant achievement of these agreements.

> Under the terms of the Accords, the parties are committing to implement projects for the benefit of fish affected by the FCRPS, to be funded primarily by BPA. The focal point of the agreements is to provide actions to help ocean-going (anadromous) fish listed under the Endangered Species Act. The agreements also provide actions to help other fish in the Basin, including non-ocean-going (resident) stocks in Montana such as the listed bull trout, as well as for non-listed anadromous and resident species in the Basin, such as Pacific Lamprey. The agreements are intended to work in concert with draft Biological Opinions for the FCRPS

> and Upper Snake developed by NOAA Fisheries and released for public review on October 31, 2007, and with the final versions of those Biological Opinions set for release on May 5, 2008.

Columbia Basin Fish Accords ROD at 4.

The Accords support BPA's responsibilities under the ESA and also under the Northwest Power Act. The ROD for the Accords provides the following summary of their economic impact.

> BPA's preliminary estimates are that the costs of these agreements may translate into wholesale power rates approximately 2-4 percent higher than they would otherwise be, all other things being equal. While BPA seeks to avoid increasing power rates at all, and a 2-4 percent increase is to be avoided if reasonably possible, BPA believes that the value of these agreements in providing measurable benefits for fish, providing certainty of funding expectations and obtaining collaborative support for a holistic, comprehensive package of hydro operations and mitigation projects with the parties make the agreements worth the increased costs to ratepayers.

Columbia Basin Fish Accords ROD at 40-41.

Because the Accords clarified and added operational, habitat, and hatchery measures to benefit fish, and the collaboration leading to the Accords clarified the analysis, methods, and assumptions used by NOAA, the signatory tribes and the Columbia River Inter-Tribal Fish Commission recently sent a letter to NOAA in support of the NOAA BiOp's approach and the measures in the RPA and Accords as meeting ESA responsibilities. April 30, 2008, letter to NOAA from the Executive Director of CRITFC and attorneys for the Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes and Bands of the Yakama Nation, and Confederated Tribes of the Umatilla Indian Reservation.

For a thorough review of the Accords and the collaboration efforts leading to the Accords, see "BPA Administrator's Record of Decision: 2008 Columbia Basin Fish Accords" (May 2, 2008), plus the Accords themselves.[8]

E. The FCRPS Action and BiOp Result from and Offer Opportunities for Continued Dialogue and Collaboration.

1. Results of Collaboration

The FCRPS Action and BiOp are the result of numerous discussions, meetings, and collaborations among Federal Agencies, states, tribes, and other entities and individuals. The Federal Agencies met frequently with state and tribal representatives to help develop the methodology and measures in the Action

[8] See note 3.

Agencies' Biological Assessment and new 2008 BiOps. The 2008 FCRPS BiOp provides the following summary.

> Judge Redden's Order of October 2005 directed the Federal Agencies to collaborate with the sovereign entities to achieve the following goals:
> (1) developing items to be included in the proposed actions; and
> (2) clarifying policy issues and reaching agreement or narrowing the areas of disagreement on scientific or technical information.
>
> In response to this ruling, the Federal, State and Tribal entities outlined a collaborative process and formed a Policy Working Group (PWG), made up of one representative from each of the sovereign entities. (Members included representatives from Oregon, Washington, Idaho, Montana, the Nez Perce Tribe, the Confederated Tribes of Warm Springs, the Confederated Tribes of the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, the Kootenai Tribe of Idaho, the Spokane Tribe; and the Confederated Tribes of the Colville Reservation, as well as from the FCRPS Action Agencies and NOAA Fisheries.)
>
> The PWG established technical workgroups and policy subgroups according to the steps of the "Collaboration Framework" approach. Technical working groups were also open to non-sovereign parties to the litigation as observers. As of April 2007, (the most recent date for which the statistics have been complied) there have been 272 PWG and Technical Workgroup meetings involving more than 150 participants from 26 organizations. The PWG also provided ten briefings and discussions with other parties to the litigation at key milestones to keep them informed and to seek their input. In order to readily share materials and information, the PWG created a collaborative website, which served as a resource to over 320 users.
>
> One key goal of the Collaboration was to identify priority actions to guide the identification of hydro, habitat, hatchery, and harvest actions for the FCRPS Action Agencies Biological Assessment. In addition, the collaboration has contributed to improved understanding among the sovereigns of positions on technical and policy issues, and the tools available to address them. It has added to the breadth of scientific data and knowledge available to understand the condition of the fish and the actions that will be most beneficial for their recovery.

2008 FCRPS BiOp at 1-7 – 1-8. Collaboration, therefore enabled development of the Action Agencies' Biological Assessment and, subsequently, the 2008 BiOps.

The Action Agencies' Biological Assessment recognizes the collaboration as well. The Action Agencies, through the Remand Collaboration Process,

developed a draft proposed action that was shared with the parties to the litigation and the Court on May 21, 2007. 2007 FCRPS Biological Assessment at 1-5 – 1-6. In this BA, the agencies have generally returned to the approach used in the 2000 BiOp, paying particular attention to opinions by the courts.

The excerpt from the 2008 FCRPS BiOp notes that 272 PWG and Technical Workgroup meetings took place as of April 2007, a date prior to the August 2007 Biological Assessments. Since April 2007, the Federal Agencies have had many additional meetings with tribes and states. Collaboration also led to the Columbia Basin Accords, as noted above.

2. 2008 FCRPS BiOp Framework for Continued Collaboration

The 2008 FCRPS BiOp provides a framework for this dialogue to continue. In-season water management of flow augmentation water and exchange of data and research is done through the Regional Forum of Federal Agencies, states, and tribes. 2008 FCRPS BiOp, Appendix at 8 - 9 (RPA No. 6, "In-season Water Management"); 2008 FCRPS Biological Assessment, Appendix B at B.2.1-13. Participants have experience with the Regional Forum, as it has been part of prior BiOps since 1995. The 2007 FCRPS Biological Assessment provides the following description.

> Prioritization of the use of flow augmentation water is done through in-season management. Each fall, the Action Agencies prepare an annual WMP [Water Management Plan] and seasonal updates that describe planned hydrosystem fish operations for the upcoming fall and winter, and for the spring and summer passage seasons. The annual WMP strives to achieve the best possible mainstem passage conditions, recognizing the priorities established in this document and the need to balance the limited water and storage resources available in the region. . .
>
> The WMP and seasonal updates are reviewed by the Regional Forum Technical Management Team (TMT). . . .
>
> The Regional Forum TMT considers in-season changes to FCRPS operations, which include changes formally proposed as an SOR [System Operations Request]. If the TMT cannot reach consensus on an SOR, the proposed operational change may be elevated to the Implementation Team (IT), which includes policy representatives from the same Federal Agencies, States and Tribes. The TMT also serves as a forum for the exchange of data and research findings, which assures that the FCRPS is managed according to the most up-to-date information available.

FCRPS Biological Assessment, Appendix B, p. B.2.1-13.

In addition, the 2008 FCRPS BiOp's RPA includes adaptive management actions. 2008 FCRPS BiOp, Appendix, RPA Nos. 1-3, pp. 1-3. The Action Agencies will submit to NOAA Action Implementation Plans by December 2009, 2013, and 2016; Annual Progress Reports in all years except 2013 and 2016; and Comprehensive RPA Evaluations in June 2013 and 2016. NOAA will use these documents to determine whether revisions to implementation plans or the RPA are needed.

The Action Agencies' Biological Assessment further describes the adaptive management process they expect to implement, which could result in changes to the RPA based on the best available science. FCRPS Biological Assessment, § 2.1, pp. 2-1 et seq. It adds the following description to the evaluation process.

> Comprehensive Evaluations are a tool to ensure that the Action Agencies and regional parties step back and take a comprehensive and cumulative check on implementation of FCRPS actions. This allows the opportunity to both build on successes and make mid-course corrections where necessary. Comprehensive Evaluations are also a juncture to examine the broader context of recovery, looking at the status of listed fish, actions by others across the salmon lifecycle, and environmental or other changes.
>
> * * *
>
> The results of the evaluations will be used to guide adaptive management of the Proposed RPA and to ensure that Action Agencies are making adequate progress on achieving the strategies and performance standards, as well as to inform the 2012 to 2015 implementation plan. If it is determined that course changes are necessary in order to achieve expected performance, the Action Agencies will discuss those changes with NMFS and the Collaboration parties prior to implementation.

FCRPS Biological Assessment at 2-12. The Action Agencies also committed to explore contingencies in the event that actions, even after adaptive management are not as successful as needed. FCRPS Biological Assessment at 2-14 – 2-15.

The Biological Assessment also states that the Federal Agencies, States, and Tribes want to continue to collaborate during implementation of the BiOp and actions. To serve this purpose, the Action Agencies will support a recovery implementation coordination group to enable continued dialogue among the regional sovereigns and to engage in adaptive management. FCRPS Biological Assessment at 2-15 – 2-16. The Biological Opinion calls for the Action Agencies to implement this collaboration. FCRPS Biological opinion RPA Table Adaptive Management Actions. The parties to Columbia Basin Fish Accords support the adaptive management process described in the Biological Opinion. Columbia Basin Fish Accords Record of Decision at 5. The Accords themselves also use

adaptive management: parties agreed to adapt the Accords on a broader scale based on new information or changed circumstances. Id. at 14.

3. Plaintiffs' Motions for Leave to File Fourth Supplemental Complaint and Notice of Intent to Sue

During the time taken by BPA to prepare this ROD, some parties to the NWF v. NMFS litigation filed Supplemental Complaints regarding analyses underlying NOAA's 2008 BiOps. Some parties have also sent to the Action Agencies a Sixty-Day Notice of Intent to Sue (NOI) for violations of the ESA. NOAA and the Action Agencies considered prospective plaintiffs' views and have made reasoned decisions to implement the 2008 FCRPS BiOp RPA, based upon the best available scientific information. In this section of the ROD, BPA addresses the principal allegations in plaintiffs' documents.

BPA considered the views of NWF, State of Oregon and other individuals and entities at many points during the course of the remand and collaboration process. But the Action Agencies and NOAA have not adopted all of the recommendations made by these parties. In many cases other sovereign states and tribes made different recommendations. Throughout the remand and collaboration leading to the 2008 BiOps, NOAA and the Action Agencies have considered multiple points of view. Especially in a subject as complex as the life cycles of salmon and steelhead and other species throughout the Basin, and how the many activities and natural conditions within their range affect them, points of view and analyses can, and should be expected to, differ. NOAA and the Action Agencies have considered the best available scientific information and have made reasonable and supported decisions based on that information.

In the Supplemental Complaint, the NWF plaintiffs refer to many human activities as causes for the declines in Columbia basin salmon and steelhead populations. While BPA does not disagree with the contention that human activities – including the construction and operation of hydropower facilities – have played a significant role in the decline of salmonid species, natural conditions, particularly longer term cycles in ocean and climate conditions are causes as well.

Regardless of the causes of decline, the fact that these species are listed as threatened or endangered species under the ESA shows that they are not currently in a condition needed for recovery and delisting. This status requires great sensitivity to the effects of particular actions on the listed species. But the status by itself does not mean that a proposed action will jeopardize a listed species. As expressed by the appellate court in NWF v. NMFS, each actor must be careful that its proposed action does not cause additional material harm and thereby jeopardize these species. 524 F.3d at 929-30.

NWF states in its Supplemental Complaint that the listed fish have "collapsed" and presents a graph showing a downward trend in salmon returns since 1962.

Supplemental Complaint, pp. 15, 19 (¶ 27, 32). But a careful inspection of this chart shows a contrast for the period covered by FCRPS BiOps. The graph shows an upward trend since the early1990s, a time period beginning soon after the first listing of Pacific Northwest salmonids (Snake River sockeye in 1992) and encompassing the 1995, 2000, 2004 and now the 2008 FCRPS BiOps. This observation is consistent with the quantitative trend analysis by the Action Agencies and NOAA. These analyses show trends of increasing abundance of listed salmonid species in the Interior Columbia basin since 1990. See, for example, the ESU abundance and trends discussion for Snake River spring/summer chinook salmon in the Comprehensive Analysis at 4-6.

In addition, incoming reports of returns to date in 2008 suggest maintenance of improved returns. But, given the extremely high inter-annual variability in present and historic Columbia River basin salmonid abundance, one should not draw any conclusion from adult returns in any given year. Comprehensive scientific analysis of salmonid population dynamics focuses on longer term averages and trends, rather than point estimates for one year or another. The CA and SCA use metrics indicative of longer term trends and averages, such as the Biological Recovery Team abundance trend estimates, average recruit-per-spawner productivity estimates and lambda, a measure of median annual population growth rates.

NWF states in its Supplemental Complaint and NOI that the RPA in the 2008 BiOp has few changes compared to prior BiOps. Supplemental Complaint at ¶ 66; Notice of Intent to Sue, p. 7. But, as expressed in this ROD and the federal agencies' analyses, NOAA and the Action Agencies describe a package of measures that represent real improvements targeted at specific biological performance and that reflects substantive changes resulting from extensive collaboration among the sovereigns (federal agencies, states, and tribes). For example, hydro passage improvements are now targeted at a dam survival performance standard of 96% for spring migrants and 93% for summer migrants. And, contrary to plaintiffs' assertions, the habitat program to be implemented roughly doubles the Action Agencies' past ESA efforts, while also improving them, by targeting the populations most in need of habitat actions. The Action Agencies' Biological Assessment describes the RPA in detail, and NOAA's 2008 FCRPS BiOp Appendix entitled "Reasonable and Prudent Alternative Table" further enhances this description. In their analyses, NOAA and the Action Agencies provide reasoning for the measures they have chosen. See 2008 FCRPS Biological Opinion, NOAA's Supplemental Comprehensive Analysis, the Action Agencies' Biological Assessment, and the Action Agencies Comprehensive Analysis.

In its Supplemental Complaint, NWF states that NOAA did not consider the "Conceptual Framework for the Remand Process Including the Jeopardy Analysis. Supplemental Complaint at ¶¶ 54 - 56. But the Action Agencies describe expressly how they considered the Conceptual Framework in their

Comprehensive Analysis. It was intended to provide a link to longer term recovery efforts and ultimate delisting and "can be understood to represent the Collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed ESUs in the Interior Columbia River Basin." CA at 3-10. It provided a metric for considering impacts of the proposed FCRPS action on recovery and delisting. Id. In its chapters for listed species in the Interior Columbia River Basin, the Comprehensive Analysis considers the "gaps" needed for recovery. NOAA's Supplemental Comprehensive Analysis incorporates this information. Supplemental Comprehensive Analysis, Aggregate Analysis Appendix, pp. 1-2. The Conceptual Framework therefore informed the Action Agencies and NOAA's analyses, which focused on whether particular actions were jeopardizing the listed species.

The Supplemental Complaint, beginning at ¶78, contends that the viability standards and associated survival gaps calculated by the Interior Columbia River Basin Technical Recovery Team (ICTRT) are the standards that should be used in NOAA's jeopardy analysis. The Conceptual Framework, however, allocated percentage shares of the ICTRT's gaps to various sources of human-caused mortality, of which the FCRPS is only one. This was deemed to be the FCRPS share in the long term effort to achieve recovery, and is necessarily a lower hurdle to surmount than closing the full ICTRT gaps.

Fundamentally, the ICTRT's viability standards represent a biological condition that is indistinguishable from full recovery of the species. This is because the Technical Recovery Teams (TRTs), including the ICTRT, were established by NOAA to make recommendations regarding the "objective, measurable criteria for determining when delisting is warranted" under the ESA.[9, 10] As NOAA noted in its responses to comments on the draft FCRPS BiOp: "Viability criteria were developed by the ICTRT to serve as the biological requirements for long-term recovery, or delisting. ... Delisting occurs according to the standards of ESA § 4 whereas the jeopardy standard is set by ESA §7(a)(2), a different ESA provision. Thus the ICTRT viability criteria are different than the jeopardy standard." NOAA Response to Comments on the Draft FCRPS BiOp, May 2, 2008, Response 1-A. While avoiding causing jeopardy entails avoiding causing additional material harm to listed species, delisting goes further to entail achievement of recovery.

Nevertheless, both the 2008 BiOp and CA analyses relied heavily upon the ICTRT's work. Both analyses used the ICTRT spawner-recruit datasets. Both analyses used the ICTRT metrics, such as average recruit-per-spawner productivity – that were derived from the underlying datasets. Both analyses carefully considered the ICTRT's status assessments and assessments of Viable Salmonid Population factors other than abundance and productivity. Both

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[9] NMFS 2000 Memorandum, *Recovery Planning Guidance for Technical Recovery Teams*

[10] "These biological viability criteria are intended to inform long-term regional recovery planning efforts, including the establishment of delisting criteria." *Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs*, Interior Columbia Basin Technical Recovery Team, March 2007.

analyses relied upon the ICTRT's recommendations for ESU-level viability in determining whether an ESU as a whole avoided jeopardy, based upon a consideration of status of individual populations within that ESU. In this manner, the CA and BiOp relied upon the best available scientific information in reaching their respective conclusions.

In its Supplemental Complaint and NOI NWF makes numerous other specific criticisms of NOAA's jeopardy analysis. Supplemental Complaint at ¶¶ 82-83; NOI at 7-11. But, in their extensive Biological Assessment and Comprehensive Analysis and the 2008 BiOp and Supplemental Comprehensive Analysis, the Action Agencies and NOAA have thoroughly addressed the following considerations, as well as others not noted here:

- effects on recovery by considering, among other factors, whether individual populations and the ESUs of which they are parts are likely to increase in abundance and productivity during the term of the BiOp;
- the risks of extinction over a reasonable period of time and under a range of modeling assumptions;
- the possible future effects of global climate change (which hydroelectric projects help avoid by minimizing production of greenhouse gases such as carbon dioxide, which alternative sources of generation would produce in large quantities), as well as a set of strategies to mitigate those effects;
- the effects of hatchery programs on listed fish and a set of hatchery actions and principles intended to guide the Action Agencies' future hatchery funding decisions in a manner that will not jeopardize listed fish[11];
- the biological benefits of specific measures to improve fish habitat and fish survival.

BPA is satisfied that the analytical methods employed in the BiOp and other related documents are consistent with ESA directives, the best available data and that full consideration was given to all of the issues raised by the plaintiffs.

Further, in its May 2, 2008 document entitled, "Comments on the 2007 Draft FCRPS Biological Opinion," NOAA summarized and responded to comments on 29 different scientific issues encompassing jeopardy approaches and analyses, reasonable and prudent alternatives, hydrosystem operations and effects, cumulative effects, the action area, climate change, habitat analysis, hatchery reform, harvest, particular species (Snake River Fall chinook and sockeye), breaching dams, adaptive management, and water quality. NOAA also wrote an

[11] For *hatcheries*, the Action Agencies specific objective is to fund the FCRPS Mitigation Hatchery Program in a way that ensures they do not impede recovery and, where appropriate, reduce extinction risk and promote recovery. The Action Agencies also will reform FCRPS hatchery operations to reduce negative ecological effects on ESA listed salmon and steelhead. In addition, the Action Agencies will implement safety net and conservation actions to preserve and build genetic resources to reduce short-term extinction risk and assist in promoting recovery.

Issues Summary addressing hydrosystem actions, hydrosystem effects, tributary effects, and climate change. In general, BPA concurs in NOAA's responses.

Both NWF plaintiffs, Supplemental Complaint at ¶ 83, and the State of Oregon, Supplemental Complaint at ¶ 31, disagree with NOAA's no jeopardy determination in the case of Snake River sockeye. The Action Agencies believe that NOAA's RPA proposes appropriate and timely steps to continue the process of bringing these fish back from virtual extinction.

Snake River sockeye have suffered from a variety of impacts in addition to hydroelectric development, including a state-sponsored program in the 1950s and 1960s aimed at eradicating sockeye from lakes in the Stanley Lakes basin. FCRPS BiOp at 8.4-3 and CA at 6-1. By the time of listing, the ESU had been reduced to a small remnant population that some considered functionally extirpated. An experimental captive broodstock program was initiated coincident with listing in an attempt to save the species from extinction.

The program is coordinated through the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC). Members of the SBSTOC have concluded that the program has succeeded in its original goal of preventing extinction. The BiOp further notes: "The SBTOC has determined that the next step toward meeting the goal of re-establishing and amplifying the wild population is to increase the number of smolts released." FCRPS BiOp at 8.4-9. This is precisely what the Action Agencies propose to do. In addition, the Action Agencies will be funding a radio-tracking study to identify location(s) and potentially the source(s) of the relatively high sockeye smolt mortality between the Stanley Basin of Idaho and Lower Granite Dam. Results of these studies will inform adaptive management to improve conditions for Sockeye.

The Action Agencies conclude that the RPA is likely to significantly increase the numbers of returning adult sockeye by significantly expanding the number of smolts produced and released from the captive broodstock program, improving in-river survival for Snake River juvenile and (potentially) adult sockeye, and by improving long term understanding of the factors negatively affecting survival of these fish.

In its Supplemental Complaint and NOI, NWF makes additional claims respecting how NOAA should have considered the impact of FCRPS operations on Southern Resident Killer Whales. Supplemental Complaint at ¶¶ 85-89; NOI at 10. The "State of Washington Status Report for the Killer Whale" (2004) cited by plaintiffs speculates on many factors that "may" have an affect, but does not document or support the claims made in the Supplemental Complaint. While plaintiffs may support different weightings of speculative effects, NOAA and the Action Agency have considered all views submitted and made estimates based on the best available scientific information.

Using a method of statistical analysis also applied to populations of listed salmon in the CA and BiOp, the Action Agencies April 2008 supplement to their Comprehensive Analysis, entitled "Analysis of Effects on Listed Killer Whale and Green Sturgeon Distinct Population Segments," showed a trend of increasing abundance since 1980 of chinook salmon (viewed as a preferred food source for killer whales) returning to the mouth of the Columbia River. This analysis involves looking at the *total number of fish* produced from the Columbia, both listed and non-listed, and both hatchery- and natural-origin fish. Chinook salmon returns to Bonneville Dam, while showing significant variation between years, has overall remained remarkably constant since 1938, when most of the FCRPS did not exist (of course the fraction of these returns composed of hatchery-origin fish has grown considerably in recent decades). This analysis shows that neither the existence nor the operation of the FCRPS has had a significant effect on that portion of the killer whales' prey base that originates in the Columbia River basin. NOAA also presented an analysis showing that FCRPS-funded hatchery production in the Columbia River basin more than compensates for the estimated effects of the FCRPS on salmon abundance.

In its Supplemental Complaint NWF also raises a concern that hatchery-origin adults may return in a much more compressed timeframe than wild fish, thus reducing the period during which these fish are available as a food source for killer whales. BPA has recently completed additional statistical analysis of adult Chinook salmon returns to Bonneville Dam to determine whether the distribution of arrival times for Chinook salmon has changed since adult salmon counts began at Bonneville Dam in the late-1930s. Our analysis shows that there have been only slight changes in the distribution of arrival times since adult counts began. Specifically, spring chinook arrived slightly earlier on average during the 1988-2007 period than was the case from 1939-1955 (by about 5 days), though there has been no statistically significant compression of run timing, as the supplemental complaint supposes. The fall chinook run has actually become slightly more extended (by 4 days) during the recent period than was the case from 1939-1955, thus increasing the period of time during which these fish are hypothetically available to killer whales feeding off of the mouth of the Columbia River. These changes are not biologically significant from the standpoint of killer whales.

NWF also cites the Washington State report for their suggestion that hatchery salmon size and nutritional value is inferior to that of wild fish. The cited report does indeed note that overall salmon size has decreased "during the past few decades" (although the cited research apparently does not distinguish between wild and hatchery fish). The report goes on to note the obvious correlation between decreased salmon size during the past few decades and the major and prolonged shift in North Pacific ocean and climate conditions that occurred in the mid-1970s. This shift in the Pacific Decadal Oscillation rendered the ocean far less hospitable to Columbia basin and Puget Sound salmon than had been the

case from about the mid-1940s to the mid-1970s.[12] The Washington State report also notes that in addition to reduced ocean productivity (which could more than account for observed size reductions), other factors including intense harvest pressures, genetic changes and even hatchery practices may have also played a part. The report also suggests that hatchery fish may have lower body fat content and therefore may be less nutritious than wild fish. The only support offered for this claim is a personal communication from B. Sanford. No published, peer reviewed studies are cited. The report also suggests that hatchery fish may have less nutritional value than their wild counterparts. None of these claims appear to be well supported in the cited document. Considering the rigorous consideration that the 2008 FCRPS BiOp gives to the possible effects that the operation and existence of the FCRPS may have on killer whales, and the generally speculative nature of the hatchery-related considerations presented in the Washington State status report and cited by plaintiffs, BPA is satisfied that NOAA's conclusions in the BiOp with respect to killer whales are sound.

In its Supplemental Complaint NWF recommends that the action area include watersheds that include harmful projects by federal, state, or private actors. But NOAA has already defined the action area to include "[a]ll additional spawning areas above Bonneville Dam that are accessible to listed adult salmon or steelhead that are affected by the FCRPS RPA," as "[t]he hydrosystem could have an indirect effect on the amount of marine derived nutrients returning to spawning and rearing areas due to a reduction in the number of adult fish returning to spawn and die." FCRPS BiOp at 4-4. Consequently, the action area already includes all watersheds reached by listed salmon and steelhead.

In its Supplemental Complaint NWF recommends that NOAA's description of cumulative effects (effects of non-federal actions reasonably certain to occur) be more specific and include negative effects of non-federal actions. But, as plaintiffs recognize, as part of the collaborative process NOAA and the Action Agencies requested and received input from states and tribes about recovery actions. SCA at 6-3; CA at 17-1. The Action Agencies' CA lists the state actions in detail. See the many pages of tables attached to the CA, Ch. 17. NOAA and the Action Agencies' consideration of cumulative effects went beyond just beneficial actions. NOAA and the Action Agencies recognized that types of human activities with adverse impacts on listed fish are reasonably certain to occur, including human population growth, water withdrawals, land use practices, fisheries, resource extraction, and state, tribal, and local government actions and policies. SCA at 6-3 – 6-4; CA at 17-3. NOAA finds the cumulative effects of these activities will likely have adverse effects commensurate with those of similar past activities, but future effects are not quantifiable. SCA at 6-3 – 6-4. The Action Agencies' CA states, "As the population of the Pacific Northwest

[12] See, for instance, Mantua et al., 1997, showing that salmon abundance in the North Pacific Ocean is strongly correlated with the Pacific Decadal Oscillation.

continues to increase, the quantity and magnitude of these effects will likely continue to increase as well." CA at 17-3.

The State of Oregon also filed a supplemental complaint-in-intervention for declaratory and injunctive relief (supplemental complaint) in NWF v. NMFS. Most, if not all, of the issues raised by Oregon in its filing were also raised in Oregon's comments on the draft FCRPS BiOp. Those comments were fully considered by NOAA and explicit responses to (and disagreements with) many of Oregon's concerns were included in the final BiOp. Oregon also raised many of the same issues in the court-ordered collaboration among the sovereigns, which the federal agencies considered.

In the following paragraphs, we summarize our views on two issues raised in Oregon's complaint.

First, at ¶14 of its complaint, Oregon states: "...the 2008 BiOp's 'potential for recovery' analysis bears no logical or analytical connection to any scientifically-based recovery criteria." In the same paragraph, Oregon notes: "Because NOAA fails to first determine the point at which survival and recovery are placed at risk, it cannot demonstrate that the likelihood of achieving both will not be appreciably reduced."

With regard to recovery, the Federal agencies' CA uses widely accepted measures of population growth and productivity to inform its conclusions. For example: "A population with an average long-term population growth rate >1.0 is, by definition, a population whose size is increasing, not decreasing. A population that persists with an average growth rate >1.0 over an extended period of time will eventually recover. It is, in short, on a trend towards recovery." CA at 3.1.2.4. Of course, this statement is true only if recovery criteria are not set at an unrealistically high level. If the level of abundance deemed to be needed for recovery is beyond the maximum capacity of the available habitat, for instance, the population is unlikely to ever maintain itself at those levels. But that is more a function of analytic error in the setting of recovery levels than one of basic population dynamics.

For populations at historically low levels of abundance, the CA's conclusion holds. The point at which a population's growth rate changes from one of decline (mean R/S<1.0, for instance) to increase (mean R/S>=1.0) is a significant threshold when considering both the likelihood of survival and the potential for recovery of that population.

NOAA's BiOps and Supplemental Comprehensive Analysis, too, consider impacts on recovery. For each listed species, the SCA considers the species' potential for recovery.

Second, both Oregon and NWF plaintiffs incorrectly contend that NOAA does not rely upon its quantitative analysis in determining whether the RPA jeopardizes listed species. Oregon states, "...NOAA ultimately does not rely on its quantitative analysis in determining whether the RPA satisfies the survival prong of the jeopardy analysis. Instead, due to 'considerable uncertainty' involved in the quantitative assessment of short-term extinction risks, see, e.g., 2008 BiOp at 8.3-32, 34, NOAA ultimately depends on qualitative factors to make its no jeopardy finding...". Oregon Supplemental Complaint at ¶19.

A jeopardy determination must ultimately rely both upon quantitative analysis and a host of considerations that are largely qualitative. This is the case for many reasons, including uncertainty in the quantitative estimates used in the analysis. Other reasons include, but are not limited to, the fact that for many listed ESUs, insufficient information exists to support a quantitative analysis, so conclusions are almost entirely based upon qualitative considerations. Also, even for those ESUs for which sufficient information is available, the quantitative portion of the analysis is done at the level of individual populations within an ESU. Evaluating the status of an ESU based upon estimates of the status of individual populations within that ESU requires the exercise of qualitative judgment. Finally, the use of multiple metrics, while providing a more complete basis for reaching conclusions respecting survival and potential for recovery, necessitates a qualitative consideration of the metrics themselves, since each metric has its own particular strengths and weaknesses. More discussion on this point can be found in Chapter 3 of the CA.

Past biological opinions have necessarily taken a qualitative approach to section 7(a)(2) determinations. The 2000 FCRPS BiOp had this to say: "...NMFS relies on this [quantitative] analysis primarily to provide a standardized measure of risk against which to judge the significance of the action to the continued existence of the ESU. In the end, however, NMFS' determination of consistency with ESA Section 7(a)(2) is qualitative, informed to the extent possible by standardized quantitative analysis." 2000 BiOp at 1.3.1.1. Likewise, the 2008 BiOp clearly describes a qualitative approach to a jeopardy determination. FCRPS BiOp at 1-10 et seq. We conclude that NOAAF has appropriately relied upon both quantitative analysis and qualitative (i.e., best professional) judgment in reaching its conclusions.

In summary, BPA and the other federal agencies have considered diverse views, including plaintiffs' views, and made responsible evaluations. Using not only the 2008 BiOp, its underlying analyses, but also the Action Agencies' Biological Assessments and their underlying analyses, and taking plaintiffs' views into account, BPA continues to believe that the RPA does not jeopardize listed species and does not destroy or adversely modify their critical habitat.

Prospectively, the federal agencies will continue to consider plaintiffs' and others' views during the 2008 FCRPS BiOp RPA's adaptive management process.

Since the District Court's remand of the 2004 BiOp, the federal agencies have engaged in regular communications with non-sovereign as well as sovereign parties, and collaboration with sovereign parties. BPA expects that these communications will continue.

F. The FCRPS Action Is Consistent with Other Federal Laws and Responsibilities.

1. Essential Fish Habitat Recommendations under the Magnuson-Stevens Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), § 305, NOAA makes conservation recommendations to mitigate adverse effects on essential fish habitat (EFH) of species regulated under federal fishery management plans. As part of the 2008 FCRPS BiOp, NOAA considers EFH designated by the Pacific Fisheries Management Council (PFMC) for Chinook and coho salmon, groundfish, and coastal pelagic species. FCRPS BiOp at 15-4. As its MSA conservation recommendation for FCRPS operations, NOAA recommends that the Action Agencies implement the 2008 FCRPS BiOp RPA. FCRPS BiOp at 15-8. NOAA notes that the RPA will:

- Manage water to benefit salmon and steelhead survival, reduce water temperatures during juvenile and adult fish migration,
- Use spill and fish transportation programs to reduce juvenile passage mortality,
- Undertake modifications at FCRPS projects to improve passage survival, primarily installation of surface bypass systems,
- Tributary and estuary habitat improvements,
- Support for hatcheries, including conservation and safety-net objectives,
- Predator control, and
- Research, monitoring and evaluation.

As stated in this decision document, BPA will, as one of the Action Agencies, implement the 2008 BiOp's recommended RPA, and thereby also implement NOAA's MSA conservation recommendation.

2. Tribal Treaty and Trust Responsibilities

The relationship between the federal government and the tribes of the Columbia River Basin are governed by a series of treaties, statutes, regulations, executive orders, and judicial decisions. Many tribes in the Basin reserved rights to hunt, fish, and gather traditional foods and medicines, not only on the lands now within their established reservations but also on lands that they ceded yet remain open and unclaimed. In addition, tribes in several treaties (the "Stevens treaties") reserved the right to take fish at usual and accustomed grounds in recognition of

the primacy of salmon in their lives. Treaties are federal laws that BPA is bound to observe and to uphold.

In addition to the recognition of treaty and other reserved rights, the federal government also has a trust responsibility to Indian tribes. A specific enforceable trust responsibility may arise when a federal agency receives statutory direction to manage tribal resources. Absent a specific responsibility, agencies have a general responsibility influenced by the treaties and internal policies and guidance, such as BPA's Tribal Policy (1996), and Executive Orders such as Executive Order 13175 (2000) regarding consultation and coordination with Indian tribal governments.

BPA fulfills its treaty and trust responsibilities with tribes by meeting the statutory obligations prescribed in general statutes applicable to all Federal Agencies, such as the National Environmental Policy Act, and in statutes tailored specifically to BPA's activities, such as section 4(h)(10)(A) of the Northwest Power Act. BPA seeks to give special consideration to tribal views and concerns pursuant to BPA's Tribal Policy,[13] through government-to-government consultation and careful review of tribal concerns when making decisions that could affect tribal resources.[14]

BPA and other Federal Agencies have seriously taken tribal views into account. They met frequently with tribal representatives to help develop the methodology and measures in the new 2008 BiOps. Section III.C, "The FCRPS Action and BiOp Result from and Offer Opportunities for Continued Dialogue and Collaboration," of this document highlights the dialogue leading to the 2008 BiOps.

These meetings resulted in agreements with four tribes and two states. Section III.D, "The Columbia Basin Fish Accords among the Action Agencies and Tribes Result from Collaboration Encouraged by the District Court and Provide Additional Benefits that the Action Agencies' and NOAA's Analyses Take into Account," of this Decision Document describes these agreements.

The Columbia Basin Fish Accords will benefit not only fish but also improve the parties' working relationships with each other. The Record of Decision for these agreements makes the following statement.

> The Columbia Basin Fish Accords represent a watershed event in BPA's relationship with the participating tribes, and demonstrate BPA's commitments to supporting tribal treaty interests and the government's

[13] http://www.bpa.gov/corporate/About_BPA/tribes/link.

[14] For a detailed discussion of BPA's trust responsibility, see section 2.8 of the Administrators Record of Decision for the 2003 Safety-Net Cost Recovery Adjustment Clause Final Proposal; see also the NEPA Record of Decision for BPA's Fish & Wildlife Implementation Plan Final EIS, http://www.efw.bpa.gov/environmental_services/nepadocs.aspx.

> general trust responsibility to tribes. In general, BPA's commitment to these agreements supports tribal resources and tribal communities. BPA's implementation decision includes a wide variety of hatchery, habitat, research, monitoring, and evaluation, and coordination proposals that help protect and restore anadromous and other stocks that support tribal subsistence, ceremonial, and commercial harvest. BPA is also committing to continue its collaborative relationship with the tribes developed over the course of negotiations, involving the tribes in the monitoring and evaluation of our mutual implementation efforts. In addition, BPA's financial and technical support of tribal resource management expertise promotes tribal participation in mitigation activities which in turn provides economic opportunities and support to tribal sovereignty. While the agreements do not resolve treaty issues, the parties recognize that the mutual commitments are consistent with the tribes' treaty or reserved rights and the United States' trust obligation.[15]

Administrator's Record of Decision: Columbia Basin Fish Accords at 44.

BPA's commitment to implement the RPA in the 2008 FCRPS BiOp, too, provides further action consistent with tribal treaty and trust responsibilities. The RPA meets ESA responsibilities to avoid jeopardy to listed fish and the destruction or adverse modification of their critical habitat. It took into account the many discussions and dialogue with tribes during the remand collaboration.

In addition, implementation of the BiOp's RPA will continue to take tribal views into account. As described in section III.E, "The FCRPS Action and BiOp Result from and Offer Opportunities for Continued Dialogue and Collaboration," of this document, continued use of the Regional Forum provides a continuing vehicle for discussions.

3. National Environmental Policy Act (NEPA)

BPA's environmental analysis of the effects of implementing its activities described in the 2008 FCRPS BiOp, plus the terms and conditions of the BiOp's Incidental Take Statement, is provided by several existing BPA programmatic NEPA analyses. The System Operation Review Environmental Impact Statement (SOR EIS) (1995) (DOE/EIS-0170) evaluates a range of system operating strategies of the multiple uses of the FCRPS. The SOR Record of Decision (SOR ROD) (1997) selected a system operating strategy to support the recovery of ESA listed fish species by storing water during the fall and winter to meet spring and summer flow targets; protect other resources by managing detrimental effects caused by operations for ESA species by establishing minimum summer reservoir levels; provide public safety through flood protection and other actions; and provide for reasonable power generation.

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[15] Three Treaty Tribes MOA at V.D; Colville MOA at III.E.

The programmatic Wildlife Mitigation Program EIS (1997) (DOE/EIS-0246) provided a comprehensive analysis of different program alternatives for addressing BPA's wildlife mitigation projects, including land acquisitions and management, habitat restoration and improvements, installation of watering devices and riparian fencing, and other conservation actions. In the Wildlife Mitigation Program ROD (1997), BPA decided to implement a program to support this wide range of potential wildlife mitigation actions.

The programmatic Watershed Management Program EIS (1997) (DOE/EIS-0265) provided a comprehensive analysis of different program alternatives for addressing BPA's watershed management projects, including riparian restoration and other vegetation management techniques, in-channel modifications and fish habitat improvement structures, various land management techniques, and other watershed conservation and rehabilitation actions. In the Watershed Management Program ROD (1997), BPA decided to implement a program to support this wide range of potential actions intended to benefit fisheries, fish habitat, and aquatic ecosystems in the region.

BPA's Fish and Wildlife Implementation Plan EIS (FWIP EIS) (2003) (DOE/EIS-0312) and ROD (2003) is a cumulative effects analysis of the policy choices available to BPA for managing its fish and wildlife responsibilities in the Pacific Northwest region, including its fish and wildlife mitigation and recovery efforts. Under the FWIP EIS and ROD, BPA adopted the Preferred Alternative 2002 (PA 2002) as its policy direction for funding and implementing its fish and wildlife obligations. PA 2002 focuses policy direction on enhancing fish and wildlife habitat, modifying hydroelectric power operations and structures, and reforming hatcheries to both increase populations of listed fish stocks and provide long-term harvest opportunities. PA 2002 is a blend of the Weak-Stock and Sustainable-Use Alternative Policy Directions that were identified in the FWIP EIS. These alternatives protect weak stocks of fish and achieve performance standards and biological objectives—including those set forth in NOAA's biological opinions and the Integrated Program—while sustaining overall populations of fish and wildlife.

In February 2007, BPA prepared a NEPA ROD tiered to the FWIP EIS and ROD for its Fiscal Year 2007-2009 Fish and Wildlife Project Implementation Decision (07-09 F&W Decision). This tiered ROD addressed BPA's decision to implement certain new and ongoing fish and wildlife projects for fiscal years 2007 through 2009. The projects included in the 07-09 F&W Decision were designed to help meet BPA's responsibilities to protect, mitigate and enhance fish and wildlife affected by the development and operation of the Columbia River Basin hydroelectric dams from which BPA markets power. In the tiered NEPA ROD, BPA found that the majority of the projects included in the 07-09 F&W Decision were routine actions requiring no further NEPA documentation, but that would be subject to a "validation" process. Through this process, BPA committed to reviewing each project to ensure all applicable tribal, local, state, and federal

laws and regulations in addition to NEPA have been addressed prior to implementation. For non-routine projects (e.g., new artificial production projects) included in the 07-09 F&W Decision, BPA intends to prepare additional NEPA documentation as appropriate.

BPA also has prepared a NEPA ROD tiered to the FWIP EIS and ROD for its 2008 Columbia Basin Fish Accords (Accords). This tiered ROD, which was included in the May 2008 Administrator's ROD for the Accords, addressed BPA's decision to implement, for a ten-year time period, both ongoing and new fish and wildlife projects in the Columbia River Basin. The projects in the Accords are primarily intended to improve fish survival and habitat, and to advance fish recovery in the Columbia River Basin, for fish affected by FCRPS dams, with a focus on salmon and steelhead fish listed under the ESA. Similar to the 07-09 F&W Decision NEPA ROD, BPA committed in the NEPA ROD for the Accords to reviewing each Accord project to ensure all applicable tribal, local, state, and federal laws and regulations in addition to NEPA have been addressed prior to implementation. BPA also committed to preparing additional NEPA documentation as appropriate for non-routine projects.

BPA will rely on these existing NEPA analyses to implement its activities described in the 2008 FCRPS BiOp, plus the terms and conditions of the BiOp's Incidental Take Statement. For BiOp actions that are within the scope of these existing NEPA documents, BPA will determine whether the environmental effects of the actions are adequately covered by the existing NEPA documents and no further NEPA documentation is necessary, or whether it will prepare additional NEPA documentation such as a tiered ROD or Supplement Analysis. To the extent that the BiOp proposes actions that are not covered by BPA's existing NEPA analyses, BPA will conduct additional environmental analyses, including any necessary NEPA documentation, as appropriate. In preparing our NEPA analyses, BPA also integrates other applicable environmental laws.

4. Pacific Northwest Electric Power Planning and Conservation Act

a. Protect, mitigate, and enhance fish and wildlife consistent with the Council's Power Plan and Fish and Wildlife Program.

The Northwest Power Act directs BPA to use its Bonneville Fund and authorities to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the FCRPS, in a manner consistent with the Council's Power Plan and Fish and Wildlife Program, and while providing an adequate, efficient, economical, and reliable power supply. BPA believes the phrase "in a manner consistent with" is a programmatic provision that applies to BPA's overall efforts, not to every program element or project. Nonetheless, BPA generally seeks to fulfill its ESA obligations through projects reviewed and recommended by the Council. In addition, the foundational elements in the Action Agencies' Biological Assessment, the Accords, and the final Biological Opinion—the flow, spill,

transportation, configuration, habitat improvement, hatchery, and RM&E actions—either originated with the Council's Program or build on program measures addressing the same issues. BPA thus continues integrating its ESA activities with the Council's program and processes and taking the Program into consideration at each relevant decision point (such as this).

b. Equitable treatment

In addition, the Northwest Power Act requires that Bonneville exercise its responsibilities for hydropower operations consistent with the purposes of the Act "in a manner that provides equitable treatment for . . . fish and wildlife with the other purposes for which such system and facilities are managed and operated."[16] The Council describes equitable treatment as "meet[ing] the needs of salmon with a level of certainty comparable to that accorded the other operational purposes."[17] Historically, BPA has provided equitable treatment on a system-wide basis primarily by implementing the Council's integrated fish and wildlife program and relevant Biological Opinions related to FCRPS operations.[18] Implementation of the 2008 FCRPS BiOp's RPA continues this approach. It continues and expands upon BPA's commitments to benefit fish and wildlife. Implementation of the BiOp furthers BPA's contribution to manage the FCRPS equitably for both fish and power.

c. In Lieu Provision

Under section 4(h)(10)(A) of the Northwest Power Act, Congress expressly limited BPA's authority to provide protection, mitigation, and enhancement in the in-lieu provision, which states:

> Expenditures of the Administrator pursuant to this paragraph shall be in addition to, not in lieu of, other expenditures authorized or required from other entities under other agreements or provisions of law.[19]

As explained by the House of Representative's Interior Committee, "other fisheries efforts outside this Act . . . are expected to continue and to be funded separately."[20]

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[16] 16 U.S.C. § 839b(h)(11)(A)(i).
[17] Council Program 1992, Vol. II. p. 9.
[18] *See, e.g.*, BPA, System Operation Review Environmental Impact Statement Record of Decision, page 14 (Feb. 21, 1997) (selecting an FCRPS operating strategy in which "[c]onflicts between power and fish are resolved in favor of the fish, providing equitable treatment of fish and wildlife with the other purposes for which the FCRPS is operated"); BPA, Fish and Wildlife Implementation Plan Environmental Impact Statement, pages 2-33 to 2-36 (Apr. 2003) (summarizing how BPA provides equitable treatment in FCRPS management); FCRPS Action Agencies, Biological Assessment for Effects of FCRPS and Mainstem Effects of Other Tributary Actions on Anadromous Salmonid Species Listed under the ESA, pages 1-9 to 1-15 (Aug. 2007) (describing the FCRPS' overhaul—structural and operations changes for fish since 1994).
[19] 16 U.S.C. § 839b(h)(10)(A).

Thus, if another entity is authorized or required under other agreements or provisions of law to undertake an activity, BPA cannot fund the activity under the authority of section 4(h)(10)(A) unless BPA's funding is in addition to, not in lieu of that other entity's funding. The in-lieu provision helps ensure that BPA's funding for fish and wildlife protection, mitigation and enhancement under section 4(h)(10)(A) is additive to on-going and future mitigation conducted by others, and is not simply supplanting other efforts outside of the Northwest Power Act. As it implements measures in the 2008 BiOp RPA, BPA will act consistent with the in-lieu provision.

As an example, the 2008 BiOp RPA includes RPA No. 50 (RM&E Strategy 1) regarding fish population status monitoring. The RPA notes that specific projects for implementation in the 2007-2009 period are identified in the FCRPS BA Attachment B.2.6-1-24, Table 8. In that Table 8, BPA noted that while BPA currently provides support for obtaining this regional fish population status data, all of these Table 8 projects are under review for efficiencies and prioritization of RM&E efforts, and their scope of work and/or funding levels are subject to change in FY 2008 and FY 2009.

BPA has determined it will continue these projects through the FY 2009 period at the budget levels BPA identified in its FY 2009 start of year budget planning letter.[21] Funding for these projects in FY 2010 and beyond will depend on this additional review, including consideration of in lieu issues. BPA also notes that, in addition to the projects noted in Table 8 of the BA, BPA will implement two other projects during the 2007-2009 period (not mentioned in Table 8) [22] subject to these same review principles, including in lieu limitations.

d. Adequate, Efficient, Economical, and Reliable Power Supply

The Action Agencies' and NOAA's data and analysis supporting the BiOp and RPA show that implementing the RPA will provide measurable benefits for fish and marine species. The RPA represents significant changes. The Action Agencies' Biological Assessment describes how these changes represent a

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[20] H.R. Rep. No. 976, 96th Cong., 2d Sess., pt. 2, at 45. See also 126 Cong. Rec. H9846 (daily ed. Sept. 29, 1980) (Rep. Lujan: section 4(h)(10)(A) would "insure that the program will not call for measures already bring implemented to protect, mitigate, and enhance fish and wildlife").

[21] Letter from William Maslen, BPA to Tony Grover, Northwest Power and Conservation Council, July 8, 22008, available at http://www.efw.bpa.gov/IntegratedFWP/policyframework.aspx

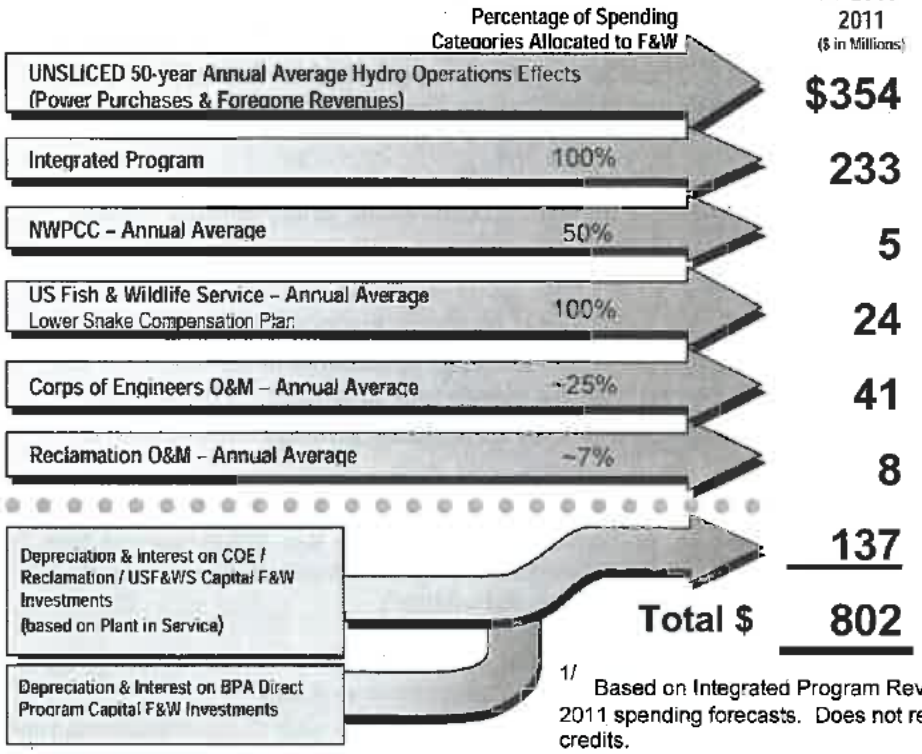
[22] BPA Project No. 199902000—Analyze Persistence/Dynamics (limited to adult Chinook monitoring) and BPA Project No. 198902401—Evaluation Umatilla Juvenile Outmigration (limited to adult, SAR, and smolt production monitoring of steelhead). See letter from Greg Delwiche, BPA to Bruce Suzumoto, NOAA Fisheries, June 27, 2008.

major overhaul to federal hydroelectric projects. Biological Assessment at 1-8 – 1-9, and Appendix A, Overhaul of the System.

Implementation of the 2008 BiOp and RPA brings significant challenges to BPA's ability to meet its responsibilities under the Northwest Power Act to protect, mitigate, and enhance fish and wildlife while also maintaining an adequate, efficient, economical, and reliable power supply. These challenges are described below.

The RPA does entail significant costs and requires limits on the generation of power. Since the beginning of the Northwest Power Act in 1980, BPA's annual funding for fish and wildlife has increased significantly. The combined cost of BPA's funding for fish and wildlife is expected to rise to almost $800 million annually, of which about $100 million annually is the incremental direct fish and wildlife program and hydro operations costs associated with the 2008 BiOp RPA's and the Fish Accords. The 4(h)(10)(C) credits, which are applied to the annual payment BPA makes to the U.S. Treasury, will reduce this incremental cost to BPA ratepayers by approximately $30 million. See the Total Annual Average Cost of BPA Fish and Wildlife Actions Table below.

Total Annual Average Cost of BPA Fish and Wildlife Actions 1/



1/ Based on Integrated Program Review for FY 2010-2011 spending forecasts. Does not reflect 4(h)(10)(C) credits.

After the initial ramp-in period, the new work in the RPA is expected to result in an estimated 3 percent increase in BPA's costs. Together the Fish Accords and the RPA's are expected to result in about a 4 percent increase in BPA's costs.

BPA analysis indicates that, under operations to benefit fish, the Federal hydro system produces over 900 annual average megawatts less electricity than operations without changes to benefit fish. This difference is equivalent to 90 percent of the average annual electric energy use of the city of Seattle. The estimated hydro operations costs (foregone revenues and power purchases needed during fish operations) associated with anticipated operations under the RPA have increased by about $11 million annually compared to those under the 2004 FCRPS Biological Opinion – from $343 million to $354 million. These are average annual estimates, and the year-to-year variability around the $354 million estimate ranges from $19 to $814 million due primarily to natural variations in water supply. It should be noted that the RPA commits BPA to biological performance standards for fish survival through the dams. If ongoing research and testing show that different operations are needed to meet the standards, these costs could decrease or increase. After the initial ramp-up period, BPA's Direct Fish and Wildlife Program costs to accomplish required habitat and hatchery actions and research, monitoring and evaluation activities called for in the RPAs are expected to increase from $143 million in 2008 to $235 million in FY 2010 and 2011. Cost associated with the construction of fish improvements and related maintenance and operation costs are also increasing.

While the impacts of climate change on ESA listed fish are examined in the Action agencies' PA and CA and NOAA's biological opinion, there is an element of climate change that deserves further exploration. The electricity production of the federal hydrosystem is essentially carbon free. As the electricity output of the federal hydrosystem declines for measures such as spill, electricity usage remains unaltered. Even the most aggressive efforts to develop cost effective conservation and renewable resources will be seriously challenged to meet even modest goals for emissions reduction. It is very unlikely there would be extra conservation and renewables available to offset the loss of clean hydro output. Moreover, limits on federal hydroelectric production are immediate and do not await new resource development. Therefore, the replacement of electricity production produced in the Pacific Northwest based on existing resources will almost always increase the use of fossil fired units. Consequently, the replacement of the federal hydro system electricity reduction will, on average, increase greenhouse gas emissions. The Northwest Power and Conservation Council has described this effect in their September 13, 2007 report (Council Document 2007-15). This means actions taken to enhance salmon restoration that reduce federal hydrosystem output will lead to increases in greenhouse gas emissions.

In addition, there are substantial amounts of intermittent renewable resources, particularly wind power, that are being added in the Columbia River Basin to meet load growth. These resources are carbon free but due to a lack of output

predictability common to more traditional generating resources they present a particular challenge for electric power system operators. As noted in the Pacific Northwest Wind Integration Action Plan, a report developed by utilities, wind developers, environmental advocates and utility regulators, "Wind energy is a renewable, clean energy resource that will lower the fuel consumption and environmental emissions of other resources. But wind energy cannot provide reliable electric service on its own." (p. 9). Large amounts of wind have been developed in the Pacific Northwest in recent years and integrated with the existing power system, primarily relying on the federal hydropower system, to compensate for the vagaries of wind production to assure reliability. The ability of the hydrosystem to support wind power development is limited by constraints to the flexible operation of that system including hourly spill requirements with small error bands, tight requirements for flow levels, reservoir elevation requirements and tailwater constraints. In order to assure reliability, existing and future development of wind power will be more costly or may be physically constrained based on the limitations placed on federal hydrosystem operational flexibility. In addition, the non-hydro resources available to provide the flexibility necessary to assure reliability are likely to be fossil fuel fired leading to further greenhouse gas emissions at least until there are substantial improvements in technology.

BPA is also cognizant of the impacts of its costs on Pacific Northwest residents. In a declaration in 2005, Paul Norman, Senior Vice President of the Power Business Line at the Bonneville Power Administration wrote the following:

> While it is true that the Northwest has historically had some of the lowest retail rates in the nation, retail rates have been rising. Relatively lower retail rates do not necessarily mean that the regional economy can easily sustain additional incremental costs, because low rates are a foundation of the regional economy. Furthermore, the effects of BPA's rate increases are not necessarily felt evenly across the region. Roughly speaking, about 70 percent of the revenues collected by BPA's requirement power rates come from the central and eastern parts of Oregon and Washington, as well as the portions of Idaho and Montana that BPA serves. These areas tend to have weaker economies dominated by agriculture and ranching and tend to have a difficult time absorbing any rate increase from BPA.

Declaration of Paul E. Norman, National Wildlife Federation v. National Marine Fisheries Service. On appeal to the U.S. Court of Appeals for the Ninth Circuit from the United States District Court for the District of Oregon Nos. CV 01-00640-RE; CV 05-23 (July 14, 2005), at ¶ 10.

5. Water Qualify, Clean Water Act

In developing the proposed RPA the Action Agencies have collaborated extensively with the four Columbia Basin states and various Columbian Basin

Tribes throughout the consultation, and considered their comments during the development of the proposed RPA. The action agencies considered the respective ecological objectives of the ESA and the Clean Water Act (CWA). The Action Agencies harmonize federal dam operations to comply with both the ESA requirements, determined by the NMFS and FWS, and the state and tribal water quality standards. In many instances, actions implemented to attain water quality standards (e.g., reducing Total Dissolved Gas (TDG) and improving water temperature) will also benefit ESA-listed species. The Action agencies will continue to update the annual water quality plan as part of the RPA implementation, and to provide information on water quality at its dam and reservoir projects to assist the four Northwest states, tribes and EPA in their TMDL and other CWA processes.

BPA complies with the Clean Water Act when it implements its habitat improvement projects. For example, the Habitat Improvement Programmatic Biological Opinion (HIP), originally issued in 2003, will be followed when implementing offsite habitat improvement actions proposed in the RPA. The list of authorized activities include: stream channel, floodplain, and instream monitoring devices; acquisition of water rights; stream bank protection actions; riparian and wetland creation and restoration actions; livestock impact reductions to waterways; soil erosion control projects; irrigation and water delivery management projects; and bridge, road, and culvert replacement or improvement projects.

IV. Decision

My decision requires a significant commitment of resources from the region's ratepayers, including replacement power and opportunity costs for spill and flow augmentation, repayment to the Treasury for configuration improvements, extensive support for research, monitoring, and evaluation of the system and off-site measures, and new actions within our already extensive off-site mitigation program. I make my decision recognizing concern that implementation of the 2008 BiOp and RPA increases significant challenges to BPA's ability to meet its responsibilities under the Northwest Power Act to assure the Pacific Northwest of an adequate, efficient, economical, and reliable power supply, as described in section III.F.4.d, above. I also recognize that operations under this biological opinion may increase the challenges of reducing green house gas emissions from the Pacific Northwest electric power system

Based on the Action Agencies' 2007 FCRPS and Upper Snake Project Biological Assessments and Comprehensive Analysis; the Addenda to the Biological Assessments; NOAA's 2008 BiOps and Supplemental Comprehensive Analysis; the Columbia Basin Accords among Federal Agencies, tribes, and states; the extensive collaboration and discussions with states, tribes and other interested persons and entities, and related documents; and public, state, and tribal comments received on the these documents, it is my decision that BPA, in

cooperation with the other Action Agencies, will implement the 2008 BiOps' RPA and measures, terms, and conditions in the 2008 BiOp Incidental Take Statement.

Issued in Portland, Oregon, this 12th day of August, 2008.

/s/ Stephen J. Wright

Stephen J. Wright
Administrator and Chief Executive Officer

Attachment B

BONNEVILLE POWER ADMINISTRATION

RECORD OF DECISION

following the

MAY 20, 2010, NOAA FISHERIES
SUPPLEMENTAL BIOLOGICAL OPINION

to the

May 2008 FCRPS BIOLOGICAL OPINION

for

OPERATION

of the

FEDERAL COLUMBIA RIVER POWER SYSTEM,

11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,

and

ESA SECTION 10 PERMIT FOR
JUVENILE FISH TRANSPORTATION PROGRAM

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ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

2008 FCRPS BiOp	NOAA's May 2008 Biological Opinion on operation and configuration of the Federal Columbia River Power system.
2008 BPA ROD	BPA's ROD to implement the 2008 BiOp RPA and ITS.
2010 Supplemental BiOp	Supplemental Biological Opinion for operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program. NOAA Fisheries, May, 2010.
2010 BPA ROD	BPA's ROD to implement the 2008 BiOp RPA and ITS, as amended by the 2010 Supplemental BiOp.
Action Agencies	U. S Department of the Interior Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers, Bonneville Power Administration, the agencies responsible for management and operation of federal hydroelectric projects in the Columbia and Upper Snake Rivers
Adaptive Management	The process of adjusting management actions and/or directions based on new information.
AMIP	Adaptive Management Implementation Plan, Adopted September 11, 2009
Anadromous Fish	Species that are hatched in freshwater migrate to and mature in salt water and return to freshwater to spawn
BA	Biological Assessment
Biological Assessment	The Action Agencies' analysis of impacts of their proposed actions on species listed and proposed to be listed under the ESA. The Action Agencies produced biological assessments on projects in the Federal Columbia River Power System in the Columbia River and on projects in the Upper Snake River. See definition at 50 C.F.R. 402.02.

Biological Opinion	A document expressing NOAA Fisheries' opinion regarding whether and how a proposed action avoids jeopardy to listed species and the destruction or adverse modification of their designated critical habitat. See 50 C.F.R. § 402.02
BiOp	biological opinion
BPA	Bonneville Power Administration
Columbia Basin Accords	Agreements signed by the Action Agencies, five tribes, and two states to support the 2008 FCRPS BiOp and provide additional benefits to fish. Also includes an Agreement signed with the State of Washington to support the 2008 FCRPS BiOp and provide additional benefits to fish in the estuary.
Comprehensive Analysis (CA)	The analysis conducted by the Action Agencies to assess impacts of proposed operation of major projects in the Federal Columbia River Power System (FCRPS). The CA provides the basis underlying the biological assessments on the FCRPS and Upper Snake projects.
Corps	U.S. Army Corps of Engineers
Cumulative Effects	Effects of future State or private activities, not involving federal activities, that are reasonably certain to occur. See definition at 50 C.F.R. 402.02.
EFH	Essential fish habitat under the Magnuson Stevens Fisheries Management Act
EIS	environmental impact statement
Environmental Baseline	Past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. See definition at 50 C.F.R. 402.02.
ESA	Endangered Species Act, 16 U.S.C. 1531 et seq.

ESA Recovery Plan	A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.
ESU	Evolutionarily Significant Unit
Evolutionarily significant unit (ESU)	A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other specific units and (2) represents an important component of the evolutionary legacy of the species.
FCRPS	Federal Columbia River Power System
Jeopardize	Jeopardize the continued existence of means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. 50 C.F.R. § 402.02 (definition of "jeopardize")
NEPA	National Environmental Policy Act
NOAA Fisheries	National Marine Fisheries Service, an agency within the National Oceanic and Atmospheric Administration
NW Power and Conservation Council	Pacific Northwest Electric Power and Conservation Planning Council, created under the Pacific Northwest Electric Power Planning and Conservation Act, which develops a power plan and a fish and wildlife program to guide activities by the Bonneville Power Administration and other federal and nonfederal entities in the Pacific Northwest.
Prospective Actions	The federal agency actions reviewed by NOAA's 2008 Supplemental Comprehensive Analysis and 2008 BiOps and 2010 analyses and 2010 Supplemental BiOp on operation and configuration of FCRPS projects, operation and configuration of Reclamation Upper Snake Projects, a permit to the Corps of

	Engineers to transport fish, and the United States v. Oregon Harvest Management Agreement (collectively described as the "Prospective Actions").
Reasonable and Prudent Alternative (RPA)	Recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the purposes of the action, that is consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that NOAA Fisheries concludes will ensure it is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. See definition at 50 C.F.R. § 402.02.
Reclamation	U.S. Bureau of Reclamation
Recovery	Improvement in the status of a species to the point at which listing under the ESA is no longer warranted.
ROD	Record of decision.
RPA	Reasonable and Prudent Alternative
Spill	Water released from a dam over the spillway instead of being directed through the turbines.
Supplemental Comprehensive Analysis	An analysis by NOAA Fisheries of the effects of three actions in the context of the environmental baseline and cumulative effects. The SCA provides the analysis underlying the evaluations in NOAA Fisheries' 2008 BiOps on operation of FCRPS projects, operation of Upper Snake River projects, and harvest activities under U.S. v. Oregon.
U.S. v. Oregon	Litigation under which federal, state, and tribal parties resolve differences respecting harvest levels of anadromous fish.

BONNEVILLE POWER ADMINISTRATION
RECORD OF DECISION
Following the
MAY 2008 NOAA FISHERIES FCRPS BIOLOGICAL OPINION
for
OPERATION
of the
FEDERAL COLUMBIA RIVER POWER SYSTEM,
11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,
and
ESA SECTION 10 PERMIT FOR JUVENILE FISH TRANSPORTATION PROGRAM

I. Summary

In May 2008, NOAA Fisheries concurrently issued Biological Opinions on the operations of FCRPS projects consistent with NOAA's recommended reasonable and prudent alternative (RPA), operations of Reclamation's Upper Snake Projects, and the *United States* v: *Oregon* Harvest Management Agreement (collectively described as the "Prospective Actions"). The collective effects of these actions were evaluated in the Supplemental Comprehensive Analysis that NOAA Fisheries issued simultaneously with the biological opinions listed above. NOAA Fisheries concluded that the reasonable and prudent alternative recommended in the 2008 FCRPS BiOp avoids jeopardizing listed species and the destruction or adverse modification of their designated critical habitat.

In its ROD dated August 12, 2008, the Bonneville Power Administration (BPA) expressed its decision to implement the Reasonable and Prudent Alternative (RPA) FCRPS action and incidental take statement (ITS) terms and conditions recommended by the May 5, 2008, the National Marine Fisheries Service (NOAA Fisheries) Biological Opinion (BiOp) on Operation and Configuration of Major Projects in the Federal Columbia River Power System (FCRPS). BPA made this decision because it determined that the RPA met BPA's ESA responsibilities to ensure that its actions to operate the FCRPS did not jeopardize ESA-listed species and did not destroy or adversely modify designated critical habitat (2008 BPA ROD).

On February 19, 2010, the National Wildlife Federation v. National Marine Fisheries Service (NWF v. NMFS) court allowed a limited, voluntary remand of the BiOp to enable the federal agencies to "consider, among other actions, integrating the Adaptive Management Implementation Plan and its administrative record into the 2008 BiOp." During this remand, NOAA Fisheries and the Action Agencies (Bonneville Power Administration, Army Corps of Engineers, and Bureau of Reclamation) and NOAA reinitiated formal consultation. Exhibits 2 & 3,

Notice of Completion of Remand, May 20, 2010. Concluding consultation, on May 20, 2010, NOAA issued a supplemental biological opinion to the 2008 BiOp (2010 Supplemental BiOp).

This current BPA document records BPA's decision to implement the 2010 Supplemental BiOp. Because the 2010 Supplemental BiOp builds upon the 2008 BiOp, BPA's 2010 ROD builds upon and incorporates by reference BPA's 2008 ROD and attaches it as Attachment A. BPA concludes that the 2008 BiOp RPA and ITS, as amended by the 2010 Supplemental BiOp, does not jeopardize listed species and does not result in the destruction or adverse modification of their designated critical habitat. The particular species addressed by the 2010 BiOp follow.

> Interior Columbia River Basin Salmon and Steelhead. NOAA Fisheries continues to find that the RPA, as amended through this remand, is not likely to jeopardize the continued existence of listed SR spring/summer Chinook, SR fall Chinook, SR steelhead, SR sockeye, MCR steelhead, UCR spring Chinook, or UCR steelhead or destroy or adversely modify their designated critical habitat. 2010 Supplemental BiOp, § 4.1
>
> Lower Columbia Basin Salmon and Steelhead. NOAA Fisheries continues to find that the RPA, as amended through this remand, is not likely to jeopardize the continued existence of listed CR chum, LCR Chinook, or UWR Chinook salmon or of LCR or UWR steelhead or destroy or adversely modify their designated critical habitat. The modified RPA is also not likely to jeopardize the continued existence of LCR Coho salmon (critical habitat has not yet been designated for this species). 2010 Supplemental BiOp, § 4.2.
>
> Southern Resident Killer Whale Distinct Population Segment (DPS). NOAA Fisheries concurs with the Action Agency determination that the FCRPS RPA may affect, but is not likely to adversely affect this listed DPS of killer whales. 2010 Supplemental BiOp, § 4.3.
>
> Southern Resident DPS of North American Green Sturgeon. NOAA Fisheries concludes that the RPA may affect, but is not likely to adversely affect green sturgeon. 2010 Supplemental BiOp, § 4.4.

The 2010 Supplemental BiOp and BPA's 2010 ROD are also products of the federal agencies' responses to issues with prior biological opinions, as expressed in opinions and orders by the federal District Court of Oregon and Courts of Appeal for the Ninth Circuit in the NWF v. NMFS litigation.

This decision by BPA complies with the regulations on Endangered Species Act consultation, which provide, "following issuance of a biological opinion, the federal agency shall determine whether or in what manner to proceed with the

action in light of its section 7 [of the Endangered Species Act (ESA)] obligations and the Service's [National Oceanic and Atmospheric Administration (NOAA)] biological opinion." 50 CFR § 402.15(a).

II. Background

BPA's August 2008 ROD summarizes BPA responsibilities, the FCRPS action, a chronology of documents and events leading to the 2008 BiOp and decision to implement the 2008 BiOp RPA. See additional descriptions in the 2008 FCRPS BiOp itself and the accompanying administrative records for NOAA and the Action Agencies.

Subsequent to issuance of the 2008 BiOp, the Action Agencies proceeded to implement the 2008 BiOp's RPA. In 2009 the Obama administration thoroughly reviewed the BiOp, carefully considering the Court's suggestions in its May 18, 2009 letter to the parties. See AMIP § 1.A, including Appendix 1 at 3-6. The court observed, and the United States agrees, "that the concept of 'adaptive management' is flexible enough to allow the implementation of additional and/or modified mitigation actions within the structure of the existing BiOp." Four different Cabinet-level agencies and the White House were represented in this process. The lead official for each agency in this review was: NOAA Administrator Dr. Jane Lubchenco for the Department of Commerce; Council on Environmental Quality Chair, Nancy Sutley for the White House; Principal Deputy Assistant Secretary of the Army, Terrence "Rock" Salt for the Department of Defense; Associate Deputy Secretary, Laura Davis for the Department of the Interior; and, for the Department of Energy, Bonneville Power Administration Administrator Steve Wright.

Dr. Jane Lubchenco, the administrator of the National Oceanic and Atmospheric Administration, led the Administration's review. Dr. Lubchenco met with parties to the litigation, consulted with NOAA staff and scientists from the Northwest Fisheries Science Center, and heard from some of the most respected fisheries scientists in the nation, who had reviewed the 2008 FCRPS BiOp. In July 2009, these scientists met with Dr. Lubchenco and the leadership of the other federal agencies involved in this litigation to present the results of their individual independent reviews.

The independent scientists viewed the 2008 BiOp as based on the best available science and information. The methodology used in the BiOp to link habitat improvements to improved salmon survival was deemed to be sound, given the limitations of the underlying science. While confirming the fundamental soundness of the BiOp's scientific underpinnings, the reviewers noted that uncertainty existed with respect to the BiOp's future projections – both due to the state of the science and the likely future impacts of global climate change.

In response to these recommendations, the Action Agencies and NOAA Fisheries jointly developed the Adaptive Management Implementation Plan

(AMIP), which set out a more precautionary approach to the implementation of the 2008 BiOp. The AMIP enhances and strengthens implementation of activities, research, and contingencies within the RPA's adaptive management provisions. The AMIP addresses uncertainties about the future condition of the affected salmon and steelhead, particularly focusing on how climate change may affect these species and their habitat.

The AMIP consists of four basic components: (1) immediate acceleration and enhancement of RPA mitigation actions (Section II); (2) enhanced research, monitoring, and evaluation (RM&E) actions to increase and improve the data and analytic tools available to know how salmon and steelhead are performing and to inform what to do if they are declining (Section III); (3) new biological triggers that, if exceeded, will activate a range of specified near- and long-term responses to address significant fish declines (Section IV); and (4) clearer definition of regional collaboration, scientific review and dispute resolution (Sections IV-VI).

One important AMIP enhancement to the RPA is the Memorandum of Agreement on Columbia River Estuary Habitat Actions with the State of Washington (Estuary MOA), which adds 21 protection and restoration projects including significant RM&E by making available an additional $4.5 million annually (equivalent to $40.5 million over the 9-year term of the MOA). AMIP §§ I.B, II.A, Appendix 3. Other AMIP enhancements include additional efforts to control predators and invasive species, and biologically based changes to spring and summer spill. AMIP §§ II.C&D.

RM&E enhancements include expanded adult status and trend monitoring to help evaluate whether the BiOp's mitigation actions are having the intended effect and to improve scientific understanding of the entire salmonid lifecycle; expanding Intensively Monitored Watersheds (IMWs) to monitor the effects of climate change; a new Life-cycle model to evaluate contingent actions; and enhanced research on predators, invasive species and potential reintroduction. AMIP § III.

The AMIP's biological triggers and contingency plans are insurance against unexpected declines in species abundance – not a substitute for the BiOp's performance standards and metrics. AMIP § IV. The first trigger is an Early Warning Indicator intended to indicate the potential for a significant decline in abundance in the near future. This trigger would set contingency actions in motion if it is determined that a significant decline in abundance is likely to occur within one to two years. The second trigger is the Significant Decline trigger, which automatically triggers short-term contingency measures ("Rapid Response Actions") that could be implemented within a relatively short period of time. These actions include possible modifications to hydrosystem operations that would exceed juvenile dam passage performance standards in the BiOp by altering spill or transport, additional efforts to target predators and invasive species, modifications to harvest management (within existing agreements), and the possible use of safety-net hatcheries. If a Significant Decline Trigger is

reached, concurrent with the determination of what Rapid Response Actions will be taken, the Action Agencies will initiate an All-H Diagnosis informed by life-cycle modeling of potential Long-term Contingency Actions. The AMIP calls for the development of these more detailed short term (Rapid Response) and longer term (Long-Term Contingency Actions) contingency plans by specific dates. The Action Agencies and NOAA have begun work on these plans.

Finally, the AMIP adds greater detail and specificity to the ongoing regional collaboration between federal agencies, States and Tribes through the Regional Implementation Oversight Group (RIOG). AMIP § V.

After completion of the Administration's review and submission of the AMIP to the Court, procedural objections were made to the Court's consideration of the AMIP in ruling on the merits of the 2008 BiOp. On February 19, 2010, the Court authorized a three-month remand "to allow these Agencies [NOAA, the Bureau of Reclamation and the U.S. Army Corps of Engineers] to consider, among other actions, integrating the Adaptive Management Implementation Plan and its administrative record into the 2008 BiOp." The Court clarified that the voluntary, limited, remand was granted without any finding concerning the legal sufficiency of the 2008 BiOp. The Court has retained jurisdiction throughout this entire process.

During the remand, the Action Agencies formally requested that NOAA Fisheries reinitiate formal consultation on the 2008 FCRPS BiOp for the purpose of integrating the AMIP into the BiOp in a procedurally sound fashion and conducting a thorough review of new and relevant scientific information not available at the time the 2008 BiOp was completed. Exhibits 2 & 3 to the Notice of Completion of Remand, May 20, 2010. As part of its review, NOAA solicited new scientific information from Northwest states and tribes, parties to the litigation, its Northwest Fisheries Science Center, and the Independent Scientific Advisory Board (ISAB). The new and relevant scientific information that was submitted and considered by NOAA included:

- new information on salmon and steelhead status;
- new information on the physical and biological effects of climate change;
- new information on impacts from avian predation;
- new information on ecological interactions between hatchery and wild salmon and steelhead;
- new harvest information
- and new information with respect to Southern Resident Killer Whales and the Southern DPS of North American Green Sturgeon.

NOAA found the new quantitative information on species status to be within the range of variability anticipated in the BiOp. BPA agrees with NOAA's interpretation. Most importantly, species abundance has improved when new information is considered and trends in abundance are stable or increasing for all listed species with the exception of Snake River Sockeye salmon, due to the degree of artificial propagation necessary to maintain this ESU. Under the 2008 BiOp's RPA 3, the Action Agencies will conduct a Comprehensive Evaluation of species status and BiOp implementation in 2013.

Climate change was a particular concern raised by many of the independent scientific reviewers and commenters during the voluntary remand process. After a thorough review of new climate science, NOAA concluded in the Supplemental BiOp that the physical effects of climate change, for the remainder of the BiOp, are likely to be within the range of effects considered in the BiOp. Most importantly, as noted at section 8.1.3 of the 2008 BiOp: "The full breadth of long-term climate change is unlikely to be realized in the ten-year term of this Opinion."

In response to the new information NOAA considered, and consistent with the RPA and AMIP, the Action Agencies and NOAA developed the additional implementation actions noted below to amend and further enhance the AMIP. As a precautionary measure, a number of these new actions are intended to further reduce uncertainties associated with climate change. Others address uncertainties regarding the potentially adverse effects of hatchery fish, non-indigenous species and toxics. The specific actions are listed below.

A. Amendments to the 2008 BiOp RPA and AMIP

Amendment 1:

"Under RPA Action 55 the Action Agencies will undertake selected hydrosystem research to resolve critical uncertainties. As part of this action, by June 2012, the Corps will complete a NOAA Fisheries Supplemental FCRPS Biological Opinion report to identify the use and location of adult salmon thermal refugia in the lower Columbia and lower Snake Rivers using existing information on adult migration, temperature monitoring data, and modeling efforts. Additional investigation or action may be warranted based on the results of this report."

Amendment 2:

"Under RPA Action 52, the Action Agencies will enhance fish population monitoring. As part of this action, in February 2011 the Corps will initiate a study at The Dalles and John Day Dams to determine a cost effective adult PIT tag detection system design and whether installation of PIT tag detectors will improve inter-dam adult survival estimates. The study will be completed by

December 2012. Following the results of the study, by April 2013, the Action Agencies will determine in coordination with NOAA if one or both of these PIT tag detectors substantially improve inter-dam adult loss estimates. If warranted, the Action Agencies will proceed to construction. Funding will be scheduled consistent with the RPA requirement and priorities for performance standard testing and achievement of these performance standards at the projects."

Amendment 3:

"Under RPA Action 15, the Action Agencies are providing water quality information and implement water quality measures to enhance fish survival and protect habitat. As part of this action, the Action Agencies will contribute to regional climate change impact evaluations by providing NOAA past and future water temperature data from their existing monitoring stations, to be used as part of a regional temperature database. The Action Agencies will begin to provide data to NOAA within 6 months following the establishment of a regional database and annually thereafter. NOAA anticipates having a regional database established no later than 2012."

Amendment 4:

"Under RPA Action 35, the Action Agencies are identifying tributary habitat projects for implementation and consider potential effects of climate change on limiting factors. As part of this action, the Action Agencies will continue to coordinate with NOAA in its efforts to use existing tributary habitat effectiveness studies, IMWs, and the NOAA enhanced lifecycle modeling to track climate change impacts. Starting in September 2011, the Action Agencies will annually provide NOAA with study data to be used as part of a regional climate change database. After 2011, new climate change findings will be provided to the tributary habitat expert panels to apply and use to help identify and prioritize habitat improvement actions."

Amendment 5:

"Under RPA Action 35, the Action Agencies are identifying tributary habitat projects for implementation based on the population specific overall habitat quality improvement identified in the RPA Action. As part of this action, after 2011, the Action Agencies will include as a consideration in the expert panel project evaluation process 1) the presence of invasive species and 2) site-specific toxicology issues, based on information made available by the appropriate state and Federal agencies."

Amendment 6:

"Under RPA Action 64 and under the AMIP Hatchery Effects p. 22, the Action Agencies are supporting efforts to resolve hatchery critical uncertainties. As part

of this effort, beginning in December 2010, the Action Agencies will assist NOAA to further develop or modify existing studies that address the Ad Hoc Supplementation Workgroup Recommendations Report and that additionally address potential density-dependent impacts of FCRPS hatchery releases on listed species. These studies would provide support for future hatchery management actions to reduce potential adverse hatchery effects. By December 2010, the Action Agencies will work with NOAA to convene a technical workgroup with fishery managers to discuss potential studies and potential management tools. The goal for the workgroup will be to complete its work by December 2011."

B. New RPA to integrate AMIP as amended into the 2008 BiOp

NOAA also integrated the AMIP into the 2008 BiOp as a new RPA. The text of that decision follows.

"NOAA has further determined that the AMIP as amended should be integrated into the 2008 BiOp by including in the 2008 RPA the following New RPA Action 1A:

"New RPA Action 1A:
The Adaptive Management Implementation Plan (AMIP), as adopted by NOAA on September 14, 2009, and as further amended on May 19, 2010, is hereby integrated into the 2008 BiOp's RPA. The AMIP, as amended, is integrated into the implementation of the 2008 RPA as more fully described in the AMIP, Chapter 1.C at page 14.

"Integration of 2008 BiOp and its RPA, as amended, into the 2010 Supplemental Biological Opinion

"NOAA hereby integrates into this supplemental biological opinion the 2008 BiOp and its RPA, as amended to include new RPA Action 1A."

C. Supplement to the 2008 BiOp's Incidental Take Statement

NOAA then supplemented the 2008 BiOp's incidental take statement as follows.

"5.1 Introduction

This section supplements the Incidental Take Statement (ITS) of the 2008 BiOp (Section 14.2.6 - Amount of Incidental Take from RM&E Actions). It documents NOAA Fisheries' conclusion that additional take of ESA-listed adult salmon and steelhead is necessary for research to assess transport of adult sockeye salmon as a method of increasing late summer survival from Lower Granite Dam to Sawtooth Valley lakes (or artificial production facilities). Estimates of take provided in this section are in addition to those already specified in the 2008

BiOp (Section 14.2) and the reasonable and prudent measures (and related terms and conditions) to reduce take associated with these activities, as specified here, are also in addition to those already specified in the 2008 BiOp (Sections 14.4 and 14.5). As explained in Section 4, NOAA Fisheries concludes that the incidental taking of threatened or endangered species specified in the 2008 BiOp's ITS as supplemented here will not violate ESA Section 7(a)(2).

5.2 Capture and Transport of Adult Sockeye

5.2.1 Amount or Extent of Anticipated Take

Implementation of RPA 42 is intended to evaluate the benefits of transporting up to half of adult listed Snake River sockeye salmon arriving at Lower Granite Dam. Incidental take will occur for the capture and handling of these adults that is necessary to implement this RPA action. Mortalities associated with this measure will result in losses of no more than 5% of the number of adults captured (or one fish – whichever is greater).[1] Adult listed Chinook salmon and steelhead will also likely be handled incidentally to the capture of sockeye for transport. However, effects (minor handling and delayed passage) on these species, considering that only a small proportion of spring-summer Chinook and steelhead pass Lower Granite Dam in July when the majority of sockeye are passing, should be minimal. Mortalities for these non-targeted species, collectively, shall not exceed 10 individuals per species as a result of this action.

1 Losses of sockeye salmon between Lower Granite Dam and the Sawtooth Valley lakes can be high (in the general range of 25 to 50%) in the mid- to late-summer; most likely due to the relatively high temperatures in the snake and Salmon rivers. If effective, adult transport (to Sawtooth Valley Lakes or artificial production facilities) could substantially improve adult survival rates.

5.2.2 Reasonable and Prudent Measures

The FCRPS Action Agencies (or their designated contractors conducting research) shall conduct research and handle fish at the adult trapping facilities in accordance with existing NOAA Fisheries-approved protocols (use of anesthetics, handling criteria, trap operation criteria, NOAA Fisheries Supplemental FCRPS Biological Opinion temperature criteria, etc.) to ensure that lethal take resulting from the handling of adults salmon and steelhead is minimized to the extent practicable.

5.2.3 Terms and Conditions

No additional terms and conditions are needed beyond those prescribed in the 2008 BiOp, Sections 14.5.3."

III. Reasons for Decision

A. BPA Reviewed and Concurs with NOAA's Reasoning and Determinations in the 2010 Supplemental BiOp.

Based on its review of new scientific information, NOAA Fisheries concluded that the operation of the FCRPS, through the 2008 BiOp RPA, as amended by the AMIP and through this remand, is not likely to jeopardize the continued existence of listed salmon and steelhead considered in the 2008 FCRPS BiOp or destroy or adversely modify their designated critical habitat. 2010 Supplemental BiOp, §§ 4.1, 4.2.

The 2010 Supplemental BiOp reaches similar conclusions with respect to the listed Southern Resident Killer Whale Distinct Population Segment (DPS). NOAA based its conclusions on NOAA's scientific assessment that the new information does not represent a significant deviation from the information and conditions analyzed in the 2008 BiOp. NOAA reasons the FCRPS RPA will continue to positively affect the survival and recovery of listed salmon and steelhead and bolsters protection for salmon and steelhead on the Columbia and Snake rivers in the Pacific Northwest by adding contingency measures that provide extra insurance that the fish will survive with an adequate potential for recovery, and that hatchery production contained in the FCRPS RPA more than offsets losses to the killer whale prey base, Therefore, NOAA Fisheries concurs with the Action Agency determination that the FCRPS RPA may affect, but is not likely to adversely affect Southern resident killer whales. 2010 Supplemental BiOp § 4.3.

NOAA also concludes that the 2008 RPA, as amended by the 2010 Supplemental BiOp, may affect, but is not likely to adversely the listed Southern Resident DPS of North American Green Sturgeon. NOAA's review of the new scientific information did not change its determinations respecting effects of the RPA on the listed green sturgeon and concludes that the RPA may affect, but is not likely to adversely affect green sturgeon. 2010 Supplemental BiOp § 4.4.

As described in this ROD, during implementation of the RPA, and reinitiation of formal consultation leading to the 2010 Supplemental BiOp, BPA has provided information and analysis to NOAA, reviewed NOAA's analyses and reasoning, and concurs with NOAA's conclusions that the RPA as amended by the 2010 Supplemental BiOp, ensures that the FCRPS action is not likely to jeopardize listed salmon and steelhead or result in the destruction or adverse modification of their designated critical habitat. BPA will also, together with the other Action Agencies, implement the measures and terms and conditions of 2008 BiOp's incidental take statement, as supplemented by the 2010 Supplemental BiOp. BPA has also reviewed and concurs with NOAA's conclusions respecting Southern Resident killer whales and Southern Resident green sturgeon.

B. Reviewing Action Agency Analyses, BPA Concludes the FCRPS Action Is Not Likely to Jeopardize Listed Species or Result in the Destruction or Adverse Modification of their Designated Critical habitat.

During the reinitiation of consultation in 2010, the Action Agencies reviewed their Biological Assessment and Comprehensive Analysis leading to the 2008 BiOp, the 2008 BiOp and Supplemental Comprehensive Analysis by NOAA, and scientific information and analyses becoming available after their decisions to implement the 2008 BiOp RPA. The Action Agencies also conducted their own review of the new information considered by NOAA.

With respect to the new species status information considered by NOAA, the Action Agencies conclude that the NOAA Fisheries 2009 Government Performance and Results Act review of species status provides the most recent ESU-level status review. 2010 Supplemental BiOp, section 2.1.1.1.2. The GPRA report's conclusions that all listed ESUs considered in the 2008 FCRPS BiOp are stable or increasing in size is consistent with both the datasets gathered for the AMIP and the updated population-level datasets considered in NOAA's review.

NOAA also considered a number of updated population-level datasets representing a subset of the datasets used in the Supplemental Comprehensive Analysis. As part of its review, NOAA updated the metrics derived from these datasets. These metrics formed the basis for the quantitative analysis in the SCA. It is important to stress, however, that the 2008 Biological Opinion appropriately considered multiple metrics indicative of species status. Each of these metrics provides a complementary but slightly different view of the same underlying population processes. Each has its strengths and weaknesses. As NOAA indicated in its July 12, 2006 jeopardy standard memo, "Because of the uncertainty attendant to any metric regarding the prospects for recovery and the difficulty in extrapolating from the population level on which those metrics are based, no one metric will be used to assess an ESU's potential for recovery. Instead, NOAA will consider a number of metrics, including those generated in the recovery planning process, along with other qualitative biological information and apply its best professional judgment as to an ESU's prospects for recovery."

With respect to the updated metrics, extinction risk modeling results are little changed from the BiOp when new information is considered, suggesting that the survival prong of the BiOp's analysis remains sound. Respecting recovery, while extended base period average recruit-per-spawner and lambda estimates have declined compared to the BiOp's base period, the declines are within the range of annual variability anticipated in the BiOp's analysis. Furthermore, the decline in average recruit-per-spawner productivity appears to be caused by a temporary period of poor ocean conditions that has not had a significant effect on longer term abundance or abundance trends. With stronger than average adult returns expected in 2010 and 2011, it is likely that these estimates will improve over the next two to three years. Finally, the updated status metrics are conservative

because they do not incorporate or assume the survival improvements anticipated under the 2008 BiOp.

Also, in addition to addressing contingencies in the AMIP for steep declines, the Action Agencies will use adaptive management to respond to new information about species status.

The Action Agencies concur with NOAA that new climate change information is consistent with the BiOp's assumptions and is appropriately addressed by the actions called for in the RPA and as supplemented by new RPA Action 1A, integrating the AMIP as amended.

The BiOp RPA calls for a Comprehensive Evaluation of RPA implementation and species status in 2013. This date was chosen in order to allow the effects of some of the BiOp's RPA actions to be reflected in updated data expected to be available at that time. As noted above, the new data available for this review do not reflect the effects of any of the actions implemented so far under this BiOp. With the addition of the AMIP's safeguards, it is reasonable to continue implementation of the BiOp's RPA and revisit the status of these species in the 2013 Comprehensive Evaluation.

Based on this review, the Action Agencies conclude that the 2008 BiOp RPA, as supplemented by the 2010 Supplemental BiOp, ensures that FCRPS operations and configuration are not likely to jeopardize ESA-listed species and are not likely to result in the destruction or adverse modification of their designated critical habitat.

C. The FCRPS Action and BiOp Continue to Use Guidance from and Address Concerns Expressed by the NWF v. NMFS District and Appellate Courts.

BPA's ROD to implement the 2008 BiOp RPA describes how this decision is consistent with guidance and responds to concerns expressed by the NWF v. NMFS and appellate courts. BPA has reviewed these decisions again, plus subsequent decisions, and concludes that implementation of the 2008 BiOp RPA, as revised by the 2010 Supplement, continues to respond to these courts' opinions.

D. The 2010 Supplement to the 2008 BiOp Continues to Take into Account the Importance of the Habitat Program and the Support to the Program Afforded by the Columbia Basin Fish Accords among the Action Agencies and Tribes and States.

Since the 2008 BiOp, the Action Agencies have: (1) identified specific habitat projects beyond 2009 for implementation in the 2010-2012 period; (2) committed substantial funding for implementation of habitat projects through the Fish Accords and other contracts; (3) identified specific habitat implementation

partners; and (4) identified and are implementing specific scientific reviews during habitat project selection. AMIP Appendix 1, p. 7. Together, these actions increase the certainty that selected habitat actions will have the intended benefits for ESA-listed salmon and steelhead.

As noted previously, in response to the Court's concerns, and in conjunction with the Administration's review of the 2008 BiOp, the Action Agencies have also added to the Fish Accords executed in 2008[1] by negotiating and entering into a new Fish Accord with Washington in September, 2009 addressing the Columbia River estuary (Estuary MOA) and which makes available $40.5 million over the course of 9 years for on-the-ground habitat actions.[2] This effort is in addition to the BPA and Corps estuary habitat funding under the 2008 BiOp.

These collective commitments increase certainty with respect to implementation both from a funding standpoint and in the identification of specific projects (in the case of the Columbia Basin Fish Accords through 2018). The project selection process for 2008 BiOp implementation (which includes scientific scrutiny of all projects, including those specified in the Accords), is designed to ensure that the best available science is used to determine the biological value of habitat improvements to salmon and steelhead.

The 2008 BiOp RPA's habitat measures use an adaptive management framework designed to meet specific habitat quality improvement performance standards by 2018. See RPA Nos. 35 and 51, for example. BPA, with the other Action Agencies, will implement these RPA measures, actively monitor progress, and make any needed adjustments through adaptive management to remain on course for successful completion of the RPA measures by 2018.

Examples of Adaptive Management include the following:

In the Upper Columbia, the Action Agencies have initiated a very large increase in their tributary habitat program and are working in concert with local entities (including the salmon recovery board constituted by the State of Washington) to integrate FCRPS BiOp habitat projects with other salmon recovery efforts in the

[1] May 2, 2008, Memorandum of Agreement Among the Umatilla, Warm Springs and Yakama Tribes, the Bonneville Power Administration, U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation. *May 2, 2008*; Memorandum of Agreement between the Confederated Tribes of the Colville Reservation, the Bonneville Power Administration, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation; May 2, 2008; Memorandum of Agreement between the State of Idaho, the Bonneville Power Administration, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation. *May 2, 2008;* Memorandum of Agreement between the State of Montana, the Bonneville Power Administration, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation; and November 7, 2008, Memorandum of Agreement between the Shoshone-Bannock Tribes, the Bonneville Power Administration, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation.

[2] Memorandum of Agreement on Columbia River Estuary Habitat Actions Between the State of Washington, The Bonneville Power Administration, the U.S. Army corps of Engineers, and the U.S.. Bureau of Reclamation. Sept. 16, 2009.

area. This extensive expansion of effort by the Action Agencies took a year or more to fully establish and the program is now proceeding efficiently to achieve the performance requirements of the BiOp.

In the estuary, the Action Agencies have also initiated a large increase in effort and are engaging local organizations to assist in implementation. As with the effort in the Upper Columbia tributaries, the increase in effort has required a ramp up in infrastructure to execute the program, and the Agencies have made a concerted effort to build the program capacity needed to achieve the estuary performance requirements during the term of the BiOp. In order to accelerate the speed at which the Agencies will attain their commitments, the Agencies executed the Washington MOA (described above) which makes available an additional $40.5 M for implementation of habitat actions in the estuary in partnership with the State of Washington. In addition, the Agencies have modified their strategies to place more emphasis on larger, more complex projects to increase the level of biological benefit for each project and further accelerate the pace to achieve their commitments. Recently, the Action Agencies convened meetings with local organizations to describe this increased emphasis on larger projects and this collaboration has already yielded some promising proposals. As the Agencies adaptively manage implementation to meet performance requirements, continued collaboration with local organizations will be foundational to that effort.

With respect to the method developed through the regional collaboration to assess benefits of tributary and estuary habitat actions, the majority of tribal, state, and federal scientists involved in the collaboration support the method adopted in the 2008 BiOp. The Action Agencies' Comprehensive Analysis, in Appendix C, and Appendix D and Section 7.2.2 and 7.2.3 in the 2008 BiOp, provide a comprehensive overview of the analysis used to estimate habitat improvement and survival benefits. The benefits assigned to tributary habitat improvements are reasonable because they are based on expert judgment informed by scientific data and because the benefits are specific to the project, population and limiting factors being addressed. The benefits assigned to estuary habitat improvements are reasonable because they are based on recommended recovery actions addressing significant limiting factors in NOAA's draft *Columbia River Estuary Recovery Plan Module* (NMFS 2006) and evaluated relative to the project's contribution to completing the recovery action. Also, as part of RPA No. 57, the Action Agencies will "expand and refine models relating habitat actions to ecosystem function and salmon survival by incorporating research and monitoring results and other relevant information."

The Administration reviewed the methods used to estimate survival benefits from habitat projects and stated its conclusion that they are sound and retain the needed flexibility to respond to evolving scientific data, as well as to implementation challenges and opportunities

E. The 2010 Supplement to the 2008 BiOp endorses a rigorous system of expert scientific evaluation and review for projects selected to implement the BiOp's tributary and estuary habitat programs.

The Action Agencies are actively implementing the extensive program of tributary and estuary habitat actions called for in the 2008 RPA. Projects for the 2007-2009 implementation cycle that were specifically identified in the 2007 Biological Assessment (BA) are now either completed, being implemented, or being replaced by more feasible projects and projects for the 2010-2012 implementation period are underway. [3]

Project selection in the tributaries occurs in three ways, each of which incorporates independent scientific review and information gathered through ongoing research, monitoring and evaluation.

(1) Consistent with RPA Action 35, the Action Agencies regularly convene expert panels comprised of state, tribal and federal specialists familiar with local habitat condition. The expert panels identify specific habitat actions to be implemented or available for implementation, evaluate the limiting factors addressed, and estimate the associated habitat improvements. In 2009 these panels were convened for the populations listed in bold type in RPA Action 35, Table 5. The panels evaluated the habitat improvements estimated from 2007-2009 completed implementation and estimated habitat improvements from projects identified for 2010-2012 implementation. Based on this expert assessment, the Action Agencies have selected projects for 2010 – 2012 implementation. Consistent with RPA Action 35, the expert panels will be reconvened in 3-year cycles to identify projects for each remaining implementation period of the BiOp. Beginning in 2011, the expert panels will also be provided climate change, temperature, invasive species and toxics information consistent with AMIP amendments 4 and 5 to apply and use as they identify and prioritize habitat improvement actions.

(2) Tributary habitat actions funded under the Accords are linked to biological benefits based on limiting factors for ESA-listed fish, consistent with recovery plans and subbasin plans. In the areas where habitat expert panels are convened, the habitat projects advanced under the Accords will be reviewed by these panels to confirm habitat improvements and survival estimates.

(3) All projects funded by BPA are subject to Independent Science Review Panel (ISRP) review.[4]

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[3] See Action Agencies' FCRPS 2008 Progress Report and Action Agencies' Draft 2010-2013 FCRPS Implementation Plan.

[4] ISRP review is provided pursuant to the Northwest Power Act to help assure that projects recommended by the Council and funded by BPA are consistent with the Council's Program, are based on "sound scientific principles, benefit fish and wildlife, and have clearly a defined objective and outcome with provisions for monitoring and evaluation of results" (see 16 USC

Project selection in the estuary also occurs in three ways and, as in the tributary program, each project selection path incorporates rigorous independent scientific review and information gathered through ongoing research, monitoring and evaluation.

(1) Projects selected and implemented through the Washington estuary MOA are assessed by a regional expert technical group (expert panel) assembled in accordance with RPA Action 37 to determine associated biological benefits.

(2) Projects selected through BPA's Columbia Basin Fish and Wildlife Program are selected on an annual basis and utilize both the ISRP and the expert panel under RPA Action 37.

(3) Projects selected by the Corps through its Section 536 WRDA 2000 program are also assessed for biological benefits by the RPA Action 37 expert panel.

The independent science reviews and assessments common to all of these project selection processes for tributary and estuary habitat projects help ensure that the most knowledgeable experts are reviewing potential projects for their biological value to salmon and steelhead and incorporating the results of RM&E in that process. These RM&E activities, implemented under the 2008 RPA Actions 56 & 57, involve status and trend monitoring to improve the general understanding of productivity and abundance for specific salmon and steelhead populations, and effectiveness monitoring to better quantify improvements in habitat quality and the survival of salmon and steelhead populations from tributary habitat projects. For example, specific scientific investigations in six tributary subbasins, called Intensively Monitored Watersheds (IMWs), aim to contribute empirical information that ultimately can be used to inform the tributary habitat survival estimates developed through the collaboration process. Monitoring and evaluating the effects of selected individual habitat restoration actions at project sites and developing and implementing a methodology to estimate the cumulative effects of habitat conservation and restoration projects in terms of cause-and-effect relationships affecting salmon habitats and performance in the estuary is another example of efforts to better quantify improvements in habitat quality to fish survival.

839b(h)(10)(D)(iv). In the current process, the entity that will undertake the project submits a narrative of the project for ISRP review; the results of the ISRP review are made available, and if needed, the project sponsor responds; both the Council and BPA take this information into account when making their respective decisions. The ISRP process is tracked by the Council and is posted at http://www.nwcouncil.org/fw/projectselection/BiOp/Default.asp (for new BiOp projects) and at http://www.nwcouncil.org/fw/projectselection/accord/Default.asp (for new Accord projects).

Finally, additional activities help address the inherent uncertainties associated with habitat benefits. The first is that, though adaptive management, new information available from RM&E (particularly from the Intensively Monitored Watersheds), recovery plans, the scientific literature, and other sources will inform future tributary habitat project benefit estimates (see RPA Actions 35, 56, and 57 and AMIP amendments 4 and 5).

F. The FCRPS Action and BiOp Result from and Offer Opportunities for Continued Dialogue and Collaboration.

BPA's ROD to implement the 2008 BiOp describes how implementation of the 2008 BiOp RPA results from collaboration among Federal Agencies, states, tribes, and other entities and individuals, and provides opportunities for continued collaboration. The RPA, as amended by the 2010 Supplemental BiOp, results from consideration of others' views, implementation of the Accords, and continues to offer avenues for continued collaboration. AMIP at 40; AMIP Appendix 1 at 22-23.

G. The FCRPS Action Is Consistent with Other Federal Laws and Responsibilities.

1. Essential Fish Habitat Recommendations under the Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), § 305, NOAA makes conservation recommendations to mitigate adverse effects on essential fish habitat (EFH) of species regulated under federal fishery management plans. As part of the 2008 FCRPS BiOp, NOAA considers EFH designated by the Pacific Fisheries Management Council (PFMC) for Chinook and Coho salmon, groundfish, and coastal pelagic species. 2008 FCRPS BiOp § 15.2, p. 15-4. The 2010 Supp does not amend NOAA's conservation recommendations. As stated in this decision document, BPA will, as one of the Action Agencies, continue to implement the 2008 BiOp's recommended RPA, as amended by the 2010 Supplemental BiOp, and thereby also implement NOAA's MSA conservation recommendation.

2. Tribal Treaty and Trust Responsibilities

BPA's ROD to implement the 2008 BiOp RPA describes how its decision furthers BPA's tribal treaty and trust responsibilities. BPA's commitment to implement the RPA in the 2008 FCRPS BiOp, as amended by the 2010 Supplemental BiOp, continues action that helps fulfill the Federal tribal treaty and trust responsibilities. The RPA meets ESA responsibilities to avoid jeopardy to listed fish and the destruction or adverse modification of their designated critical habitat. It took into account the many discussions and dialogue with tribes during the remand

collaboration and the extensive commitments to tribes through the ten-year Columbia Basin Accords.

3. National Environmental Policy Act (NEPA)

BPA's ROD to implement the 2008 BiOp describes how several existing BPA programmatic NEPA documents provide the environmental analysis of the effects of implementing BPA's activities described in the 2008 BiOp, plus the terms and conditions of the BiOp's Incidental Take Statement. These existing NEPA documents include the System Operation Review EIS, Wildlife Mitigation Program EIS, Watershed Management Program EIS, Fish and Wildlife Implementation Plan EIS and associated RODs. BPA therefore relied on these NEPA documents to implement the 2008 BiOp and the terms and conditions of the BiOp's Incidental Take Statement. BPA continues to rely on these NEPA documents for its decision to implement the 2008 BiOp RPA, as amended by the 2010 Supplemental BiOp, because these NEPA documents also provide the environmental analysis for the types of BPA activities identified in the 2010 Supplemental BiOp. For BiOp actions that are within the scope of these existing NEPA documents, BPA will determine whether the environmental effects of the actions are adequately covered by the existing NEPA documents and no further NEPA documentation is necessary, or whether it will prepare additional NEPA documentation such as a tiered ROD or Supplement Analysis. To the extent that long-term implementation of the BiOp identifies proposed[s] actions in the future that are not covered by BPA's existing NEPA analyses, BPA will conduct additional environmental analyses, including any necessary NEPA documentation, as appropriate. In preparing our NEPA analyses, BPA also integrates other related and applicable environmental laws.

4. Equitable treatment

The Northwest Power Act requires that Bonneville exercise its responsibilities for hydropower operations consistent with the purposes of the Act "in a manner that provides equitable treatment for . . . fish and wildlife with the other purposes for which such system and facilities are managed and operated."[5] The NW Power and Conservation Council describes equitable treatment as "meet[ing] the needs of salmon with a level of certainty comparable to that accorded the other operational purposes."[6] Historically, BPA has provided equitable treatment on a system-wide basis primarily by implementing the Council's integrated fish and wildlife program and relevant Biological Opinions related to FCRPS operations.[7]

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[5] 16 U.S.C. § 839b(h)(11)(A)(i). The Action Agencies operate the FCRPS to fulfill multiple purposes such as flood control, fish mitigation, irrigation, and power production.
[6] Council Program 1992, Vol. II. p. 9.
[7] *See, e.g.*, BPA, System Operation Review Environmental Impact Statement Record of Decision, page 14 (Feb. 21, 1997) (selecting an FCRPS operating strategy in which "[c]onflicts between power and fish are resolved in favor of the fish, providing equitable treatment of fish and wildlife with the other purposes for which the FCRPS is operated"); BPA, Fish and Wildlife Implementation Plan Environmental Impact Statement, pages 2-33 to 2-36 (Apr. 2003)

Implementation of the 2008 FCRPS BiOp's RPA as amended through the May 2010 Supplement continues this approach. It continues and expands upon BPA's commitments to benefit fish and wildlife. Implementation of the BiOp furthers BPA's contribution to manage the FCRPS equitably for both fish and power.

5. In Lieu Provision

Under section 4(h)(10)(A) of the Northwest Power Act, Congress expressly limited BPA's authority to provide protection, mitigation, and enhancement in the in-lieu provision, which states:

> Expenditures of the Administrator pursuant to this paragraph shall be in addition to, not in lieu of, other expenditures authorized or required from other entities under other agreements or provisions of law.[8]

As explained by the House of Representative's Interior Committee, "other fisheries efforts outside this Act . . . are expected to continue and to be funded separately."[9]

Thus, if another entity is authorized or required under other agreements or provisions of law to undertake an activity, BPA cannot fund the activity under the authority of section 4(h)(10)(A) unless BPA's funding is in addition to, not in lieu of that other entity's funding. The in-lieu provision helps ensure that BPA's funding for fish and wildlife protection, mitigation and enhancement under section 4(h)(10)(A) is additive to on-going and future mitigation conducted by others, and is not simply supplanting other efforts outside of the Northwest Power Act. As it implements measures in the 2008 BiOp RPA, BPA will comply with the in-lieu provision.

6. Adequate, Efficient, Economical, and Reliable Power Supply

The data and analysis supporting the BiOp and RPA show that implementing the 2008 RPA, as amended by the 2010 Supplemental BiOp, will provide measurable benefits for fish and marine species. Implementing the 2008 RPA as amended by the 2010 Supplemental BiOp also helps fulfill BPA's responsibilities under the Northwest Power Act to protect, mitigate and enhance fish and wildlife. However, as discussed in the August 2008 ROD on the 2008 BiOp, implementation of the 2008 BiOp and RPA posed significant challenges to BPA's

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(summarizing how BPA provides equitable treatment in FCRPS management); FCRPS Action Agencies, Biological Assessment for Effects of FCRPS and Mainstem Effects of Other Tributary Actions on Anadromous Salmonid Species Listed under the ESA, pages 1-9 to 1-15 (Aug. 2007) (describing the FCRPS' overhaul—structural and operations changes for fish since 1994).

[8] 16 U.S.C. § 839b(h)(10)(A).

[9] H.R. Rep. No. 976, 96th Cong., 2d Sess., pt. 2, at 45. See also 126 Cong. Rec. H9846 (daily ed. Sept. 29, 1980) (Rep. Lujan: section 4(h)(10)(A) would "insure that the program will not call for measures already being implemented to protect, mitigate, and enhance fish and wildlife").

ability to meet its responsibilities under the Northwest Power Act for fish and wildlife while also maintaining an adequate, efficient, economical, and reliable power supply. The 2010 Supplemental BiOp does not significantly increase or decrease those challenges. As a result, the challenges and costs of operations to benefit fish remain as described in the August 2008 ROD on the 2008 BiOp. These include an estimated reduction in federal hydro system production by over 900 annual average megawatts of electricity when compared to an operation without changes to benefit fish and constraints to the flexible operation of the hydro system; currently the total average annual energy produced by all FCRPS projects is approximately 9000 aMW. BPA 2010 Rate Case.

During the development of the AMIP and the consultation that resulted in the 2010 Supplemental BiOp, a number of hydro operations alternatives were proposed by some parties in the region, including additional spill volumes and restrictions on reservoirs. These operations were considered, evaluated, and addressed during development of the 2008 BiOp. The 2010 Supplemental BiOp retains the 2008 BiOp's performance based approach to achieve effective fish passage rather than prescribing higher spill levels. Higher spill levels may not be necessary to achieve the BiOp performance standard but would certainly reduce hydro system output. To the extent that these alternative operations would further reduce the generation of the hydrosystem or restrict its flexibility in meeting load, they would escalate the costs and intensify the challenges of maintaining an adequate, effective, economical and reliable power supply.

For the same reasons, the proposed alternative hydro operations would also be counterproductive to the regions goals of reducing CO_2 emissions. Every 100 MW of energy lost because of spill in excess of what is needed to achieve the BiOp performance standards would increase CO_2 emissions by approximately 350[10] million metric tons, the equivalent of roughly 65 cars on the road[11]

While the impacts of climate change on ESA listed fish are examined in the 2010 Supplemental BiOp, there is an element of climate change that deserves further recognition: the benefits of the FCRPS in providing clean, renewable power for use in the Northwest and for California. According to the NW Power and Conservation Council's Sixth Power plan, it is unlikely that there will be sufficient cost effective conservation and renewable energy development to meet expected load growth. Therefore, the replacement of carbon-free hydro electricity production in the Pacific Northwest will almost always increase the use of fossil

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[10] Northwest Power and Conservation Council "*Marginal Carbon Dioxide Production Rates of the Pacific Northwest Power System*" *(June 2008)* This paper forecasts the marginal C02 production rate for the Northwest Power System to be between 0.7 lbs to 0.9 lbs per kWh for the time period 2010 to 2025 under interim base case assumptions. In this base case analysis, natural gas fired combined cycle plants are on the margin most of the time followed by biomass and coal fired power plants, and demand response programs.

[11] Source EPA: http://www.epa.gov/otaq/climate/420f05004.htm

fuel fired units and on average increase greenhouse gas emissions. This means actions taken to enhance salmon restoration that reduce federal hydro system output will lead to increases in greenhouse gas emissions.

In addition, constraints on flexibility in operating the hydro system limit the system's ability to support wind power production, another renewable resource. Large amounts of wind energy resources have been developed in the Pacific Northwest in recent years. Nearly 1300 MW of wind capacity have been added since the 2008 BiOp was issued, almost doubling the total installed wind capacity To put that in perspective, 2009 average control area load was approximately 6200 MW, so wind capacity as a percentage of average control area load has increased from about 24% to about 45% between May 2008 and May 2010. These wind facilities primarily rely on BPA to integrate them into the regional transmission grid and to use the FCRPS hydro system as a giant battery to level out the volatility inherent from wind production and to assure reliability.

Installed wind capacity is expected to increase to over 6000 MW by 2013 which is expected to give BPA the highest ratio of wind power to load of any power system in the United States. 2009 Draft Resource Program, § 4.4. BPA's 2009 Draft Resource Program estimates that by 2013 a tipping point will be reached when the projected available system reserves will be insufficient to integrate additional wind power resources. Proposals to limit reservoir operations and to limit or prohibit load following would deplete the available system reserves and as a result hasten the date when the region reaches that tipping point. Any non-hydro resources developed to replace the flexibility of the hydro system to integrate wind resources are likely to be fossil fuel fired, leading to further greenhouse gas emissions.

Some regional parties continue to advocate for removal of the four lower Snake River Dams. The 2010 Supplemental BiOp, by incorporating the AMIP into the RPA properly recognized this as an option of last resort in part because of the impact removal would have both on climate change and on maintaining an adequate, efficient, economical, and reliable power supply.

The four lower Snake River dams are major power plants critical for energy, peak loads, reliability, and wind integration. Each of the four lower Snake River dams provides significantly more power capacity than a typical coal plant. The nameplate capacity of the four lower Snake River dams totals 3,033 MW. In an extended cold-snap or other power emergency, such as another power plant shutting down unexpectedly, these four dams can produce in excess of 2,650 MW over a sustained period of 10 hours per day for five consecutive days. The four lower Snake River dams produce about 1200 aMW, annually almost as much as BPA's conservation programs have achieved in 27 years — at an investment of more than $2.3 billion[12]: Together, the four Snake River dams

[12] Four lower Snake River dams:1,022 aMW, BPA conservation programs (1982–2008):1,190 aMW.

supply 12 percent of the average energy production of the entire FCRPS and 5 percent of the Pacific Northwest. This is enough energy to serve a city about the size of Seattle.

The four lower Snake River dams carry roughly one-quarter of BPA's operating reserves, capacity that utilities are required to have available to meet unexpected hourly changes in load. Without the flexibility and operating reserves that these dams supply, BPA would lose a substantial amount of its ability to deliver energy to the power system.

Hydropower generated by the FCRPS is a renewable resource and produces virtually no greenhouse gas emissions. Replacing the power from the four lower Snake River dams would result in increased carbon emissions of 3.0 million tons year, according to the NW Power and Conservation Council's Sixth Power Plan. This is an amount five times greater than the amount of carbon saved by renewable resource standards adopted by the states of Oregon, Washington and Montana combined. A 2007 Council study on the Northwest's carbon footprint concluded[13] that:

> "Removal of the lower Snake River dams will not make additional CO_2-free energy resources available to meet future load growth or retire any existing coal plants. More than 1,000 MW of emission-free generation eventually will have to be replaced unless the supplies of renewables and conservation are considered unlimited. Given the difficulty of reducing CO_2 emissions, discarding existing CO_2-free power sources has to be considered counterproductive."

The study also found that replacing the power from the four lower Snake River dams would cost an estimated $530 million annually, resulting in an increase in BPA's wholesale power rate of 24 percent to 29 percent.[14] Similarly, BPA's own analysis found that replacing the power from the four lower Snake River dams would cost the Northwest $444 million to $501 million (net of the dams' annual $38 million operation and maintenance costs), increasing BPA's wholesale power rates by roughly 25 percent. As indicated by this information, the four lower Snake River dams are important to the Northwest's power needs and help keep our system low in carbon emissions.

In summary, implementing the 2008 RPA, as amended by the 2010 Supplemental BiOp will provide benefits to listed fish and marine species. However, actions reducing federal hydro system output can limit the system's ability to integrate wind power resources, and substitute resources can increase greenhouse gas emissions.

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[13] Northwest Power and Conservation Council, "Carbon Dioxide Footprint of the Northwest Power System" (Nov. 2007), p. 11.
[14] Ibid.

7. Water Qualify, Clean Water Act

In developing the proposed RPA for the 2008 BiOp the Action Agencies collaborated extensively with the four Columbia Basin states and various Columbian Basin Tribes throughout the consultation, and considered their comments during the development of the proposed RPA. The Action Agencies considered the respective ecological objectives of the ESA and the Clean Water Act (CWA) and harmonized federal dam operations to comply with both the ESA requirements, determined by the NMFS and FWS, and the state and tribal water quality standards. The 2008 RPA, as amended by the 2010 Supplemental BiOp, will continue to implement actions to attain water quality standards (e.g., reducing Total Dissolved Gas (TDG) and improving water temperature) that will benefit ESA-listed species. In addition, the amended 2010 RPA specifically calls for the Action Agencies to collect and share information related to climate change and water temperature, to help evaluate regional climate change impacts that may occur throughout the term of the BiOp. As these climate change evaluations are completed, their findings will be provided to the tributary habitat expert panels to apply and use to help identify and prioritize habitat improvement actions.

IV. Decision

Based on the 2008 BiOp and supporting documents, implementation of the 2008 BiOp, development of the AMIP, the 2010 Supplemental BiOp and supporting analyses and new information, and collaboration with and comments from federal and state agencies and tribes and interested persons and entities, it is my decision that BPA, in cooperation with the other Action Agencies, will implement the 2008 BiOp's RPA and measures, terms, and conditions in the 2008 BiOp Incidental Take Statement, as amended by the 2010 Supplemental BiOp and Incidental Take Statement.

My decision requires a significant commitment of resources from the region's ratepayers, including spill and flow augmentation, repayment to the Treasury for configuration improvements, extensive support for research, monitoring, and evaluation of the system and off-site measures, and new actions within our already extensive off-site mitigation program. These actions, taken together, will meet BPA's responsibilities under the ESA to avoid jeopardizing and allow for an adequate potential for recovery of species that are the subject of this

consultation, and avoid the destruction or adverse modification of their designated critical habitat. These actions also further BPA's commitment to meet its responsibilities under the Northwest Power Act to protect species and also be consistent with BPA's multiple statutory responsibilities.

Issued in Portland, Oregon, this 11th day of June 2010.

Stephen J. Wright
Administrator and Chief Executive Officer

Attachment C

BONNEVILLE POWER ADMINISTRATION

2011 AMENDMENT

To

2010 RECORD OF DECISION

following the

MAY 20, 2010, NOAA FISHERIES
SUPPLEMENTAL BIOLOGICAL OPINION

to the

May 2008 FCRPS BIOLOGICAL OPINION

for

MANAGEMENT and OPERATION

of the

FEDERAL COLUMBIA RIVER POWER SYSTEM,

11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,

and

ESA SECTION 10 PERMIT FOR
JUVENILE FISH TRANSPORTATION PROGRAM

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ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

2008/2010 BiOp	NOAA Fisheries' 2008 BiOp, as amended by NOAA's 2010 Supplemental BiOp.
2008 FCRPS BiOp	NOAA's May 2008 Biological Opinion for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program. NOAA Fisheries, May 5, 2008.
2008 BPA ROD	BPA's ROD to implement the 2008 BiOp RPA and ITS.
2010 Supplemental BiOp	Supplemental Biological Opinion for operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program. NOAA Fisheries, May, 2010.
2010 BPA ROD	BPA's ROD to implement the 2008/2010 BiOp RPA and ITS.
Action Agencies	U.S. Department of the Interior, Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers, Bonneville Power Administration, the agencies responsible for management and operation of federal hydroelectric projects in the Columbia and Upper Snake Rivers
Biological Opinion	A document that states the opinion of NOAA Fisheries as to whether or not the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. See 50 C.F.R. § 402.02
BiOp	biological opinion
BPA	Bonneville Power Administration
Corps	U.S. Army Corps of Engineers
ESA	Endangered Species Act, 16 U.S.C. 1531 et seq.

Federal Defendants	The Federal Defendants in the National Wildlife Federation v. National Marine Fisheries Service, 01-cv-640-RE (D. Or.), are NOAA Fisheries, the Army Corps of Engineers, and Bureau of Reclamation.
FCRPS	Federal Columbia River Power System
Jeopardize	"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. 50 C.F.R. § 402.02
NOAA Fisheries	National Marine Fisheries Service, an agency within the National Oceanic and Atmospheric Administration
Reasonable and Prudent Alternative (RPA)	Recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the purposes of the action, that can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that NOAA Fisheries believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat. See 50 C.F.R. § 402.02.
Reclamation	U.S. Bureau of Reclamation
ROD	Record of decision.
Spill	Water released from a dam over the spillway instead of being directed through the turbines.

BONNEVILLE POWER ADMINISTRATION

2011 AMENDMENT to 2010 RECORD OF DECISION

Following the

MAY 20, 2010, NOAA FISHERIES SUPPLEMENTAL BIOLOGICAL OPINION

to the

MAY 2008 NOAA FISHERIES FCRPS BIOLOGICAL OPINION

for

OPERATION

of the

FEDERAL COLUMBIA RIVER POWER SYSTEM,

11 U.S. BUREAU OF RECLAMATION PROJECTS in the COLUMBIA BASIN,

and

ESA SECTION 10 PERMIT FOR JUVENILE FISH TRANSPORTATION PROGRAM

I. Summary

In a 2010 Record of Decision, BPA decided to implement, in coordination with other federal agencies, NOAA Fisheries' 2008/2010 ten-year biological opinion RPA for operation and management of the federal hydroelectric projects in the Columbia and Snake Rivers. In August 2011, a federal district court declined to set aside the 2008/2010 BiOp RPA's habitat mitigation measures through 2013 but criticized the post-2013 habitat measures as indefinite and not reasonably certain to occur. The district court ordered a remand to NOAA Fisheries, directing NOAA Fisheries to issue a new or supplemental biological opinion by January 1, 2014. To avoid reliance on measures found by the court to be invalid, BPA amends its 2010 decision to implement, in coordination with other federal agencies and in collaboration with state agencies and tribes, NOAA Fisheries' 2008/2010 biological opinion RPA through 2013 or until such as time as the new or supplemental BiOp ordered by the court takes effect, whichever is later.

II. Reasons for Decision

As described in Bonneville Power Administration's attached 2008 ROD at 1-3, the Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA) have various statutory responsibilities concerning the management and operation of the federal hydroelectric projects in the Columbia and Upper Snake Rivers. In addition, Reclamation operates reclamation projects in these rivers.

To meet responsibilities under the Endangered Species Act, these agencies (collectively the Action Agencies) consult with NOAA Fisheries. After consultation, NOAA Fisheries issues a biological opinion as to whether or not the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat After issuance of a biological opinion, BPA issues decision documents or records of decision.

NOAA Fisheries issued a biological opinion in 2008 and a supplemental BiOp in 2010 (collectively referred to as the 2008/2010 BiOp) on the operation of the Federal Columbia River Power System, 11 Bureau of Reclamation projects in the Columbia Basin, and a ESA Section 10(a)(1)(A) permit for juvenile fish transportation program. The 2008/2010 BiOp is a ten-year BiOp, covering the years from 2008 to 2018.

Most recently, BPA issued a June 11, 2010, Record of Decision providing that BPA will implement, in cooperation with the other Action Agencies, NOAA Fisheries' 2008/2010 BiOp's RPA and the terms, and conditions in the 2008/2010 BiOp Incidental Take Statement (ITS). In its 2010 ROD, BPA concluded that the 2008/2010 BiOp RPA and ITS are not likely to jeopardize listed species or result in the destruction or adverse modification of designated critical habitat.

To the extent not amended herein, this 2011 ROD incorporates by reference BPA's 2010 ROD and attaches it as an appendix. The 2010 ROD incorporates in turn BPA's ROD to implement the 2008 BiOp.

The 2008/2010 BiOp has now undergone judicial review. In National Wildlife Federation v. National Marine Fisheries Service, Case 3:01-cv00640-RE Document 1855, Slip Copy, 2011 WL 3322793 (D. Or. Aug. 2, 2011), Judge Redden left in place the BiOp, including the RPA's habitat mitigation measures through 2013, but criticized the NOAA Fisheries' reliance on post-2013 habitat mitigation actions as not reasonably certain to occur.

> NOAA Fisheries relies on two types of habitat mitigation actions. The first includes specific identified projects scheduled to occur between 2008 and 2013. The second, however, includes broad, unidentified categories of projects that the Federal Defendants intend to develop and implement between2013 and 2018. (Slip Op. at 12, 2011 WL 3322793 at 5.)

> NOAA Fisheries updated various quantitative data, and identified specific habitat mitigation actions for 2010 through 2013. (Id. at 8, 2011 WL 3322793 at 4.)
>
> But NOAA Fisheries has not identified any specific habitat projects after 2013. (Id. at 12, 2011 WL 3322793 at 5.)
>
> NOAA Fisheries' reliance on undefined actions for such large survival increases is contrary to the ESA's requirements that mitigation must be specific, reliable, and certain to occur. (Id. at 14, 2011 WL 3322793 at 6.)

Judge Redden did not set aside the BiOp through 2013 but remanded the BiOp to NOAA Fisheries.

> For the reasons above, I find that the no jeopardy decision for the entire ten-year term of the BiOp is arbitrary and capricious because NOAA Fisheries has failed to identify specific mitigation plans beyond 2013, that are reasonably certain to occur. Because the 2008/2010 BiOp provides some protection for listed species through 2013, however, I order NOAA Fisheries to fund and implement the BiOp until then. (Id. at 17 (emphasis in the original), 2011 WL 3322793 at 7.)
>
> I will remand the BiOp to the action agencies and order NOAA Fisheries to keep this BiOp and its incidental take statement in place through 2013, when NOAA Fisheries' currently identified mitigation plans expire or are scheduled to be completed. The BiOp contains positive mitigation measures that provide adequate protection to the listed species through 2013. (Id. at 19, 2011 WL 3322793 at 8.)

Therefore, the court ordered that the 2008/2010 BiOp remain in place until December 31, 2013, the period over which the BiOp provides sufficiently specific mitigation actions and provides adequate protections for the listed species. Id. at 23, 2011 WL 3322793 at 10. The court also ordered that NOAA Fisheries produce a new or supplemental BiOp by January 1, 2014, to correct the 2008/2010 BiOp's reliance on post-2013 measures that the court concluded were unidentified and not reasonably certain to occur. Id. at 23, 2011 WL 3322793 at 10. The district court also required Federal Defendants to continue spring and summer spill in a manner consistent with the court's annual spill orders. Id. at 3, 22, 2011 WL 332793 at 2, 10. Federal Defendants have not sought a stay of the district court's remand order or grant of injunctive relief, and are moving forward in compliance with these measures on remand.

One practical effect of Judge Redden's opinion is to revise the temporal scope of the BiOp to run through 2013, to avoid reliance on post-2013 habitat measures that the court has rejected. Therefore, BPA amends its 2010 ROD to implement,

in cooperation with the other Action Agencies and in collaboration with state agencies and tribes, the 2008/2010 BiOp RPA through 2013, instead of through 2018, so that BPA's decision correspondingly relies only on habitat measures viewed by the court as reasonably certain to occur and providing adequate projection for the listed species through 2013.

III. Decision

Based on the 2008 and 2010 BiOps and supporting documents, BPA's RODs following these BiOps, and to act consistent with the NWF v. NMFS August 2, 2011, opinion and order, it is my decision that BPA will implement, in cooperation with the other Action Agencies and in collaboration with state agencies and tribes, the 2008/2010 BiOp's RPA, including the terms and conditions in the 2008/2010 BiOp Incidental Take Statement, through December 31, 2013, or until such as time as the new or supplemental BiOp ordered by the court takes effect, whichever is later. The RPA's habitat mitigation measures through 2013 were not set aside by the court as unspecific or not reasonably certain to occur, and BPA will also consult with NOAA Fisheries respecting the new or supplemental BiOp.

Pending the new or supplemental BiOp, these actions will meet BPA's responsibilities under the ESA to avoid taking actions that are likely to jeopardize listed species or destroy or adversely modify critical habitat. These actions also further BPA's commitment to meet its responsibilities under the Northwest Power Act to protect species and also be consistent with BPA's multiple statutory responsibilities.

Issued in Portland, Oregon, this 15th day of December 2011.

/s/ Stephen J. Wright

Stephen J. Wright
Administrator and Chief Executive Officer

Petersen,Christine H (BPA) - KEWR-4

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Thursday, February 27, 2014 5:34 PM
To: 'rich@hinrichsenenvironmental.com'
Subject: Re: ISAB Spill Study Review - materials and January 17, 2014 briefing

Thanks Rich,

Non-Responsive [redacted]

Christine

From: Richard A. Hinrichsen [mailto:rich@hinrichsenenvironmental.com]
Sent: Wednesday, February 26, 2014 12:28 PM Pacific Standard Time
To: Petersen,Christine H (BPA) - KEWR-4
Subject: RE: ISAB Spill Study Review - materials and January 17, 2014 briefing

Hi Christine,

Non-Responsive [redacted]

-Rich

From: Petersen,Christine H (BPA) - KEWR-4 [mailto:chpetersen@bpa.gov]
Sent: Thursday, January 16, 2014 2:08 PM
To: Al Giorgi (al.giorgi@bioanalysts.net); Richard A. Hinrichsen (rich@hinrichsenenvironmental.com); Charlie Paulsen <cpaulsen@paulsenenvironmentalresearch.com> (cpaulsen@paulsenenvironmentalresearch.com)
Subject: FW: ISAB Spill Study Review - materials and January 17, 2014 briefing

Hi,
In case you're following, they have most of the presentations and materials for the ISAB review of the spill test available at the dropbox link below. Jason Sweet, John Skalski and others will be giving presentations tomorrow

Christine

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, January 16, 2014 12:30 PM
To: Petersen,Christine H (BPA) - KEWR-4
Subject: FW: ISAB Spill Study Review - materials and January 17, 2014 briefing

Open the dropbox link to see documents, several documents!

From: Sweet,Jason C (BPA) - KEWR-4
Sent: Tuesday, January 14, 2014 12:47 PM
To: Barco III,John W (BPA) - A-7
Subject: FW: ISAB Spill Study Review - materials and January 17, 2014 briefing

Agenda is attached below.

From: Merrill, Erik [mailto:emerrill@nwcouncil.org]
Sent: Monday, January 13, 2014 4:22 PM
To: Merrill, Erik; Ruff, Jim; 'Scott, Teresa L (DFW)'; 'Michele Dehart'; Sweet,Jason C (BPA) - KEWR-4
Cc: Grover, Tony; 'Bill Tweit'; 'Tom Rien'; 'Robert Naiman'; 'Greg Ruggerone'; 'Rich Alldredge ((b)(6) [redacted])'; 'Rock.D.Peters@nwd01.usace.army.mil'; 'Graves, Ritchie'; Ruff, Jim; 'Mike.Ford@noaa.gov'; 'ROGP@critfc.org'; F&W State Staff; F&W Plus
Subject: RE: ISAB Spill Study Review - materials and January 17, 2014 briefing

All,

The attached publication was added to the ISAB's list of review materials and to inform the upcoming meeting on January 17, 2014 regarding the discussions regarding spill experimentation.

Thanks, Erik

Evaluating river management during seaward migration to recover Columbia River stream-type Chinook salmon considering the variation in marine conditions

Howard A. Schaller, Charles E. Petrosky, and Eric S. Tinus
Abstract: Evidence suggests Snake River stream-type Chinook salmon (Oncorhynchus tshawytscha) experience substantial delayed mortality in the marine environment as a result of their outmigration experience through the Federal Columbia River Power System (FCRPS). We analyzed mortality patterns using methods that incorporated downriver reference populations passing fewer dams, and temporal approaches that were independent of reference populations. Our results from the alternative spatial and temporal methods consistently corroborated with spawner–recruit residuals and smolt-to-adult survival rate data sets, indicating that Snake River salmon survived about one quarter as well as the reference populations. Temporal analysis indicated that a high percentage (76%) of Snake River juvenile salmon that survived the FCRPS subsequently died in the marine environment as a result of their outmigration experience. Through this and previous studies, it is evident that delayed hydrosystem mortality increases with the number of powerhouse passages and decreases with the speed of outmigration. Therefore, a promising conservation approach would be to explore management experiments that evaluate these relationships by increasing managed spill levels at the dams during the spring migration period.

From: Merrill, Erik
Sent: Friday, January 10, 2014 4:27 PM
To: Ruff, Jim; 'Scott, Teresa L (DFW)'; 'Michele Dehart'; 'Sweet,Jason C (BPA) - KEWR-4'
Cc: Grover, Tony; 'Bill Tweit'; 'Tom Rien'; 'Robert Naiman'; 'Greg Ruggerone'; 'Rich Alldredge ((b)(6) [redacted])'; 'Rock.D.Peters@nwd01.usace.army.mil'; 'Graves, Ritchie'; Ruff, Jim; 'Mike.Ford@noaa.gov'; 'ROGP@critfc.org'
Subject: ISAB Spill Study Review - materials and January 17, 2014 briefing

All,

Thank you for your assistance in providing materials for the ISAB's review of the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The ISAB and Council have received some requests to see and access the materials that the ISAB will use in the review. These materials are compiled and available on the Council's drop box at http://dropbox.nwcouncil.org/ISAB%20Spill%20Study%20Review%20Materials.

The materials are extensive, but please let us know if we are missing any critical recent documents related specifically to the proposed spill experiment. See below for a general list of the materials.

The ISAB received a briefing from the CSS team on the spill experiment at its November 15, 2013 meeting. To provide ISAB members, especially new members, with additional context for the review, the Bonneville Power Administration, U.S. Army Corps of Engineers, and potentially NOAA Fisheries are scheduled to brief the ISAB on the status of current spill operations, studies, and study results.

You are welcome to attend or participate on the phone/GoTo meeting. Please share this email as needed.

ISAB Meeting Agenda, Friday, January 17, 2014
Large Conference Room, Council Offices, Portland, Oregon
851 SW 6th Ave, Ste. 1100 (800-452-5161)

Conference Line Toll-Free Access Number: 1.800.786.1922 – Participant Code: 16628858#[1]
To follow the meeting on the Web, we've reserved GoTo meeting, follow the instructions at:
https://www1.gotomeeting.com/join/786859816; Meeting ID: 786-859-816

10:15-Noon	Context for the ISAB's review of the proposed spill experiment: briefing and discussion with Bonneville Power Administration, U.S. Army Corps of Engineers, and potentially NOAA Fisheries on the status of current spill operations, studies, and study results

Materials for ISAB review of the proposed spill experiment

See the Council's request letter: "Council spill review request to ISAB 16Dec13.pdf"

1. Jim Ruff's memo to the Council summarizes the Experimental Spill Management Proposal
2. Supporting biological reference materials are available in the "2_Spill Proposal…" subfolder)
   - presentations from the CSS annual meeting held in Vancouver, Washington, April 30, 2013, (http://www.fpc.org/documents/CSS/Presentations%20from%20the%202013%20CSS%20Annual%20Meeting.pdf); and b) a presentation by Dr. S. L. Haeseker and Dr. M. Filardo at a meeting of the Northwest Power and Conservation Council held in Coeur d'Alene, Idaho, on September 10, 2013, (http://www.nwcouncil.org/media/6877229/2.pdf). [Schaller presented to the ISAB, the PPT is included in the subfolder.]
   - Haeseker, S. L., J.A. McCann, J. Tuomikoski, B. Chockley. 2012. Assessing Freshwater and Marine Environmental Influences on Life-Stage-Specific Survival Rates of Snake River Spring–Summer Chinook Salmon and Steelhead. Transactions of the American Fisheries Society 141(1):121-138.
   - Hall, A. and D. Marmorek. 2013. Comparative Survival Study (CSS) 2013 Workshop Report. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for the Fish Passage Center (Portland OR) and U.S. Fish and Wildlife Service (Vancouver WA). 47 pp. + Appendices.
   - Marmorek, D., Hall, A., and M. Porter. 2011. Comparative Survival Study (CSS) Workshop Report. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for the Fish Passage Center (Portland OR) and U.S. Fish and Wildlife Service (Vancouver WA), 147 pp.
   - Petrosky, C.E., and H.A. Schaller. 2010. Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead. Ecology of Freshwater Fish 10:520-536.
   - Tuomikoski, J. and eleven co-authors. 2012. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead 2012 Annual Report. Prepared by the Fish Passage Center, BPA Contract #19960200, 392 pp.
   - Also see the Marmorek 2011 CSS Workshop summary and Hall and Marmorek 2013 CSS Workshop Summary
   - The FPC and CSS also comment on others' comments
3. For context, see the Action Agencies', NOAA's, and Skalski's comments on CSS findings and the spill experiment. Also see the Action Agencies' general description of current operations/studies/results in the "dam aerial…" pdfs, Progress Report, and Citizen Guide. These documents are in the subfolder "3_Action Agency NOAA…"

4. Grant County also provided some comments on the spill proposal, see “4_Grant County…”
5. One of the issues with the proposal is TDG standards, there are a couple of documents in the “5_Total dissolved gas” subfolder
6. The ISAB has conducted many reviews related to spill over the past 17 years and also some on dissolved gas. These reviews should provide useful context. For the most recent relevant review see ISAB 2010-2 in the subfolder "6_ISAB Docs on Spill TDG”

Have a great weekend,

Erik

Erik Merrill
Manager, Independent Scientific Review Program
Northwest Power and Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
503-222-5161
800-452-5161 (toll-free)

[1] Participant Star Commands: Pressing *4 will increase/decrease the volume. Pressing *6 will mute/unmute your line

From:	McNary,Sarah R (BPA) - A-7
To:	Majkut,Paul S (BPA) - L-7; Bodi,Lorri (BPA) - KE-4; Harwood,Holly C (BPA) - PGB-5; Pendergrass,Richard M (BPA) - PG-5
Cc:	Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4
Subject:	FW: Final signed Spill Test MFR - 022814
Date:	Friday, February 28, 2014 2:46:02 PM
Attachments:	Final Spill Test MFR_signed (022814).pdf

FYI. Hot off the press. I haven't reviewed this yet. The Corps will include this in their administrative record on the BiOp.
S.

-----Original Message-----
From: Peters, Rock D NWD [mailto:Rock.D.Peters@usace.army.mil]
Sent: Friday, February 28, 2014 2:22 PM
To: McNary,Sarah R (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Puckett, Kathryn
Cc: Feil, Dan H NWD
Subject: FW: Final signed Spill Test MFR - 022814

Attached is the MFR on the spill test.

ROck

CENWD-PDD 28 February 2014

MEMORANDUM FOR THE RECORD

SUBJECT: State of Oregon Proposed Spill Experiment Recommendation Concerns

1. Background – Included in comments received on the draft NOAA 2014 Supplemental Biological Opinion (BiOp) and Action Agencies Implementation Plan (IP), the State of Oregon and others recommended a systemwide spill experiment be initiated to test their hypothesis that increased spill will increase smolt to adult return (SAR) rates of listed salmon and steelhead stocks. Oregon, along with the Nez Perce Tribe, the Pacific Fishery Management Council, and environmental and fishing groups also submitted their proposed spill experiment for consideration by the Northwest Planning and Conservation Council (Council) for inclusion in the forthcoming Fish and Wildlife Program Amendments. The Council submitted scientific questions about the Oregon proposed spill experiment to the Independent Scientific Advisory Board (ISAB) The specific recommendation from Oregon is as follows:
   - *Increase spill to 125% of total dissolved gas (TDG) level or biological constraints. Because 125% TDG exceeds water quality criterion, criteria modifications through regulatory processes are required. (current water quality waivers include 120% TDG tailrace and 115% TDG in forebay (WA))*
   - *Operate these spill levels during spring operations for a period of 10 years, with a comprehensive assessment after 5 years.*
   - *Implement this program at all FCRPS projects - Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.*
   - *Use the Comparative Survival Studies (CSS) PIT-tag monitoring framework to monitor smolt-to-adult survival rates. These should be used to compare survival rates against both past survival rates and prospective model predictions and to evaluate whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.*
   - *Incorporate sideboards or "off-ramps" to ensure hydropower viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.*

2. Current BiOp Strategy – The 2014 Supplemental FCRPS BiOp is performance-based in which biological performance standards and targets for hydro, habitat, and predation management actions with associated performance metrics are required to be met by 2018. Performance measures specified in NOAA's current BiOp focus on the survival of juvenile fish as they pass dams during their outmigration through the hydrosystem; both at individual dams and through the system as a whole. In addition, adult fish survival is estimated to determine their overall success in passing through the hydrosystem as they return to spawn. SARs are currently estimated annually and used for comparing the seasonal effects of juvenile transport relative to in-river migration strategies to guide future transport operations. However, SARs are not currently specified as performance measures in the BiOp due to the fact that many factors outside of the hydrosystem passage experience influence the SAR of the various listed stocks (e.g. disease, ocean survival,

variable harvest rates, etc). The current hydro strategy includes making specific passage improvements at the dams and providing spill at levels tailored specifically to each dam's configuration to facilitate safe downstream juvenile fish passage, without impeding adult upstream passage.

3. Independent Scientific Advisory Board Review – The ISAB recently reviewed the systemwide spill test proposed by Oregon (http://www.nwcouncil.org/media/6939290/ISAB2014-2.pdf). Generally, the ISAB concluded "the spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality." Additionally, the ISAB noted that "An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region." Many of the spill test concerns pointed out by the ISAB have been previously expressed by the Corps, NOAA, and others and are included below in this memo.

4. Spill Test Concerns
   - *Biological Consequences and Uncertainties*
     - Adult salmon passage delay and fallback would likely occur at many dams as spill increases significantly beyond current levels. Adult salmon passage delay and fallback has been previously documented at spill levels much lower than what Oregon proposes. Any increase in SARs (assuming Oregon's claim was realized) may be offset by direct impacts at each dam due to increased delay and fallback.
     - Oregon claims a reduction in travel time to the estuary with increased spill. Increasing spill at run of river dams does not speed up water travel time through the system. Any reduction in fish travel time through the system would come from reduced passage delay at dams. However, passage delay under current spill operations with surface passage routes now available at all dams is on the order of a only few hours to less than hour, depending on dam. It is possible that fish travel time to the estuary may be extended under higher spill conditions. Significantly increasing spill will cause unbalanced tailrace conditions below the dams and increase the formation of tailrace eddies, which tend to delay juvenile migration. Additionally, predation by both avian and piscivorous predators would likely increase due to potential extended tailrace residence times and increased exposure of juvenile salmonids to areas where predator concentrations tend to be high.
     - The overall survival of juvenile fish passing through the system may decrease due to increased spill shifting juvenile fish passage away from surface-oriented passage spillway weirs to conventional spillbays, which typically have slightly lower passage survival.
     - Proportion of juvenile fish transported would be reduced, thereby potentially lowering SARs of Snake River ESUs, as transported fish generally tend to return at higher rates compared to fish that are left in-river to migrate.
     - Prolonged exposure to 125% TDG throughout the hydrosystem for the entire outmigration season would increase the deleterious effects of TDG on listed

juvenile and adult salmonid species, as well as other aquatic biota including organisms upon which juvenile salmon feed.

  - Current estimates of juvenile dam passage survival for spring migrants at most dams under existing BiOp spill operations have been estimated at 95-100 percent in recent years (Table 1). With the addition of surface passage at all eight dams, the proportion of fish passing dams through spillway and surface passage routes under existing BiOp spill operations currently averages ~70 percent, depending on dam and species (Table 1). The remaining proportion of fish that pass dams via turbine and screened bypass routes, up to roughly 30 percent, also survive at relatively high rates as indicated in Table 1. It is not intuitive how simply increasing spillway passage can result in a two or three fold increase in SARs when juvenile survival through screened bypass systems and/or turbines is relatively high (even higher than spillway passage in many instances) and passage is proportionally low.
  - The method for routing fish though available passage routes at each dam has not been fully described by the CSS and is not well understood. The CSS may be under estimating the proportion of fish that already pass dams though spillways and surface passage routes. If spillway and surface passage are under-represented in CSS modeling, the benefit that Oregon claims will result from increasing spill may be somewhat reduced.

- *Study Design Issues*
  - Statistician review of a similar paired design system spill test indicates it may take 28 years or more to have an 80 percent chance of detecting a 10 percent change in SARs between the current and proposed operation. Oregon proposes a comprehensive assessment after 5 years, yet does not offer a statistically valid approach for comparing the current vs. proposed test spill operations to determine differences in SARs.
  - Evaluation of Oregon's proposed spill operation would likely require conducting a paired-test study (current spill vs. 125% TDG) in order to determine if a biological response (increased or decreased SARs) can be observed. A randomized paired-test study design make take several decades to produce results to determine if SARs increased from 125% TDG spill. Furthermore, a true paired-test study design may not be statistically feasible to implement, given the likely confounding seasonal effect that would result from attempting to test two spill operations in a given year.
- *Abandonment of the Current BiOp Hydro Strategy*
  - Changing the focus midway through the current BiOp to rely solely on spill rather than making passage improvements at dams coupled with the implementation of balanced spill operations at each dam limits the operational flexibility of the system.
- *Other Concerns*
  - High spill levels would increase erosion and deterioration of spillway stilling basins and other associated spillway components. If not repaired, stilling basin

and other spillway component damage can increase the injury and mortality of juvenile fish passing through spillways.

- High spill levels may create navigation issues for commercial and juvenile fish transportation barges.

5. Conclusion – After thorough consideration of Oregon's spill experiment hypothesis and proposal, the ISAB review, and internal Corps review, the Corps concludes that the hypothesis as proposed cannot be evaluated with any degree of certainty to determine whether statistically meaningful differences in SARs exist between current BiOp spill operations and 125% TDG spill. Furthermore, the potential adverse effects identified above that 125% TDG spill could have on juvenile and adult salmonids are of great concern and could impede attainment of juvenile dam passage survival and adult performance standards specified in the BiOp.

Rock D. Peters
Senior Fishery Program Manager

Table 1.— Route of passage and route survival estimates from recent performance standard testing.

Project	Yearling Chinook Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	58.1	95.7	8.3	99.3[1], 96.9[2]	66.4	4.3	98.2	28.3	94.7[3], 96.8[4]	95.69	100 kcfs	2011
The Dalles	65.8	96.1	17.3	99.1	83.1	na	na	16.9	93	96.0	40%	2011
John Day	39.9	97.4	23.8	95.8	63.7	24.8	99.3	11.5	91	96.66 (30% spill)	30 and 40%	2011
McNary	64.3	97.1	8.3	97.6	72.6	24.2	93.6	3.2	95.5	96.16	40%	2012
Ice Harbor	22.1	98	51.3	94.7	73.4	19.1	98.3	7.5	Na	96.1 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	16.6	94.6	62.3	99.8	79.1	15.9	100	5.3	93.2	98.68	Gas Cap	2012
Little Goose	21.1	94.9	44.2	100.1	65.3	31	98.8	3.8	87	98.22	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

Project	Steelhead Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	56	96.5	17.2	98.8[1], 95.3[2]	73.2	1.7	93.8	25.1	91.9[3], 93.6[4]	97.55	100 kcfs	2011
The Dalles	75.4	100.4	13.8	101	89.2	na	na	10.9	91.9	99.52	40%	2011
John Day	30.5	99	32.3	98.9	62.8	33.2	100.3	4	79.7	98.36 (30% spill)	30 and 40%	2011
McNary	59.9	99.4	23.3	97.6	83.2	14.5	100	2.3	83.1	99.08	40%	2012
Ice Harbor	23.9	101.9	37.5	101.7	61.4	36.6	99.7	2	na	100.7 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	12.6	98.3	53.2	99.1	65.8	30.7	99.1	3.5	81.4	98.26	Gas Cap	2012
Little Goose	15.7	99.2	40.4	100.1	56.1	41.9	99.7	2	80.5	99.48	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

ISAB Review of the Proposed High Spill Experiment

Initial Summary for Fish Policy

3/5/14

Review provided material for multiple press releases

- NW River Partners-
  - “…the ISAB thoroughly panned the idea.”
  - “…In other words, the proposal lacks the basic building blocks of a scientifically-valid study, and consequently, the results wouldn’t tell us anything about how spill affects salmon survival.”
- Northwest Sportfishing Industry Association-
  - "We are convinced increasing spill has the potential to double salmon runs headed to Idaho, and are encouraged that the ISAB's recommendations will strengthen the test and answer some of the most important questions surrounding salmon recovery in the basin."
  - With the ISAB's recommendations for a more robust spill test, we have a very good shot at having salmon management policy being set by facts instead of performance standards that do not measure smolt-to-adult ratios.

The ISAB identified many biological risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.

- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.

The ISAB identified many biological risks

- The spill test <u>could result in unintended consequences</u>, including:
  - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
  - increased delay and/or predation of juvenile fish in tailraces;
  - increased fallback and/or passage delays of adult salmon at the dams;
  - difficulty in holding spill levels at desired levels, for example in a low water year;
  - increased spillway erosion problems;
  - possible navigation issues for commercial and juvenile fish transportation barges at dams;
  - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
  - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Cliff's Notes on the ISAB Answers to Council Questions

Does the experiment include an adequately researched hypothesis?

- **A: No, but…**
  - "The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis."
  - Further analysis of correlation between spill and survival is required
    - updated data sets should be considered
    - alternate hypothesis need to be considered

- "Despite these concerns…it appears that the increased spill hypothesis stands as a possible candidate for testing."

- "It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile."

Cliff's Notes on the ISAB Answers to Council Questions

Is the experiment appropriately designed to test the hypothesis?

- **A: No, but…**
  - "…what is proposed is not a rigorous experiment but a test of a management action…"
  - "It is not clear why a more rigorous experiment with controls has not been proposed."
  - Alternate study designs not considered…
    - consideration of increasing spill levels at individual dams
    - further consideration would illustrate constraints and feasibility issues
  - "Proposed study offers an opportunity to use adaptive management that might improve SARs…and increase knowledge for future decisions"

Is the proposed duration sufficient?

- **A:** not enough information provided but existing data could be mined to answer Q

Cliff's Notes on the ISAB Answers to Council Questions

Is it possible to isolate spill as a causative factor in fish survival?

- **A: <u>It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system.</u>** The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.

"Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor…"

Cliff's Notes on the ISAB Answers to Council Questions

What adjustments will ensure that the proposal is scientifically based?

- **A:** Proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns…
  - Main conceptual issues are:
  - 1) lack of experimental control group and
  - 2) low statistical power to detect effects

Two other broad questions were addressed

- **What are the potential risks and/or benefits with emphasis on TDG effects?**
  - "The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life."
  - The ISAB noted that unpublished data suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality

- **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**
  - "It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs."
  - "A spill test could also increase knowledge in other ways if appropriate monitoring is conducted."

Petersen,Christine H (BPA) - KEWR-4

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Wednesday, March 05, 2014 2:47 PM
To: Spear,Daniel J (BPA) - PGB-5; Doumbia,Julie A (BPA) - KEWR-4
Subject: RE: Meeting Agenda /March 7, 2014 with Louis Berger and DJ Warren & Assoc.

Can you give me Kevin Malone's full email? Jason Sweet has to respond to downstream/upstream SAR comparisons with regards to the ISAB review of the spill experiment proposal. He was asking about the Willamette today, and when I referred to recent returns in McKenzie and N. Santiam, he asked if we had hatchery and wild SARs for any populations. They are not blocked by dams, and the FPC tends to always point to a few lower river populations like John Day and Klickitat which always have higher SARs than the interior populations.

Non-Responsive

[redacted]

Christine

From: Spear,Daniel J (BPA) - PGB-5
Sent: Wednesday, March 05, 2014 1:32 PM
To: Petersen,Christine H (BPA) - KEWR-4; Doumbia,Julie A (BPA) - KEWR-4
Subject: FW: Meeting Agenda /March 7, 2014 with Louis Berger and DJ Warren & Assoc.

Non-Responsive

From: Rachel Kutschera [mailto:rachel.kutschera@djwassociates.com]
Sent: Wednesday, March 05, 2014 12:48 PM
To: 'Mayer, Michael'; Spear,Daniel J (BPA) - PGB-5; Kevin Malone_MEC; lars.mobrand@djwassociates.com
Cc: Dan Warren; 'Knable, Robert'
Subject: Meeting Agenda /March 7, 2014 with Louis Berger and DJ Warren & Assoc.

All,

Non-Responsive

[redacted]

Thanks,

Rachel Kutschera on behalf of Dan Warren

Rachel Kutschera, Environmental Scientist, MEM
Project Manager
D.J. Warren & Associates, Inc.
P.O. Box 1511
Philomath, OR 97370
(541) 929-4639
rachel.kutschera@djwassociates.com

From:	Sweet,Jason C (BPA) - KEWR-4
To:	"hammarj@pdx.edu"
Subject:	FW: Latest edition of the Smart Spill presentation
Date:	Friday, March 07, 2014 9:02:00 AM
Attachments:	ISAB_spill_test_presentation17Jan2014.pptx System_Analysis_More_Spill_2-5-14.pptx

---

Hi Jeff,

Here are the slides that we've been presenting to the ISAB and the Council. Please let me know if you have any questions. Thanks.

Jason Sweet

Jason Sweet
Manager | Fish and Wildlife Policy and Planning
BONNEVILLE POWER ADMINISTRATION
bpa.gov | P 503-230-3349 | C 503-318-5749
Please consider the environment before printing this email.

Recent Hydro Improvements Since the 2008 Federal Columbia River Power System Biological Opinion

Presentation to the
Independent Scientific Advisory Board
January 17th, 2014

U.S. Army Corps of Engineers®

Two Part Agenda

- Part I. Overview of Recent Improvements in the FCRPS Hydrosystem
- Part II. Questions and Concerns surrounding the proposed spill test (Dr. Skalski- University of Washington)

Results of Action Agencies (Federal) Non- Hydro Investments since 2007

- Added 180 miles of stream complexity.
- Restored 135,000 acre-feet of water to streams increasing habitat.
- Opened nearly 2,000 habitat miles (2x length of Columbia River).
- Protected or Restored 3,700 acres of estuary floodplain habitat.
- Hatchery evaluations and reforms
- Predation Management (avian, piscine, marine mammal)

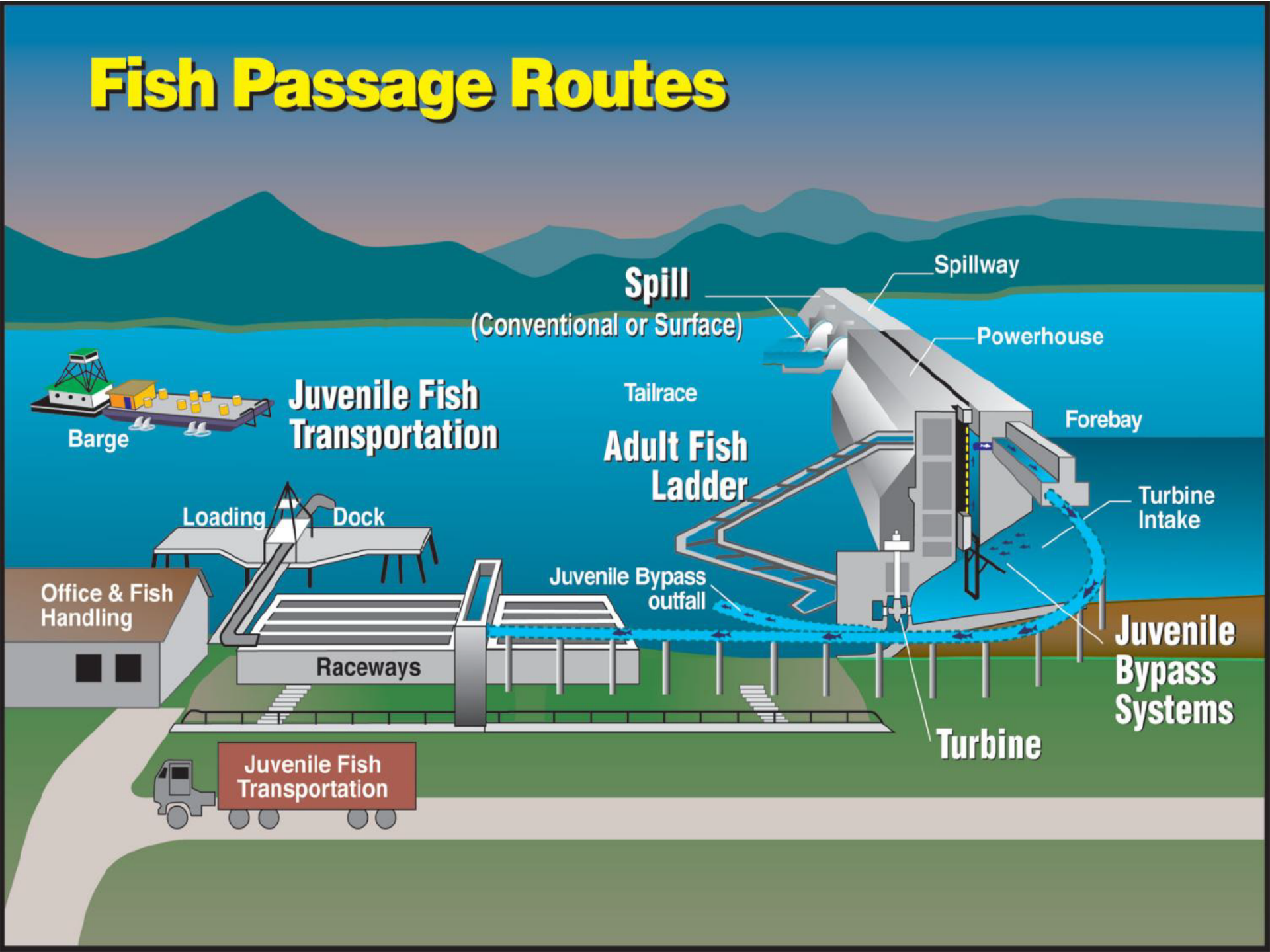
Overview:

The 2008 hydro plan is underway and deserves a chance to show results

- Congress and BPA ratepayers, in collaboration with the region, have invested heavily in recent years to achieve performance standards and in-river survival targets.
  - Research guides passage improvements at each dam.
  - Rigorous testing measures progress toward performance standards and in-river survival targets.
  - Physical models determine best spill patterns at each dam and avoid adverse effects.
- Current action plan (2008-2018) includes major dam modifications (e.g. The Dalles Spill Wall), surface passage, project specific spill volumes and patterns, turbine screens and relocation of bypass outfalls.
- Results so far are demonstrating improved fish survival.
- Actions and testing are still underway; it is too early to change course.

Columbia River Basin
Corps of Engineers Dams
Dams owned by Others
Mica
Revelstoke
Arrow Lakes
Duncan
Kootenay Lake
Keenleyside
Canada
U.S.
Libby
Hungry Horse
Grand Coulee
Chief Joseph
Albeni Falls
Wells
Noxon
Rocky Reach
Columbia R.
Pend Oreille Lake
Flathead Lake
Rock Island
Kerr
Seattle
Little Goose
Montana
Lower Monumental
Wanapum
Lower Granite
Priest Rapids
Washington
Dworshak
The Dalles
Ice Harbor
Portland
McNary
Hells Canyon
Bonneville
John Day
Oxbow
Brownlee
Idaho
Willamette R.
Oregon
Jackson Lake
Boise Projects
Snake R.

Fish Passage Routes



Implementation of 2008/10/14 BiOp

Configuration Improvements

- Hydropower Strategy 2 – Modify Columbia and Snake River Dams to Maximize Juvenile and Adult Fish Survival
  - Numerous configuration improvements to increase fish survival have been completed since 2007 and include:
    - Minimum gap runner turbines at Bonneville Dam Powerhouse I
    - Adult fish ladder improvements at John Day Dam
    - Juvenile screened bypass system improvements and/or outfall relocation at Bonneville, McNary, Lower Monumental, and Little Goose dams
    - Juvenile screened bypass system full-flow PIT detection at Bonneville, John Day, Lower Monumental, and Little Goose dams
    - Tailrace avian wire arrays at The Dalles and John Day dams
    - Spillway flow deflectors at John Day (spillbay 20) and Little Goose (spillbays 1 and 8) dams
    - Extended-length spillwall at The Dalles Dam
    - Conversion of the Bonneville Dam Powerhouse I ice and trash sluiceway to a surface passage route
    - Spillway weirs at John Day, McNary, Lower Monumental, and Little Goose dams

Implementation of 2008/10/14 BiOp

Configuration Improvements

Lower Monumental Spillway Weir

Lower Granite Spillway Weir

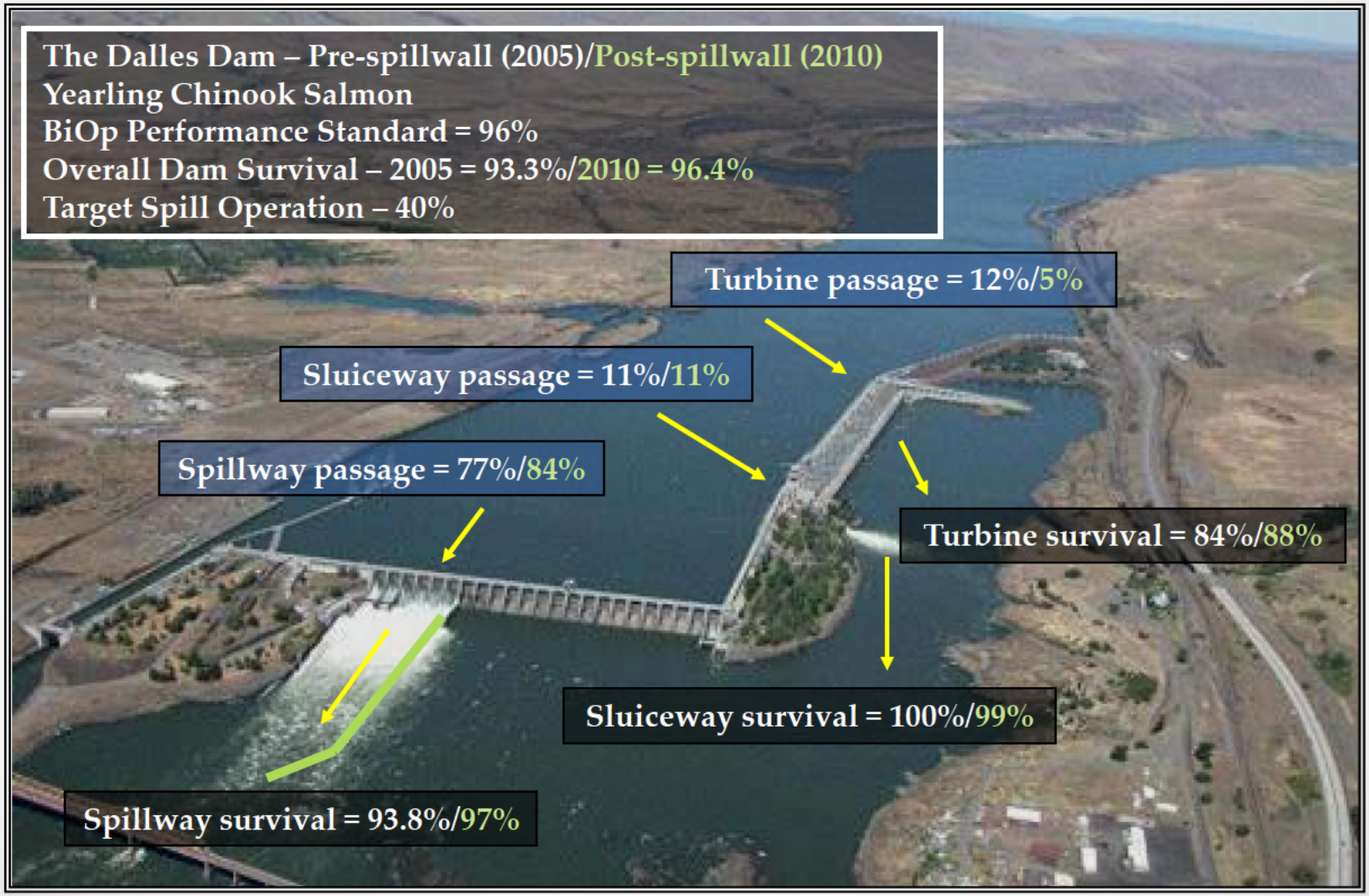
Bonneville MGR

The Dalles Spillwall

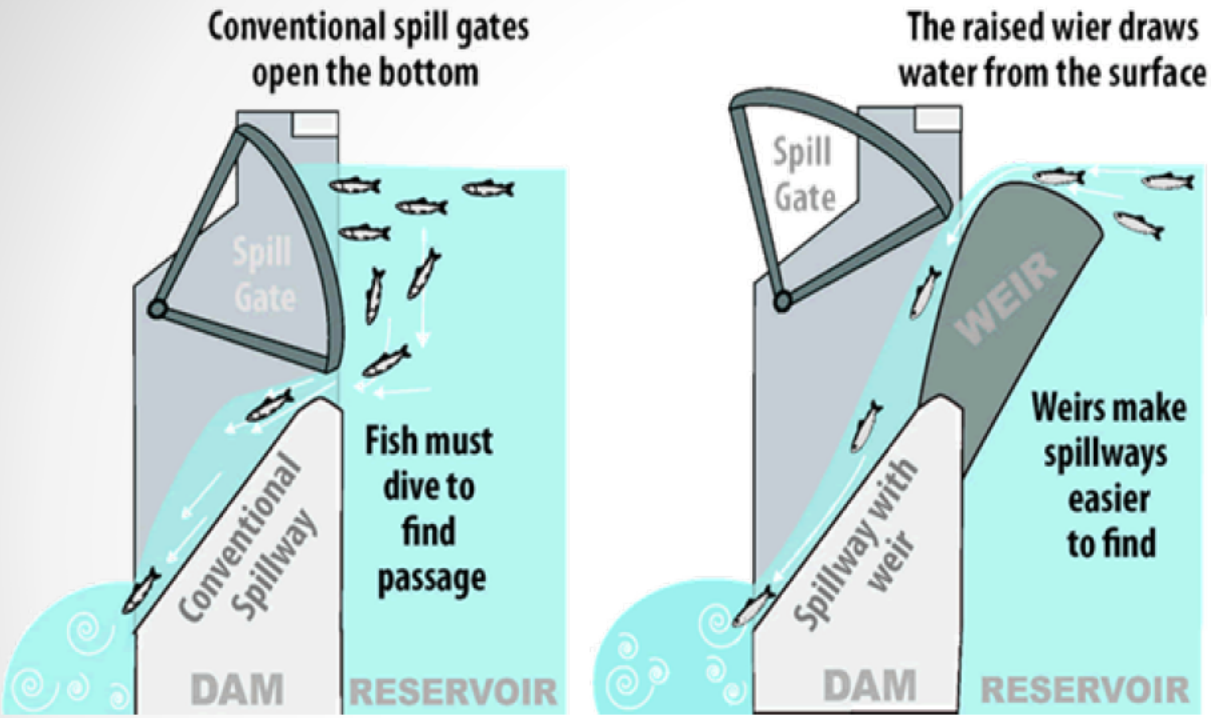
Lower Monumental Juvenile Bypass Outfall Relocation

McNary Juvenile Bypass Outfall Relocation

Yearling Chinook Dam Passage and Survival
The Dalles Dam - Pre vs. Post Spillwall



Surface Passage Characteristics



- Spillway weirs and other surface passage structures provide a surface route of passage and allow fish to pass dams at depths where they naturally migrate
  - Easier for fish to find; reduce migration delay and minimize exposure to predation near dams
  - Generally provide the highest survival of all passage routes at dams; consistently at or near 100 percent survival
  - Pass the most fish relative to the volume of water, making them the most effective passage route
  - Increase spill passage efficiency (% of fish that pass through spill); as many as 4-times the percent of fish pass the dam through spill bays equipped with spillway weirs
  - Reduces the number of fish that pass through turbines
- Surface passage routes currently exist at all 8 dams

Implementation of 2008/10/14 BiOp

Operational Improvements

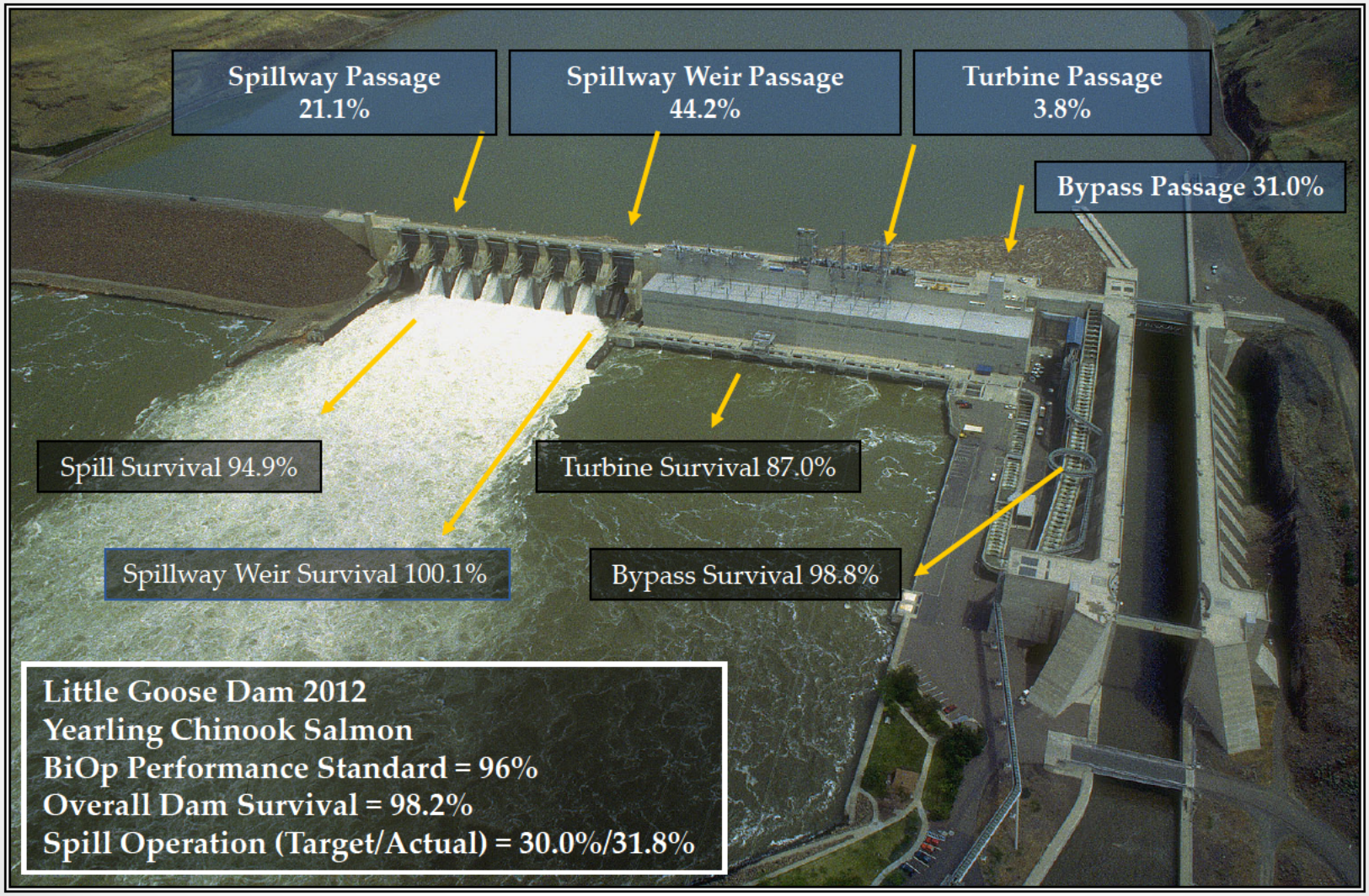
- Hydropower Strategy 3 – Implement Spill and Juvenile Transportation Improvements at Columbia and Snake River Dams
  - Spill operations coupled with configuration improvements completed at each dam are a key component of BiOp implementation to increase fish survival as they migrate through the hydrosystem
  - 24-hour spill operations occur at all eight dams from early April through August
  - Planned spring spill operations for 2014-18 are specified below

Project	Spring Spill Levels	Spring Planning Dates
Bonneville	100 kcfs	4/10 - 6/15
The Dalles	40% of total river flow	4/10 - 6/15
John Day	April 10-April 27: 30% of total river flow April 27-June 15: 30% and 40% of total river flow	4/10 - 6/15
McNary	40% of total river flow	4/10 - 6/15
Ice Harbor	April 3-April 28: 45 kcfs/Gas Cap April 28-May 31: 30% of total river flow and 45 kcfs/Gas Cap	4/3 - 5/31
Lower Monumental	Gas Cap (~27 kcfs) (bulk pattern)	4/3 - 5/31
Little Goose	30% of total river flow	4/3 - 5/31
Lower Granite	20 kcfs	4/3 - 5/31

Juvenile Dam Passage Survival Performance Standards

- As part of the 2008 BiOp implementation, configuration and operational improvements have been developed and implemented to achieve the juvenile dam passage survival performance standards of 96 percent for spring migrants and 93 percent for summer migrants specified in the BiOp
- Spill levels and spill patterns at each dam have been developed and tailored to facilitate juvenile fish passage without hindering adult passage by accounting for the unique characteristics and configuration of each dam
  - Strategy utilizes spill coupled with surface passage and other structural improvements (such as screened bypass system upgrades) to increase juvenile fish survival
- Current spill operations along with existing and planned configuration improvements outlined in the Action Agencies' Implementation Plan, are expected to help achieve the juvenile dam passage survival performance standards of 96 percent and 93 percent survival at all dams by 2018
- Performance standard testing is underway and expected to be complete by 2018

Little Goose Dam Performance Standard Testing Yearling Chinook Salmon



Recent Passage and Survival Estimates

Acquired From Performance Standard Testing

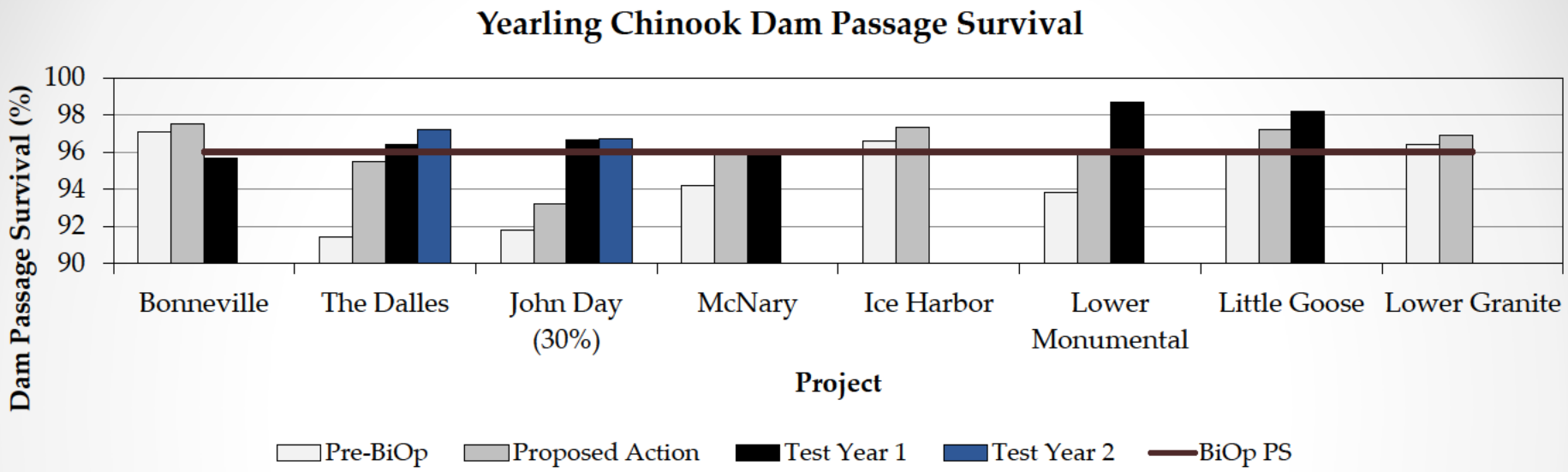
Project	Yearling Chinook Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	58.1	95.7	8.3	99.3[1], 96.9[2]	66.4	4.3	98.2	28.3	94.7[3], 96.8[4]	95.69	100 kcfs	2011
The Dalles	65.8	96.1	17.3	99.1	83.1	na	Na	16.9	93	96.0	40%	2011
John Day	39.9	97.4	23.8	95.8	63.7	24.8	99.3	11.5	91	96.66 (30% spill)	30 and 40%	2011
McNary	64.3	97.1	8.3	97.6	72.6	24.2	93.6	3.2	95.5	96.16	40%	2012
Ice Harbor	22.1	98	51.3	94.7	73.4	19.1	98.3	7.5	Na	96.1 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	16.6	94.6	62.3	99.8	79.1	15.9	100	5.3	93.2	98.68	Gas Cap	2012
Little Goose	21.1	94.9	44.2	100.1	65.3	31	98.8	3.8	87	98.22	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

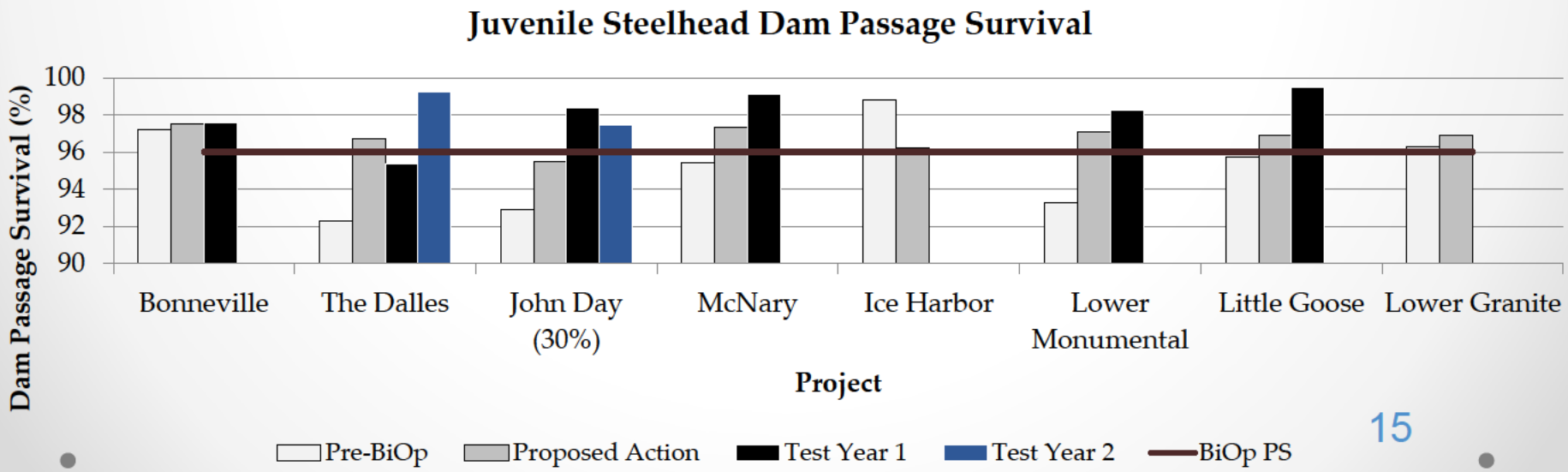
1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

Project	Steelhead Route Passage (%) and Survival (%)											
	Spill		Surface Route		Spill and Surface Passage	Screened Bypass		Turbine		Overall Dam Survival	Spill Operation	Year
	Passage	Survival	Passage	Survival		Passage	Survival	Passage	Survival			
Bonneville	56	96.5	17.2	98.8[1], 95.3[2]	73.2	1.7	93.8	25.1	91.9[3], 93.6[4]	97.55	100 kcfs	2011
The Dalles	75.4	100.4	13.8	101	89.2	na	na	10.9	91.9	99.52	40%	2011
John Day	30.5	99	32.3	98.9	62.8	33.2	100.3	4	79.7	98.36 (30% spill)	30 and 40%	2011
McNary	59.9	99.4	23.3	97.6	83.2	14.5	100	2.3	83.1	99.08	40%	2012
Ice Harbor	23.9	101.9	37.5	101.7	61.4	36.6	99.7	2	na	100.7 (30% spill)	30% and 45 kcfs/Gas Cap	2006
Lower Monumental	12.6	98.3	53.2	99.1	65.8	30.7	99.1	3.5	81.4	98.26	Gas Cap	2012
Little Goose	15.7	99.2	40.4	100.1	56.1	41.9	99.7	2	80.5	99.48	30%	2012
Lower Granite	-	-	-	-	-	-	-	-	-	-	-	-

1 - Corner Collector, 2 - BI Sluiceway, 3 - BII, 4- BI

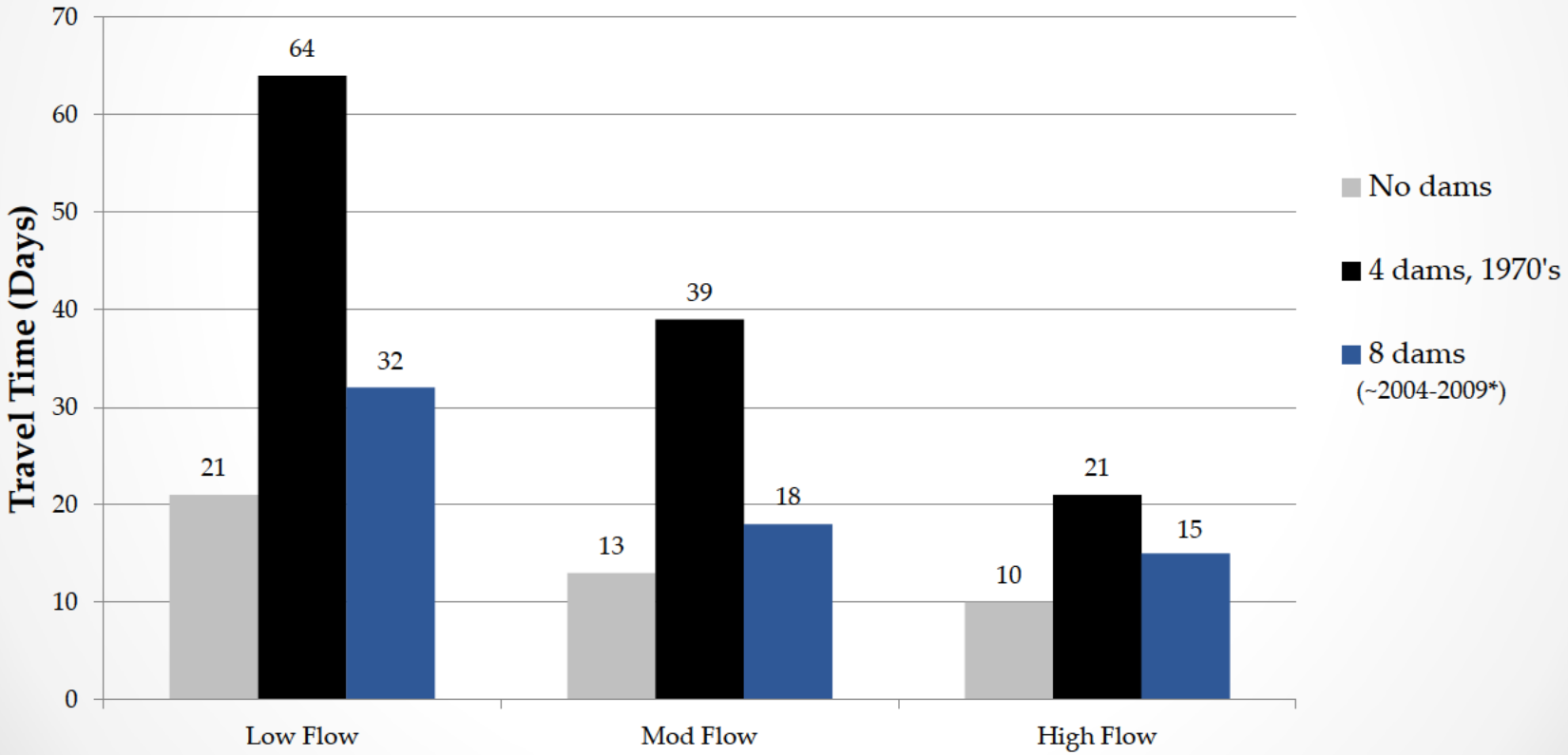
Juvenile Dam Passage Survival Performance Standards





Juvenile Fish Travel Time Through the FCRPS

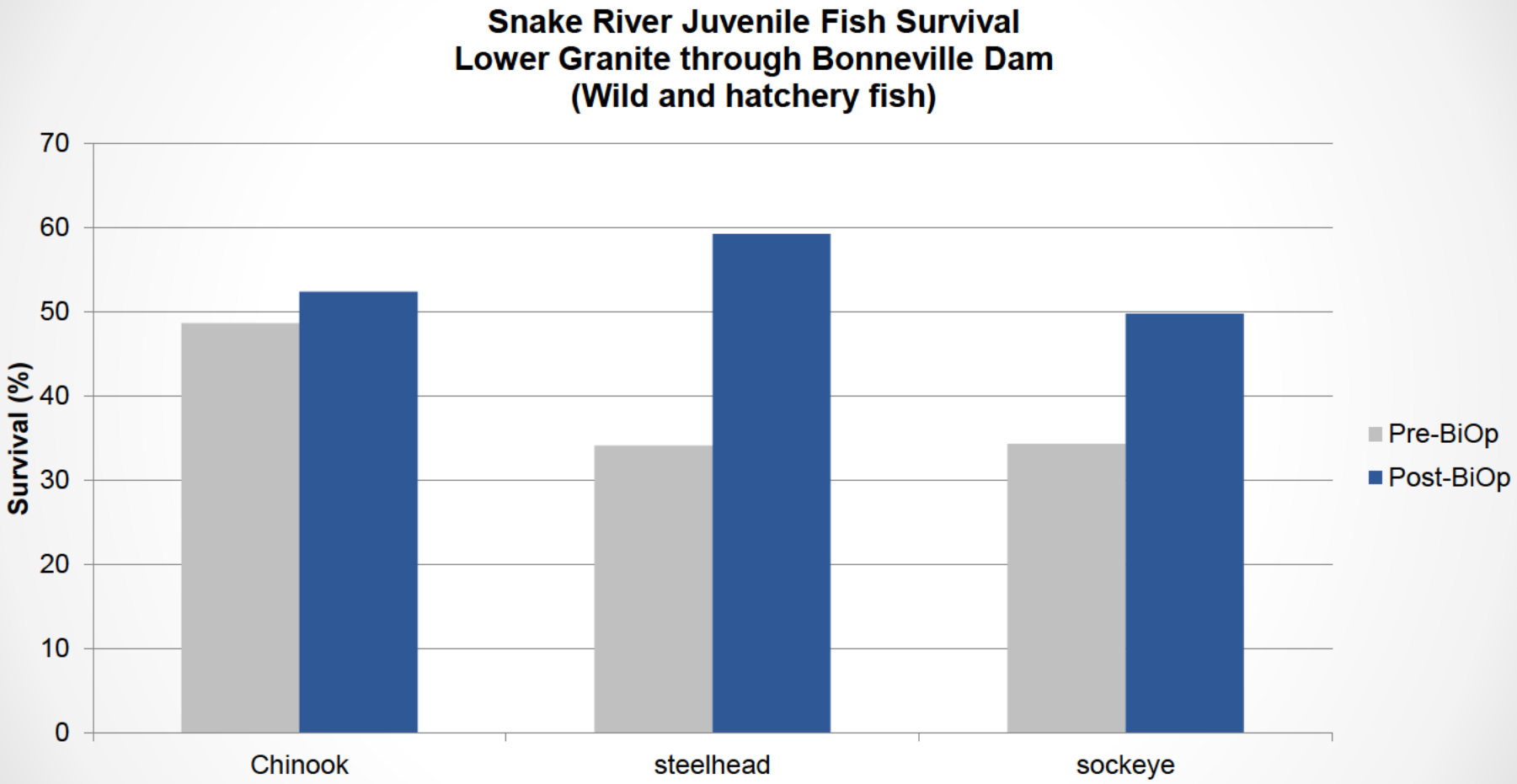
Lower Granite to Bonneville Dam Fish Migration Travel Time
Under 3 Flow Conditions (low, moderate, high)



SOURCE: Muir, W.D., Williams, J.G. 2012. Improving connectivity between freshwater and marine environments for salmon migrating through the lower Snake and Columbia River hydropower system. Ecol. Eng. 48: 19-24

In-river Juvenile Fish Survival

Pre-BiOp vs. Post-BiOp

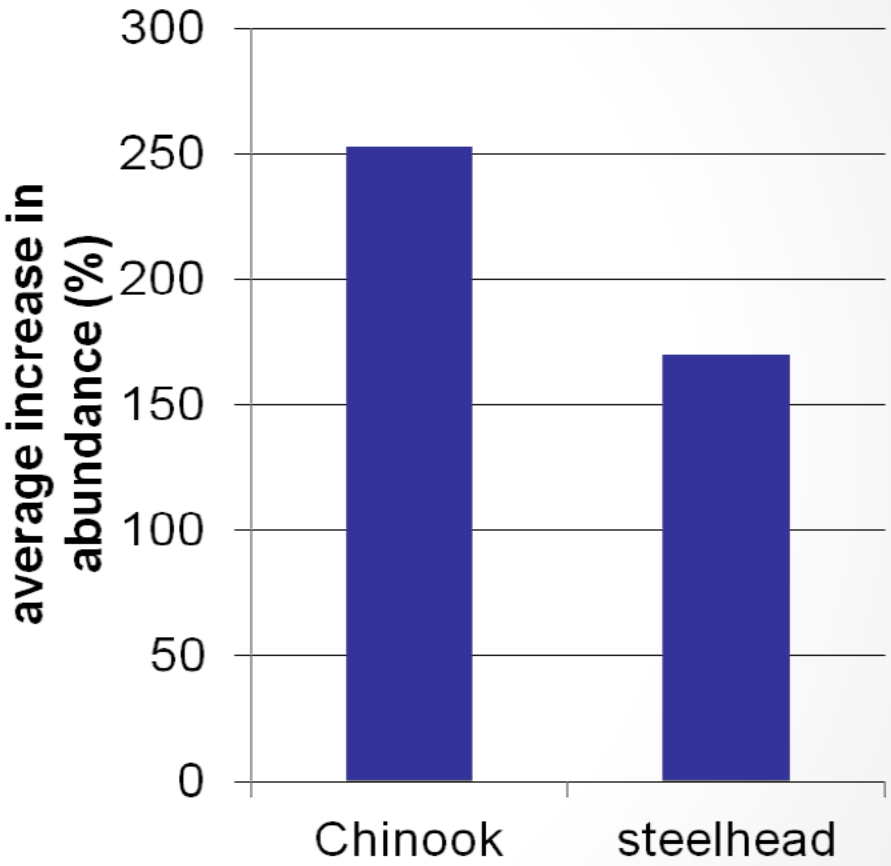


Pre-BiOp period: 1997 – 2007
Post-BiOp period: 2008 – 2012

Wild adult fish abundance is increasing

Based on 10 years of data, 2002 – 2011:

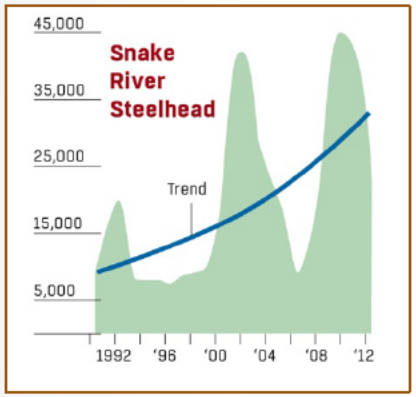
- On average, wild Chinook salmon populations have more than tripled in abundance.
- On average, wild steelhead populations have more than doubled in abundance.

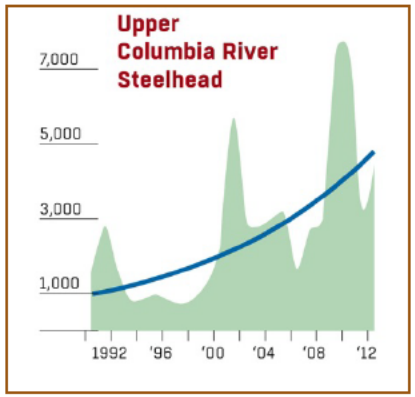


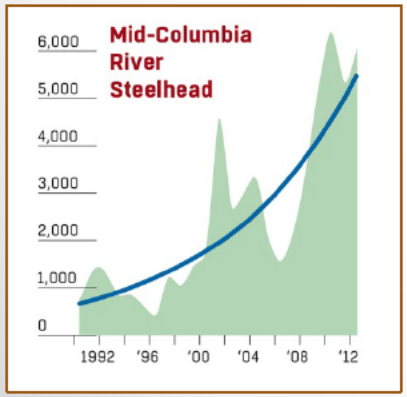
Note: Based on comparison of geometric mean of abundance from 1990-1999 to most recent 10 years, generally 2002-2011.

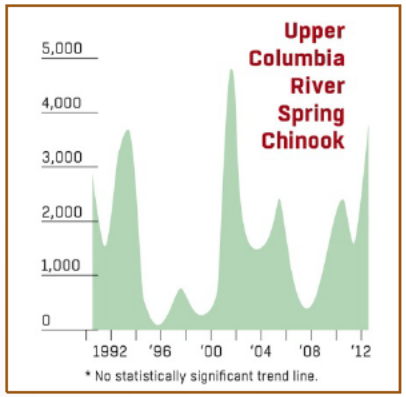
Status of wild adult fish

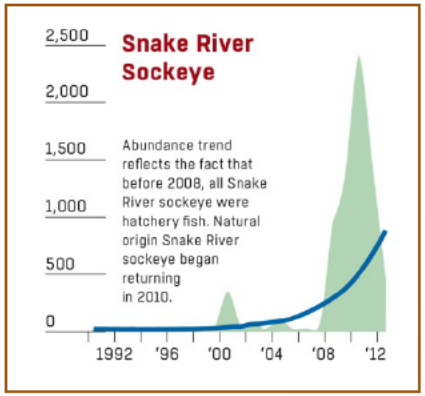
Of the 49 Interior Columbia Basin wild adult fish populations where data are available, 47 have increased in abundance since listings in the 1990s.

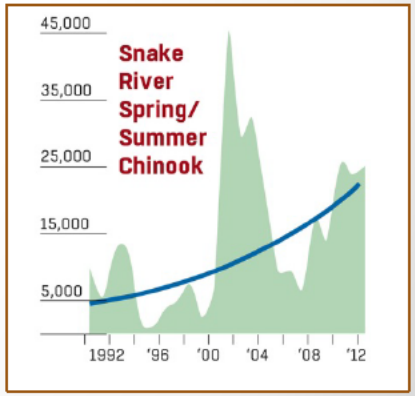












Summary: Hydro results are ongoing and promising

- Research-based improvements are delivering improved passage, higher in-river survival and faster fish travel time.
- Spill volumes and spill patterns are tailored to conditions at each dam, enhancing spill effectiveness.
- Improvements and testing are ongoing and still proving their value to the region.
- As of 2010, all mainstem dams have been equipped with a surface passage route…It is too early to change course from this current performance-based approach.

Spill Test Issues and Questions

Proposed Spill Test

- **Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:**

- What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.

- When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.

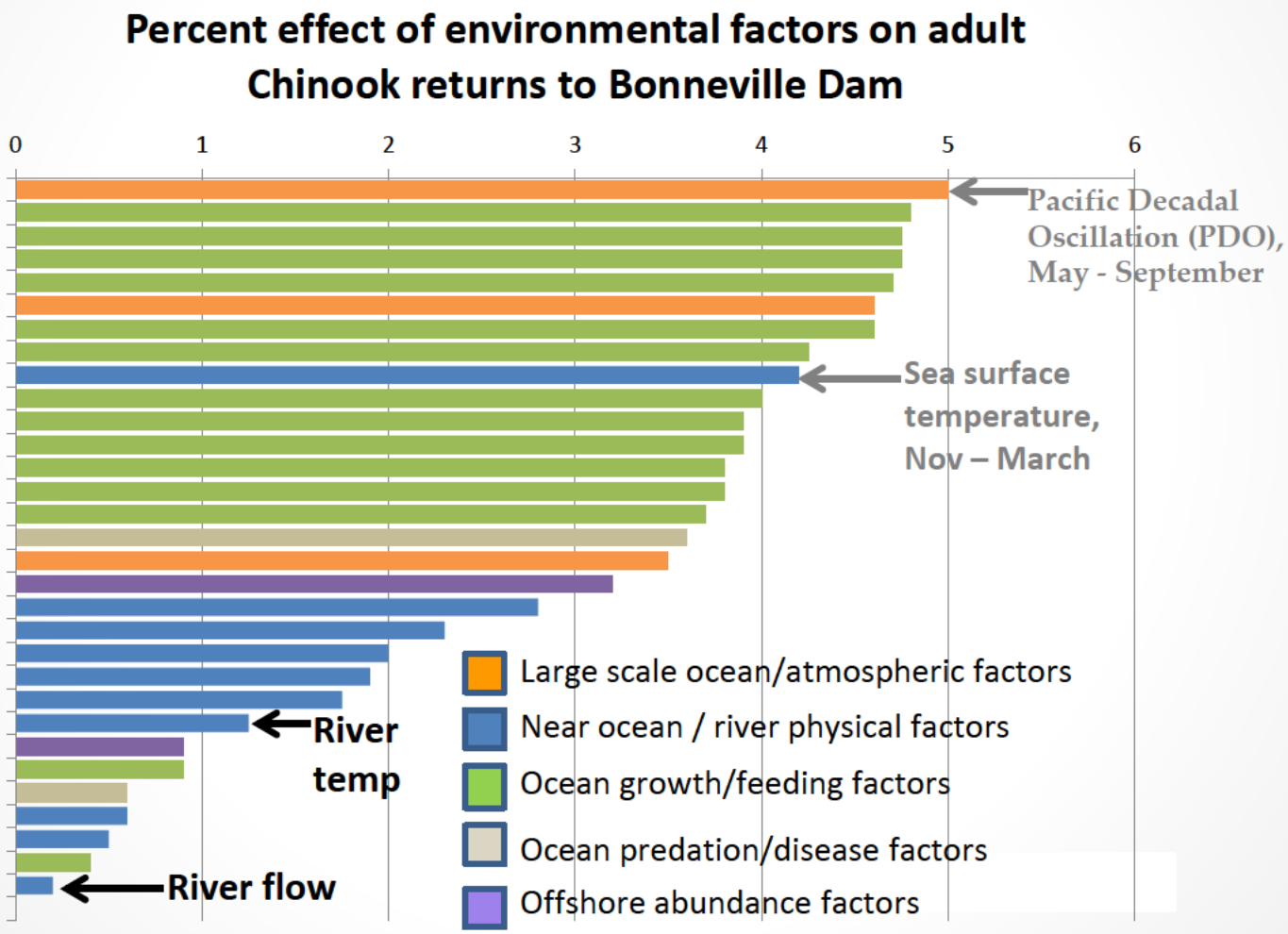
- Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects -- Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.

- Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.
- Monitoring Smolt-to-Adult survival rates.
- Comparing survival rates against both past survival rates and prospective model predictions.
- Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.
- Inclusion of sideboards or "off-ramps"…

Confounding factors make SARS a difficult metric to guide hydrosystem modifications

- Hydro performance is more appropriately measured by:
  - Juvenile dam survival which is a direct measure of hydro performance and therefore more appropriate than SARS.
  - Total in-river and reach survival (e.g. Lower Granite to Bonneville) of juveniles and adults also provide a measure of hydro performance.
- Dam operators cannot control or influence the vast majority of the factors that affect adult fish returns.
  - Approximately 60% of the environmental factors influencing Chinook returns to Bonneville Dam are related to large scale ocean/atmospheric conditions, and ocean growth/feeding. (Burke et al. 2013)
- So many factors affect SARS that tests comparing different spill conditions may require several decades to show a statistically reliable effect on SARS.
- Current rigorous survival performance standard testing at the dams and in-river survival monitoring produce reliable results on smolt survival each year.

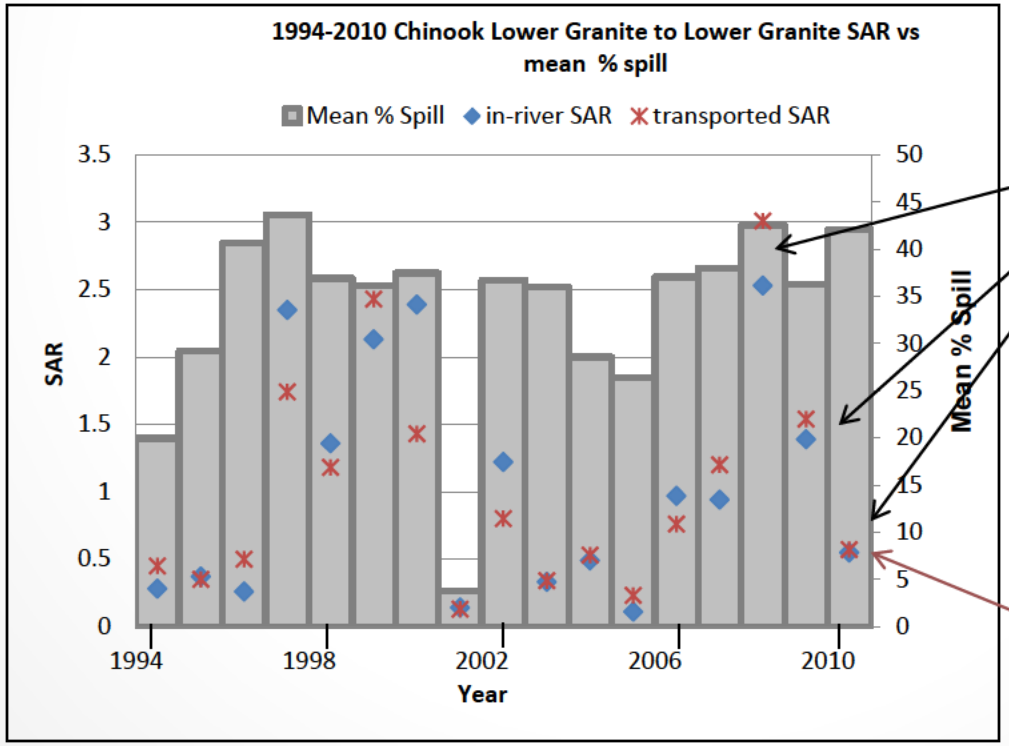
Ocean conditions, not spill levels, have the greatest influence on adult returns



Source: Burke et al. (2013)

Similar trends for transported and in-river fish suggest larger factors driving SARS

- The SARs of transported fish have similar relationships to spill as their in-river counterparts even though the transported fish did not experience spill. This demonstrates that other factors, besides spill, are affecting SARs of both groups.



In 2008, 2009, and 2010 Chinook SARS were similar for transported and in-river fish.

Even though the mean % spill was high in 2010, Chinook SARS were low for both transported and in-river fish.

Source: 2012 CSS Annual Report

CSS assumptions underlying the proposed high spill test are oversimplified

- Dam survival and passage condition data do not reflect recent advancements in the federal spill program
  - CSS does not consider 10+ years of cumulative route-specific acoustic tag information from BiOp juvenile performance standard and survival testing for each dam

- Dam specific biological and structural constraints, including total dissolved gas constraints, are not included, making the results incomplete.

- Results are extrapolated beyond the range of empirical data thus assuming that if some spill improves survival then more spill will provide further increases proportionate to volume.

Statistical Design & Analysis Considerations Regarding a Proposed Spill Study

John R. Skalski
University of Washington

Properties of Scientific Experiments

Fisher (1947)

- Replication
- Randomization
- Error control
- Treatment contrasts

Cox (1958)

- Elimination of confounding factors
- Precision
- Useful range of validity
- Simplicity
- Ability to estimate error variance

Proposed "Spill Experiment"

Fisher (1947) Criteria

- Replication: 10 consecutive years
- Randomization: None
- Error control: Whatever nature presents
  - No control for ocean effects
  - No control for fish health, size, etc.
  - No control for harvest changes
- Treatment contrasts: None
  - Single spill level, year after year

Proposed "Spill Experiment"

Cox (1958) Criteria

- Elimination of confounding factors
  - Confounding with time appears problematic
- Precision
  - No reference to sample sizes, precision, or statistical power
- Useful range of validity
  - Only one spill level evaluated
- Simplicity
  - Current proposal is too simplified
- Ability to estimate an error variance
  - No hypothesis to formally test

Other Study Considerations

1. No formal selection of response variable(s)

Possible Response Variable ($\hat{\theta}$)	Precision	Confounding Factor	Biological Relevance
Inriver survival	1	1	3
SAR	2	2	2
Adult returns	3	3	1

- Choice will influence how success or failure is measured
- Need *a priori* prioritization of response variables to measure success

Other Study Considerations (Cont.)

2. No formal tests of hypotheses

- Possible candidates mentioned:

A. Test of Means

$$H_O: \hat{\bar{\theta}}_{Before} \geq \hat{\bar{\theta}}_{Test}$$

$$H_a: \hat{\bar{\theta}}_{Before} < \hat{\bar{\theta}}_{Test}$$

Difficulties

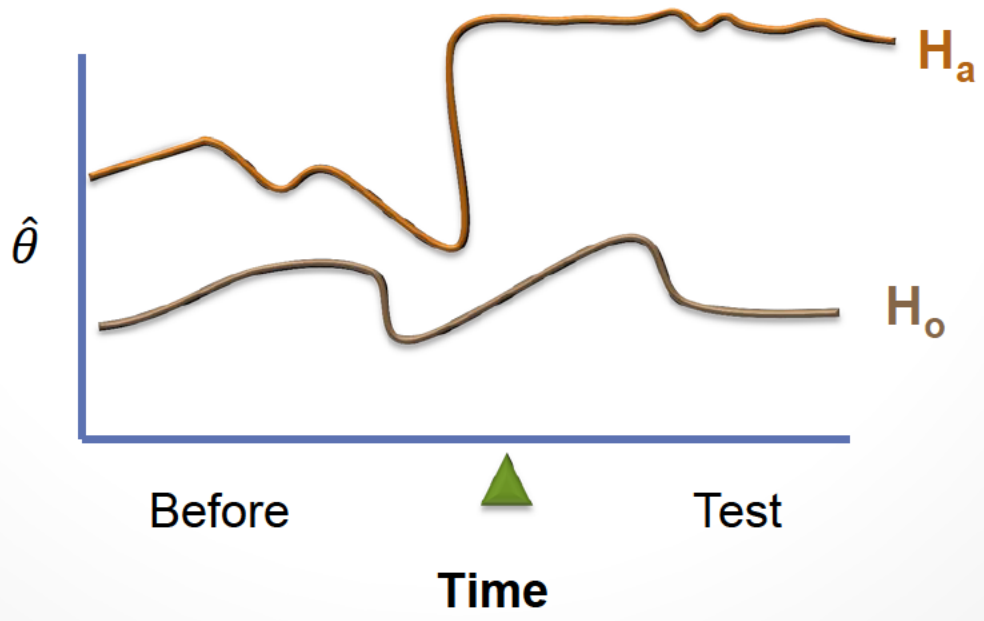
- Confounded with time
- No error control – very noisy

Other Study Considerations (Cont.)

B. Time Series Analysis

H_o: Time series stationary

H_a: Shift in response after intervention

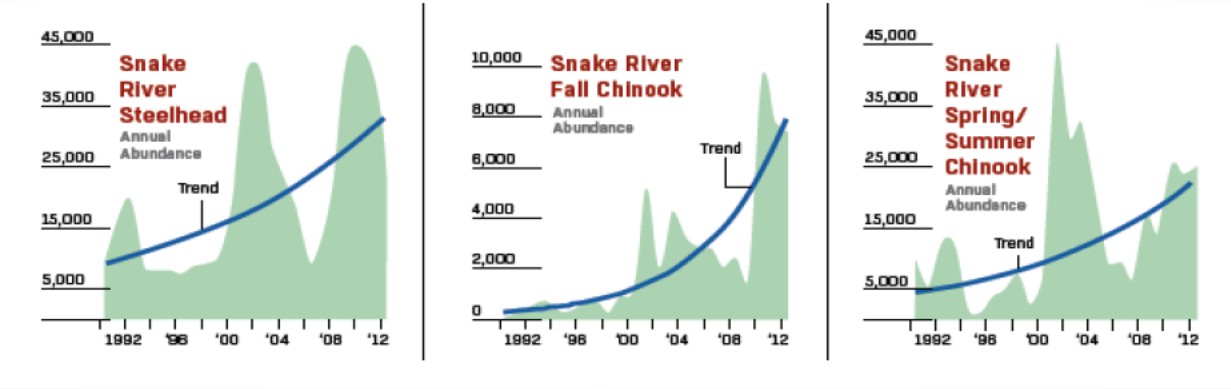


Other Study Considerations (Cont.)

B. Time Series Analysis (cont.)

Difficulties

- 5 or 10 years are not long for time series
- Paulsen & Hinrichsen (2002) found time series half as powerful as treatment contrasts
- Currently system not stationary
  - 6/7 ESUs have **upward** trends

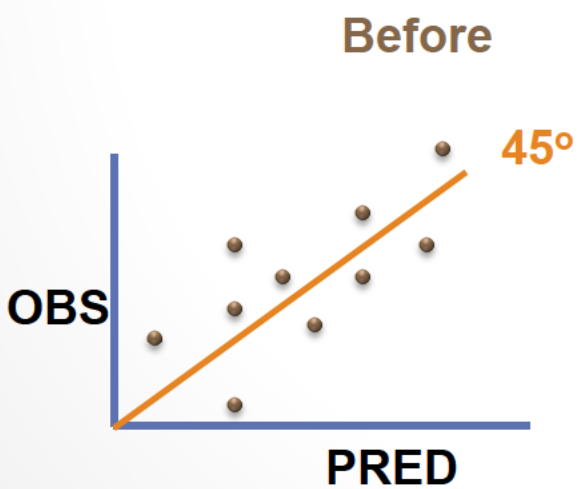


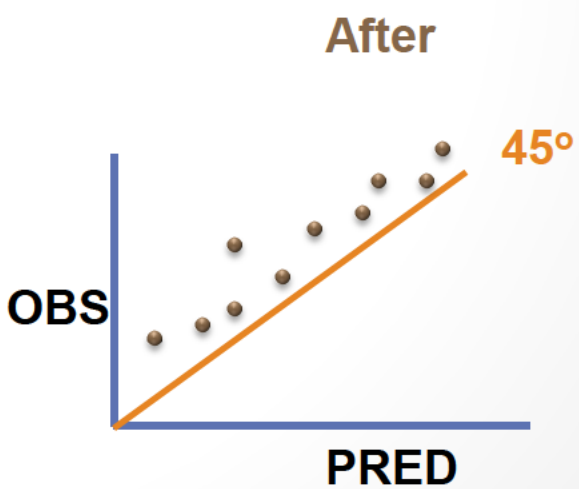
From: USACE, USBR, BPA. 2013. Citizen's Guide to the 2013 Comprehensive Evaluation.

Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions

$$H_o: \ \hat{\bar{\theta}}_{OBS} \leq \hat{\bar{\theta}}_{PRED}$$
$$H_a: \ \hat{\bar{\theta}}_{OBS} > \hat{\bar{\theta}}_{PRED}$$





Other Study Considerations (Cont.)

C. Observed vs. Modeled Predictions (cont.)

Difficulties

- Model must be selected *a priori*
- Predictive model needs to be reasonably accurate (i.e., unbiased) and precise
- Predictive model must be calibrated beyond current range of spill
- Currently, predictions of adult returns fairly poor

Other Study Considerations (Cont.)

D. No power calculations/No sample size calculations

- Calculations not possible without formal tests of hypotheses
  - No justification for 10-year study
  - No specification of within-year tagging effort
- No specification of the size of Δ that is reasonable to expect and detect under proposed spill plan
  - Haeseker et al. (2012) suggested
    - SARS : 4 – 8 times larger
    - Inriver survival: +0.30

UW Power Calculations

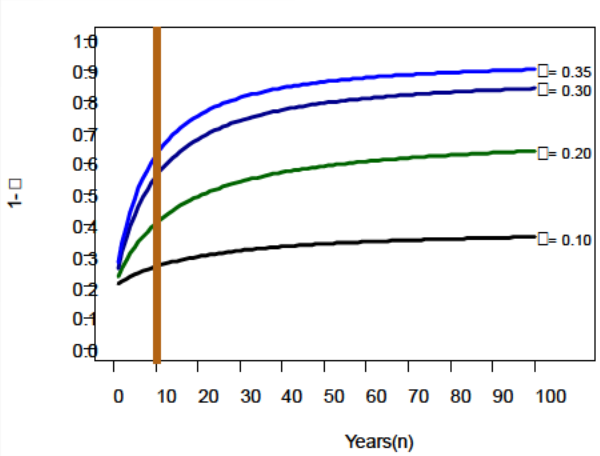
Statistical Power

- **Response variable**
- **Test of hypotheses**
- **α-level**
- **Sample size**

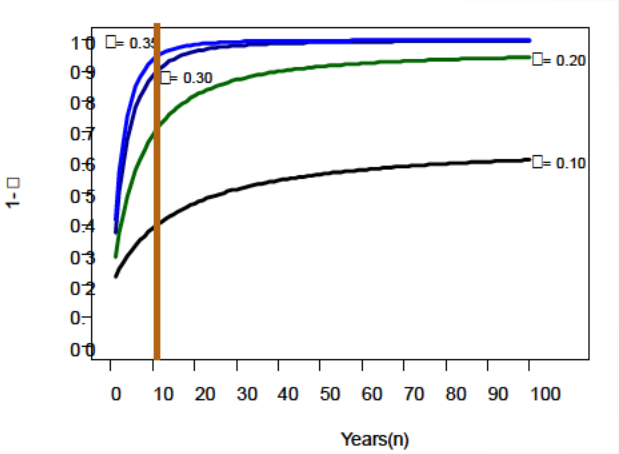
- SARs
  - Two orders of magnitude of interannual variation
  - Need century of observations
- TIRs
  - Transports control for fish condition, ocean, harvest effects
  - Vary by factor of 5 or less
  - Still need multiple decades

UW Power Calculations (cont.)

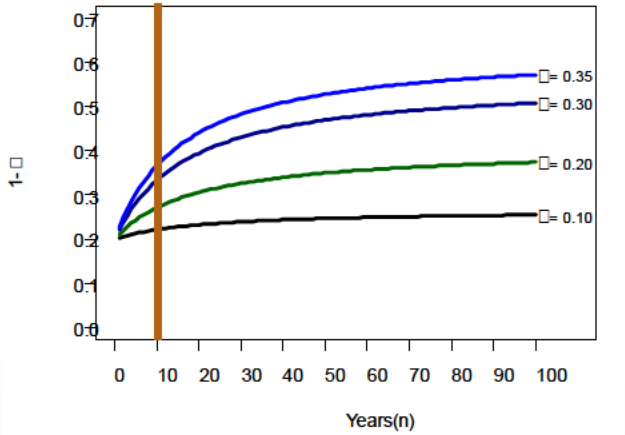
Hatchery spring Chinook (2001 omitted)



Wild steelhead (2001 omitted)



Hatchery summer Chinook (2001 omitted)



α = 0.10, one-tailed test

Other Study Considerations (Cont.)

D. No ancillary studies of extraneous effects

- Monitoring for change in smolt condition or size that could confound study
- Monitoring for increased incidence of gas bubble disease under 125% TDG
- Monitoring for changes in adult migration
- No trigger to stop study if problems occur

Other Study Considerations (Cont.)

E. No decision rules

- Plan specifies comprehensive testing in 5 and 10 years
  - No sequential testing proposed
  - No decision rules to continue or stop study

Conclusions

- Numerous design and analysis considerations central to the success of a spill study have not been fully specified
- *A priori* specifications of response variables and tests of hypotheses essential for an objective evaluation
- Preliminary calculations suggest inriver survival will need to increase substantially (i.e., $\Delta \geq 0.30$) for study to have moderate to reasonable power in 10 years
- A formal, peer-reviewed design and analysis plan must be developed prior to the investigation

Action Agency Conclusions: Best available science supports existing path forward

- The federal agencies just completed a 5-year comprehensive evaluation of our ten-year program, with very good results and measurable metrics for accomplishments, such as:
  - Juvenile Performance Standards
  - In-river passage and reach survival of juveniles and adults, including adult abundance
- This program of research-based improvements and rigorous testing is demonstrating positive results and should be completed as planned
- The proposed spill test uses a 2-6% target for Smolt-to-Adult Returns (SARS) as measure of success, but SARS reflect more than hydro system impacts.
- The proposal relies on the CSS model, which is based on oversimplified correlations between juvenile survival and SARS with averaged environmental indices (spill %, flow, etc). ISAB's annual review advised further refinement of the model.
- Outstanding science questions remain about impacts of higher spill, the rationale for the proposed test, and latent mortality.

Questions?

Preliminary Analysis of Spill Test

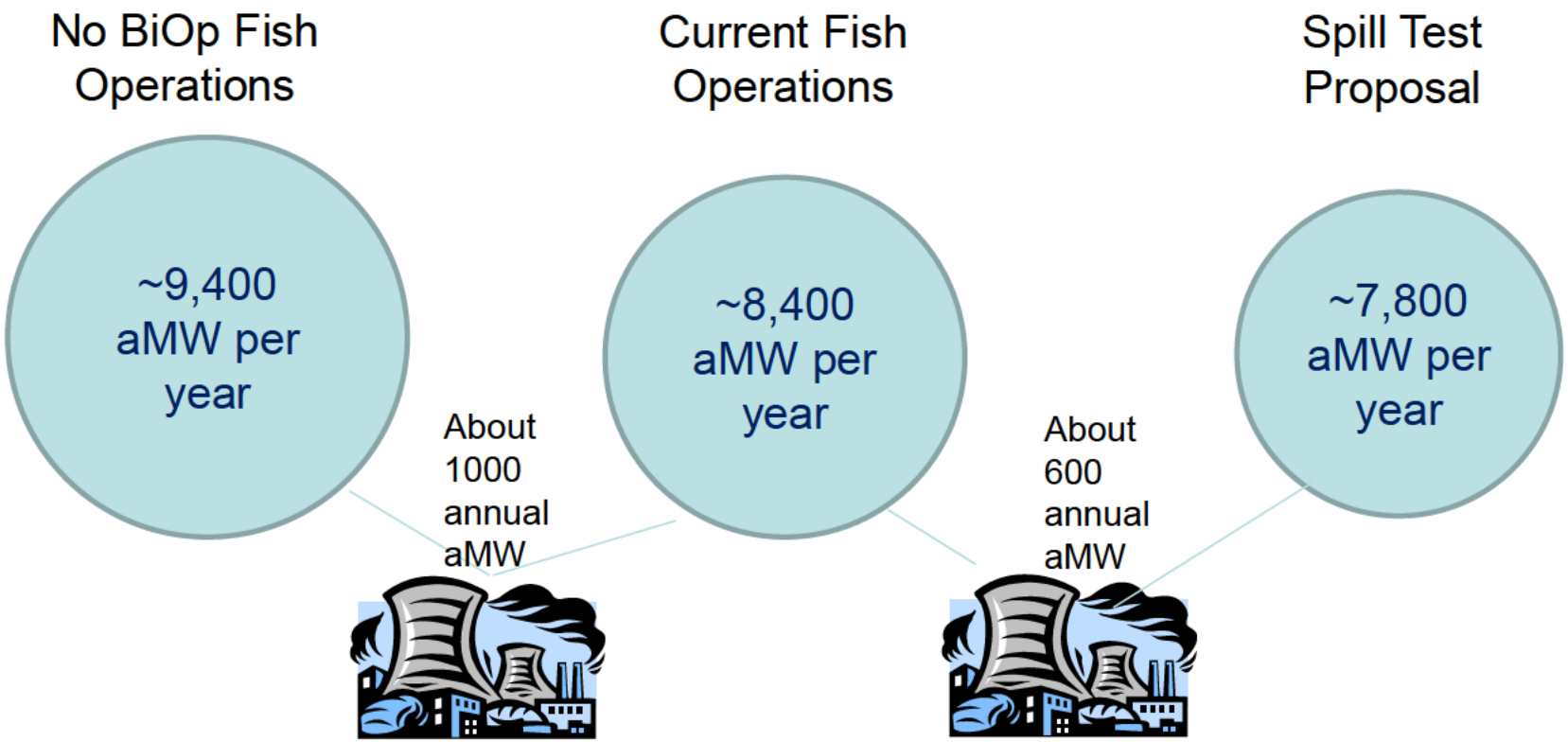
February 4, 2014

Preliminary Analysis

- A Spill Test at 125% TDG from April 3 to June 20 for 24 hours a day has been submitted through a number of venues including NOAA's draft FCRPS Biological Opinion, the federal Action Agencies draft 2014-2018 FCRPS Biological Opinion Implementation Plan and the Northwest Power and Conservation Council Fish & Wildlife Program Amendment process.

- At the request of constituents, we have conducted a preliminary analysis of the more spill proposal as we understand it. The proposal contains caveats in a number of areas, but the details were not included.

Spill Test Would Reduce Average Annual Federal Generation by 600 aMW



For perspective: City of Seattle uses about 1,171 aMW per year
Columbia Generating Station (nuclear plant in Richland) produces about 1,030 aMW per year
Centralia Coal Plant produces about 1,200 aMW per year

Estimated annual average megawatts, based on an evaluation of the historical 80 year water supply record

Lost Generation Would be Concentrated in the Spring

Current Fish Operations

~10,000 aMW produced in Spring

Generation would be reduced – on average – every hour in the spring by 2,500 MW

Spill Test Proposal

~7,500 aMW produced in Spring

For perspective: It would take more than six typical 400 MW combined cycle gas plants to produce the amount of energy removed from the system in the spring. Energy efficiency cannot replace this magnitude of power in the spring in the NW.

Estimated average megawatt hours, April 3 – June 20, based on an evaluation of the historical 80 year water supply record

10-Year Test – Would Reduce Value of Hydro System by Over One Billion Dollars

- $100 million per year in lost firm power (450 aMW per year)
- $10 million per year in lost secondary power sales (150 aMW per year)

Total Rate Effect: Almost 8% Increase

- Oregon's spill proposal increases rates since it both reduces secondary energy sales revenue that offset BPA's operating costs and and decreases the number of megawatt hours BPA has to sell – which means BPA's cost per megawatt hour will be higher
- In addition, customers will also have to replace the lost 450 annual aMW of lost firm power they can no longer get from the federal system
- The overall wholesale rate effect to BPA's customer utilities is estimated to be an increase of nearly 8 percent

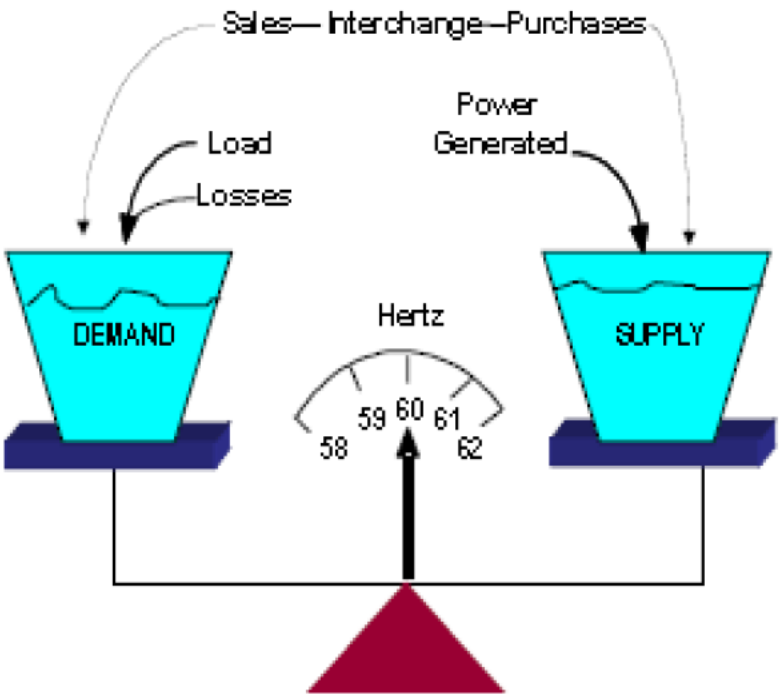
Carbon Impacts of Replacement Energy

- CO_2 production increase: ~ 1.9 million metric tons (MT)
- **$55 million per year in social cost of carbon***
- This estimate is based on a study prepared by the Northwest Power and Conservation Council in 2008
  - In the Pacific Northwest, hydro, wind, and other renewables are used before combustion turbines and coal as they have lower costs to run.
  - For most of the year, natural gas fired power plants are the last resource brought online to supply power instantaneously and to respond to decreases in hydropower production
  - A typical combined cycle natural gas fired power plant emits 800 lbs. of $C0_2$ per megawatt hour
  - A one megawatt hour decrease in hydropower results in 800 lbs. of CO_2 production
- The equivalent of about 440,000 cars or 28,000 tanker trucks of gasoline consumed

** Based on data from the May 2013 Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866. Using $29.15 per metric ton of CO2 (the medium probability case)*

Operations Impacts

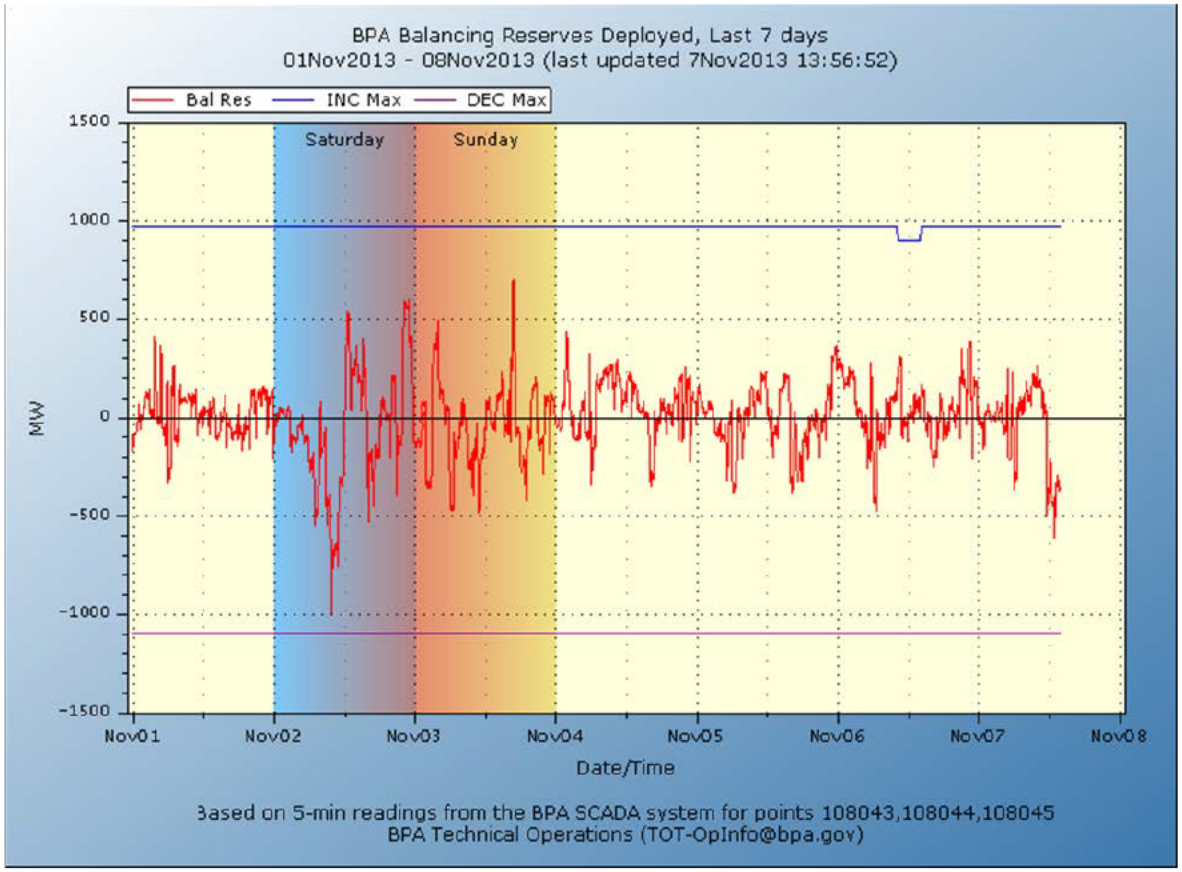
- The flexibility of the federal hydro system is used to balance changes in resources and loads on a second by second basis.
- Proposed spill test would significantly reduce the flexibility of the FCRPS to respond to changes in loads or wind output.



Generation-Demand Balance

Balancing Reserves

- The hydro system has limits on what it can provide and still comply with all hydraulic objectives including current fish operations
- Reduced flexibility could severely reduce quantity of balancing reserves that could be provided by the hydro system.
- With the addition of a large wind fleet the need for balancing reserves has increased
- With the spill proposal, new resources likely would be needed to provide balancing services for <u>both</u> existing and future variable renewable resources which would likely increase the cost to provide these resources



Oversupply of Generation

- Spilling to 125% TDG for 11 weeks may reduce the implementation of oversupply management protocol (displacement of wind);
- But the magnitude of more spill is on average 600 aMWs of hydropower, while our experience with oversupply situations has resulted in displacements of: 11 aMWs in 2011, 6 aMWs in 2012, and zero aMWs in 2013.
- We forecast oversupply situations only in about 50% of the years; not every year.
- Increased spill would <u>also</u> reduce hydropower supply in the hours when the federal power is needed to meet firm load requirements in the Northwest.
- This potential reduction in oversupply may be offset by a change in resource mix in the region. Thermal plants that normally shut down in the spring may need to continue running to meet loads. This change may contribute to oversupply because of minimum generation and run-time requirements at the thermal plants.
- Potential impacts to transmission interties may reduce access to markets outside the BPA Balancing Authority

Transmission Impacts

Initial assessments identified the following likely impacts of more spill:

- Reduced intertie transfer capacity
- Increased congestion on North of John Day and North of Hanford transmission paths
- Would be a significant change from current operating paradigm and may cause operating issues that we do not currently face

From: Klumpp,Elizabeth C (BPA) - DKR-WSGL
To: Lut,Agnes (BPA) - KEWR-4; Bodi,Lorri (BPA) - KE-4; Cogswell,Peter (BPA) - DK-7
Cc: Maslen,Bill (BPA) - KEW-4; Sweet,Jason C (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Mercier,Bryan K (BPA) - KEWB-4
Subject: WDFW - RE: Proposed Spill Test update from WDOE
Date: Monday, March 10, 2014 9:16:56 AM

I followed up with Bill Tweit at WDF&W this morning on this topic.

He indicated there is a white paper on revising TDG minimum levels, written by Ecology and DF&W, currently sitting with Governor's staff (who are likely swamped by legislative session and reviewing bills). It lays out two avenues.

1) Do we need to alter the TDG levels?
2) If we do need to consider modifying the TDG levels, then here are two open, transparent processes to consider.

He indicated that WDF&W's view mirrors the ISAB's: there is no actual proposal in front of the region, though there may be (or is) a valid, long-term issue to consider. Doesn't think it's WDF&W's role to develop a proposal. Though he added that WDF&W is a part of CSS. (Which I imagine most of you know, but I didn't.)

Interpretation of ISAB findings: 1) there is no true experiment to evaluate, 2) as we look at the data there are some correlations (not necessarily causations) that appear to be promising. Testing those might involve some adaptive management, but there are potential negative consequences.

It's possible that the white paper will be shared after legislative session wraps up.

From: Lut,Agnes (BPA) - KEWR-4
Sent: Wednesday, March 05, 2014 9:41 AM
To: Bodi,Lorri (BPA) - KE-4; Klumpp,Elizabeth C (BPA) - DKR-WSGL
Cc: Maslen,Bill (BPA) - KEW-4; Sweet,Jason C (BPA) - KEWR-4; Ball,Crystal A (BPA) - DKR-7; Weiss,Steven D (BPA) - DKR-7
Subject: Proposed Spill Test update from WDOE

Lorri, Liz
I briefed Bill Maslen yesterday on my conversation with WDOE. They have prepared a TDG Briefing Paper for the Governor's Office on an objective overview of the TDG impacts and a path forward to change the WA TDG criteria (either a variance or short term modification, both options have risks from a WDOE perspective) if they chose to support the proposed OR spill test. The Governor's Office will share this document with American Rivers and others when they are ready. I understood that Michael Garrity asked to receive a copy of the TDG briefing paper once it was available. I'm sure Liz will receive a copy, but my WDOE contact will forward a copy to me once the Governor's Office releases the briefing paper. The plan as described to me is:

Governor's Office requested this TDG Briefing Paper from WDOE.

WDFW will develop a “merits of the spill experiment” document for the Governor’s Office, as the proposed OR spill test plan gets developed.
The Governor’s Office will evaluate these documents, and consider the findings of the NW Power and Conservation Council regarding the proposed OR spill test.
The Governor’s Office will make a decision in 4 years in regards to the proposed OR spill test. (Obviously supporting the current BiOp, but the Accords process will likely influence their decision and impact the 2018 BiOp.)

Please let me know if you have any questions.
Agnes-

Agnes Lut
Fish Biologist | Hydro, Policy and Planning, KEWR-4
BONNEVILLE POWER ADMINISTRATION
bpa.gov | P 503-230-5651 | C 971-271-4784
Please consider the environment before printing this email.

Petersen,Christine H (BPA) - KEWR-4

Subject:	interactions among hatchery release groups
Location:	HQ 412 VP(15); bridge info: 503-230-5600, no passcode
Start:	Fri 3/21/2014 10:00 AM
End:	Fri 3/21/2014 11:00 AM
Recurrence:	(none)
Meeting Status:	Meeting organizer
Organizer:	Petersen,Christine H (BPA) - KEWR-4
Required Attendees:	Petersen,Christine H (BPA) - KEWR-4; Josh Murauskas (jmurauskas@anchorqea.com); Sweet,Jason C (BPA) - KEWR-4; Lut,Agnes (BPA) - KEWR-4; Haight,Mary Todd (BPA) - KEWU-4; Gislason,Jeff (BPA) - KEWR-4; Geiselman,Jim (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Christiansen, Jack (jack_christiansen@fws.gov); McClintock,Gerald (BPA) - KEWB-4; KEW Phone Bridge; Doumbia,Julie A (BPA) - KEWR-4
Optional Attendees:	Jule,Kristen R (BPA) - KEWR-4; 'Joe Miller'; Scranton,Russell W (BPA) - KEWR-4; Shields,Barbara A (BPA) - KEWM-4; Lofy,Peter T (BPA) - KEWU-4
Resources:	HQ 412 VP(15)

Josh Murauskas (Anchor QEA) will be at BPA to discuss the ISAB review of the spill experiment on the 21st. [redacted]

Non-Responsive [redacted]

We thought the set of people on this invite might be interested in the Non-Responsive topic. Josh's other presentation on the spill experiment proposal may also be moved to Friday morning so there could be a transition between the two presentations by Anchor staff.

Call in number: (503)230-5600

Paragraph on ISAB spill test review, page 18 of draft ROD:

The Northwest Power and Conservation Council's Independent Scientific Advisory Board independently reviewed the proposed spill test in February 2014 and similarly concluded that the proposal lacks sufficient details and analysis. The ISAB noted in its report (ISAB 2014-2) that the proposal involves significant uncertainties and risks of unintended consequences such as adverse effects of dissolved gas, increased delay of juvenile fish, increased predation and fallback of adult salmon and steelhead. Given the incomplete study design and monitoring plan, the test may not produce enough information to justify its cost, the ISAB said. The ISAB also called for further scrutiny of the analyses and models used to justify the test, noting that they depend heavily on correlations "which do not by themselves determine cause and effect." The ISAB also indicated that spill could probably not be isolated as the cause of changes in SARs given the confounding variables such as ocean conditions that also affect returns. "Additional effort is needed to fully vet the experimental spill hypothesis and methodology," the ISAB concluded. "An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region." BPA has reviewed and agrees with this finding.

Non-Responsive

[redacted]

From:	Ball,Crystal A (BPA) - DKR-7
To:	Lut,Agnes (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5; Sweet,Jason C (BPA) - KEWR-4; Connolly,Kieran P (BPA) - PGS-5
Subject:	FW: PPC Comment Letter to NWPCC re: Spill Test
Date:	Wednesday, April 02, 2014 6:02:18 PM
Attachments:	PPC Comments to NWPCC on Spill Test March 2014.pdf ATT00001.htm

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FYI

From: Cogswell,Peter (BPA) - DK-7
Sent: Tuesday, April 01, 2014 1:21 PM
To: Zimmer,Pat R (BPA) - DKR-7; McNary,Sarah R (BPA) - A-7; Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-WSGL
Cc: Warner,Joshua P (BPA) - PEH-1
Subject: FW: PPC Comment Letter to NWPCC re: Spill Test

FYI.

From: Scott Corwin [mailto:scorwin@ppcpdx.org]
Sent: Tuesday, April 01, 2014 1:09 PM
To: Gendron,Mark O (BPA) - P-6; Delwiche,Gregory K (BPA) - D-7; Bodi,Lorri (BPA) - KE-4; Cogswell,Peter (BPA) - DK-7
Subject: Fwd: PPC Comment Letter to NWPCC re: Spill Test

FYI, our Spill letter to the Council. Scott

From: Bo Downen
Sent: Friday, March 28, 2014 3:50 PM
To: Bill Bradbury
Cc: Phil Rockefeller; janders@nwcouncil.org; Bill Booth; Henry Lorenzen; Jim Yost; Tom Karier; psmith@nwcouncil.org; Steve Crow; Tony Grover; Mark Walker; Weist, Karl (kweist@nwcouncil.org); kberg@nwcouncil.org; 'shorton@nwcouncil.org'; Allen, Jeff (jallen@NWCouncil.org)
Subject: PPC Comment Letter to NWPCC re: Spill Test

Dear Bill,
Please see PPC's attached letter in regard to the spill test currently under consideration by the Council.
Thank you,

Bo Downen
PPC
503.595.9772

Public Power Council
825 NE Multnomah, Suite 1225
Portland, OR 97232
503.595.9770
Fax 503.239.5959

March 28, 2014

Bill Bradbury, Chairman
Northwest Power and Conservation Council
851 S.W. Sixth Avenue, Suite 1100
Portland, OR, 97204

Re: NWPCC Fish and Wildlife Program and Spill Proposal

Dear Bill:

We are writing in strong opposition to inclusion by Northwest Power and Conservation Council ("NWPCC" or "Council) in the fish and wildlife program of any version of a so-called "test" of additional spill that would adversely impact adult salmon and steelhead, threaten various aquatic species with higher gas levels, cause further loss of generation of clean hydropower, and create enormous costs to ratepayers. In light of this combination of harm to fish, ratepayers, and the environment, we urge the NWPCC to reject calls for you to spend valuable time and ratepayer dollars in further consideration of this or related proposals.

The Public Power Council (PPC) has actively followed the work the NWPCC has undertaken in developing its fish and wildlife program, and we have already twice provided amendments and comments to the NWPCC on this important topic. Just as the Council program has a statutory obligation to protect, mitigate, and enhance fish and wildlife affected by the Federal Columbia River Power System (FCRPS), it also is required to abide by other mandates in the Northwest Power Act that the program assure the region an adequate, efficient, economical, and reliable power supply. This spill proposal is wholly inconsistent with all of those program requirements.

As the Council and the region have seen in public power's support for the FCRPS Biological Opinion, public power is supportive of using the best available science in managing fish and wildlife in the Columbia Basin. This spill proposal, as measured by your own Independent Scientific Advisory Board (ISAB), is clearly not the best available science. Instead, the very bedrock upon which the proposal is premised, that higher smolt-to-adult returns are caused by higher spill, is faulty. This obfuscation of causation did not pass scientific muster with the ISAB or NOAA Fisheries analyses. Further, the studies on which the proposal was based took into account only two species in the Columbia, negating consideration of elevated TDG levels on other adult and juvenile salmon and steelhead, other anadromous and resident fish, and other aquatic organisms.

In addition to noting these grave deficiencies of the proposal, the ISAB went on to note that the proposal fails in many other respects, including but not limited to the following: an increase of spill to these levels could cause increased fallback and passage delays of adult salmon; the

proposal lacks recognition of predation effects; and, the proposal gives limited consideration of the degradation this would cause to state and federal water quality standards.

Further, BPA has said that the proposal would come at a high cost to production of emission-free hydropower and to the region's ratepayers. BPA estimated that the cost of this added spill would be $110 million annually, $1.1 billion over its ten-year timeframe. It would cost the region 600 aMW of clean, renewable power, much of which would have to be replaced by carbon producing resources.

Regional ratepayers using federal power are currently funding fish and wildlife mitigation efforts at a cost of approximately $700 million annually. This is nearly one-third of BPA's wholesale power costs. In view of other mitigation proposals that would provide far more benefit to the region's fish and wildlife, we urge Council members to dismiss speculative and harmful spill proposals in the upcoming fish and wildlife program.

PPC thanks you for your serious consideration of these comments, and looks forward to continuing to work with the NWPCC as it amends its fish and wildlife program.

Sincerely,

Scott Corwin
Executive Director

From:	Lut,Agnes (BPA) - KEWR-4
To:	Milstein,Michael C (BPA) - KE-4
Subject:	RE: Quotes from Skalski and ISAB re CSS correlations
Date:	Thursday, April 03, 2014 8:43:06 AM

I also put materials in the Smart Spill folder.

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, April 03, 2014 8:40 AM
To: Lut,Agnes (BPA) - KEWR-4
Subject: RE: Quotes from Skalski and ISAB re CSS correlations

Spoke too soon. Just found it.

http://www.nwcouncil.org/fw/isab/isab2014-2/isrp2014-2supplemental/

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, April 03, 2014 8:39 AM
To: Lut,Agnes (BPA) - KEWR-4
Subject: FW: Quotes from Skalski and ISAB re CSS correlations

Am having trouble finding the Skalski material again. The Council dropbox that seemed to have all the info from the ISAB isn't working anymore. Do we have Skalski's ppt and/or paper stored anywhere that you know of?

From: Bodi,Lorri (BPA) - KE-4
Sent: Wednesday, April 02, 2014 5:37 PM
To: Milstein,Michael C (BPA) - KE-4
Subject: Re: Quotes from Skalski and ISAB re CSS correlations

And it cd be harmful.

From: Bodi,Lorri (BPA) - KE-4
Sent: Wednesday, April 02, 2014 05:35 PM
To: Milstein,Michael C (BPA) - KE-4
Subject: Re: Quotes from Skalski and ISAB re CSS correlations

Yes.

From: Milstein,Michael C (BPA) - KE-4
Sent: Wednesday, April 02, 2014 05:09 PM
To: Bodi,Lorri (BPA) - KE-4; Lut,Agnes (BPA) - KEWR-4
Cc: Kerr,Mary K (BPA) - KE-4
Subject: RE: Quotes from Skalski and ISAB re CSS correlations

Sure, what is the focus? Basically correlation is not causation?

From: Bodi,Lorri (BPA) - KE-4
Sent: Wednesday, April 02, 2014 4:25 PM

To: Milstein,Michael C (BPA) - KE-4; Lut,Agnes (BPA) - KEWR-4
Cc: Kerr,Mary K (BPA) - KE-4
Subject: Quotes from Skalski and ISAB re CSS correlations

Can we pull together a one page list of quotes from Skalski and ISAB? It seems we will need to make another, updated round of Smart Spill discussions.

From: Kerr,Mary K (BPA) - KE-4
To: Milstein,Michael C (BPA) - KE-4
Subject: Question for you
Date: Thursday, April 03, 2014 1:22:22 PM

Hi Michael – Does this make sense to you? I am not sure I have Skalski slides and am reluctant to send to the ISAB without clarifying. Can you help? I saw Lorri asked you/Agnes for the quotes.

From: Bodi,Lorri (BPA) - KE-4
Sent: Thursday, April 03, 2014 12:06 PM
To: Kerr,Mary K (BPA) - KE-4
Subject: Re: spill slides

Can you also tell him we are developing a page of quotes from ISAB and also send Skalski slides to the ISAB. THX.

From: Bodi,Lorri (BPA) - KE-4
Sent: Thursday, April 03, 2014 11:58 AM
To: Kerr,Mary K (BPA) - KE-4
Subject: Re: spill slides

Yes but not the power costs packet. Thx

From: Kerr,Mary K (BPA) - KE-4
Sent: Thursday, April 03, 2014 11:18 AM
To: Bodi,Lorri (BPA) - KE-4
Subject: FW: spill slides

Lorri – Do you want me to send to Brent?

From: Lut,Agnes (BPA) - KEWR-4
Sent: Thursday, April 03, 2014 10:45 AM
To: Kerr,Mary K (BPA) - KE-4
Subject: RE: spill slides

Mary
I broke this up into 3 distinct presentations:

1. Smart Spill strategy – fish impacts
2. Power, Cost impacts
3. Issues w/ the spill test (optional: I'm not sure if she wanted to include this, so I broke it out separately)

From: Kerr,Mary K (BPA) - KE-4
Sent: Wednesday, April 02, 2014 3:20 PM
To: Lut,Agnes (BPA) - KEWR-4
Subject: spill slides

Lorri asked for current slides, in two parts: biological and costs. She wants to send to someone.

From: Harrison, John
Subject: Power Council will meet in Spokane next week
Date: Thursday, April 03, 2014 2:37:51 PM
Attachments: image001.png

The Northwest Power and Conservation Council will meet in Spokane next week on Tuesday, April8, and Wednesday, April 9. Here is a link to the agenda: http://www.nwcouncil.org/news/meetings/2014/04/

Newsworthy items include:

- 8:30 a.m. Tuesday at the Power Committee meeting, the Council's power planning staff will report on work to assess the adequacy of electricity generating plants to meet future demand for power. Here's link to a staff report: http://www.nwcouncil.org/media/6954989/p2.pdf
- Wednesday, 11 a.m. Briefing by the Independent Scientific Advisory Board, which advises the Council and NOAA Fisheries, on a proposal to increase spill at Columbia and Snake river dams and study the effects on migrating juvenile salmon and steelhead. Link to ISAB report: http://www.nwcouncil.org/media/6954971/9.pdf
- Wednesday, 11 a.m.: Chuck Berrie, Grant County Public Utility District, will update the Council on work to assess and repair the crack in a Wanapum Dam spillway.

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email-logo

John Harrison, Information Officer
851 S.W. Sixth Ave. Suite 1100, Portland, OR, 97204
800-452-5161 (toll-free)
503-701-2866 (mobile)

From: Lut,Agnes (BPA) - KEWR-4
To: Milstein,Michael C (BPA) - KE-4
Subject: RE: One pager on spill test quotes
Date: Thursday, April 03, 2014 3:37:29 PM

Skalski's slide start on slide 27, see Smart Spill folder:
ISAB spill test presentation17Jan2014.pdf

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, April 03, 2014 3:18 PM
To: Lut,Agnes (BPA) - KEWR-4
Subject: RE: One pager on spill test quotes

OK, good. I haven't found Skalski's slides for the ISAB so I didn't include anything from those. Let's try to keep it as close to one page as we can. Feel free to delete any of the current quotes that seem redundant or too complex.

From: Lut,Agnes (BPA) - KEWR-4
Sent: Thursday, April 03, 2014 3:11 PM
To: Milstein,Michael C (BPA) - KE-4
Subject: RE: One pager on spill test quotes

I just read thru the doc. Off the top of my head I'd like to add quotes regarding:

Length of time it would take to verify the proposed spill test was actually resulting in increased SARS
Fish Condition as a factor
Transport and in-river SARS

I can find the quotes tomorrow and send them to you then.
a-

From: Milstein,Michael C (BPA) - KE-4
Sent: Thursday, April 03, 2014 9:36 AM
To: Lut,Agnes (BPA) - KEWR-4
Subject: One pager on spill test quotes

OK, see what you think. To keep it to one page I tried to focus on key quotes about correlation/causation and risk of unintended consequences.

From:	McNary,Sarah R (BPA) - A-7
To:	Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-WSGL; Cogswell,Peter (BPA) - DK-7
Cc:	Sweet,Jason C (BPA) - KEWR-4; Bodi,Lorri (BPA) - KE-4; Milstein,Michael C (BPA) - KE-4; Barco III,John W (BPA) - A-7; Harwood,Holly C (BPA) - PGB-5
Subject:	FPC Presentation to CRITFC Commission
Date:	Thursday, April 03, 2014 4:42:02 PM
Attachments:	FPC Presentation Pages from 2014-03-Book.pdf

Public Affairs compadres – we are not spreading this all over the landscape, but as most of you know, we learned that the day after Lorri presented to the CRITFC commission last week, Michelle DeHart made this presentation to the Commission. Much of the content is consistent with material presented to the ISAB during their consideration of the CSS-sponsored spill test proposal. However, there are several slides that go beyond that content and are consistent with the recent FPC memo. I have been advised that this presentation was also given to Oregon and Washington. Let's discuss.
Take care,
Sarah

2013 Fish Passage Monitoring

Fish Passage Center
Smolt Monitoring Program
Comparative Survival Study

Passage Management

- The fish passage operations in 2013 and recent past years were implemented under the auspices of the 2005 Federal Court Order and the 2008 Biological Opinion
- The Court Order provides more fish passage protection than the 2008 Biological Opinion
- The Accords incorporate the measures in the 2008 Biological Opinion
- The Court Order protection has been reduced with in-season implementation
- The 2014 Biological Opinion returns to the 2008 Opinion measures reducing Court Order protection

The Fish Are Talking To Us

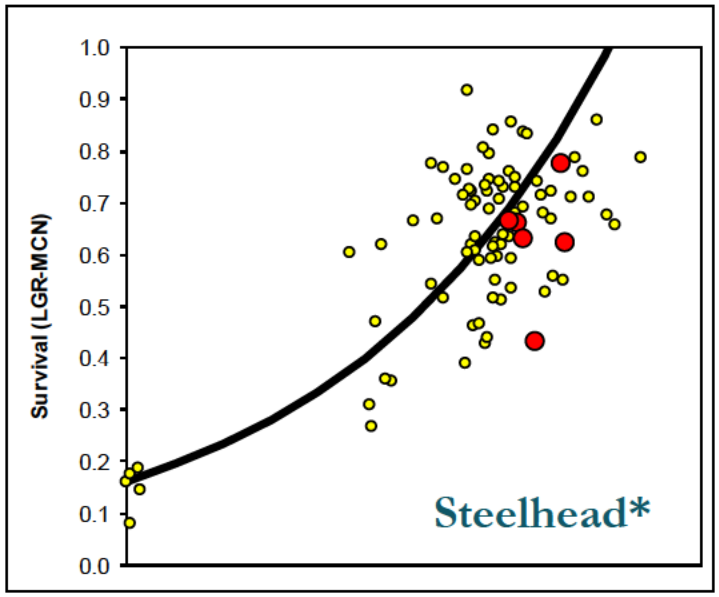
- Smolt Monitoring Program
  - Collecting migration characteristics and conducting analyses since 1984
  - Juvenile survival, travel time, passage timing
- Comparative Survival Study
  - Conducting data and analyses since 1998
  - Life-cycle monitoring
  - Juvenile survival, smolt-to-adult return rate
  - Smolt-to-adult return by route of juvenile passage
  - Identify conditions that result in higher survival and higher adult return rates

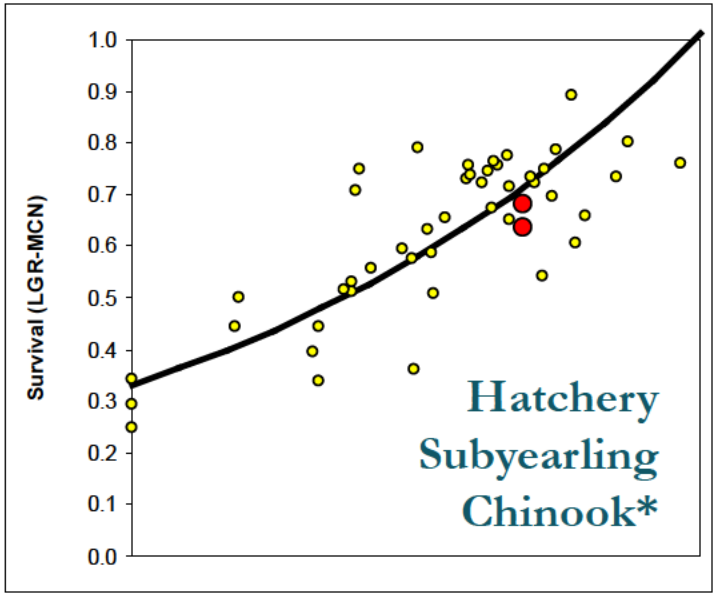
What Are the Fish Saying?

- Since the 1970s the Fish have been repeating themselves
  - All of the data that has been collected over 40 years of monitoring and analyses shows that salmon and steelhead survival is higher when spring and summer flows are high and when spill levels are high
  - Smolt transportation does not mitigate the adverse impacts of the hydroelectric projects on salmon and steelhead
- Recent years monitoring confirm historical findings

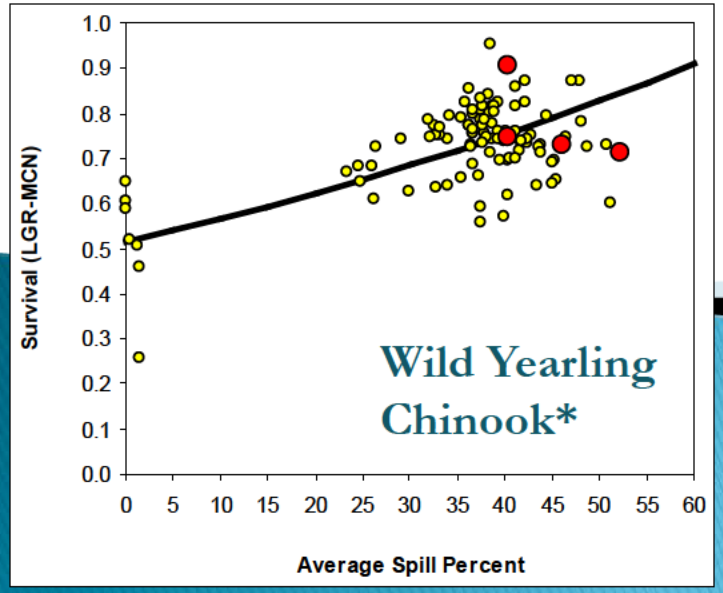
Snake River

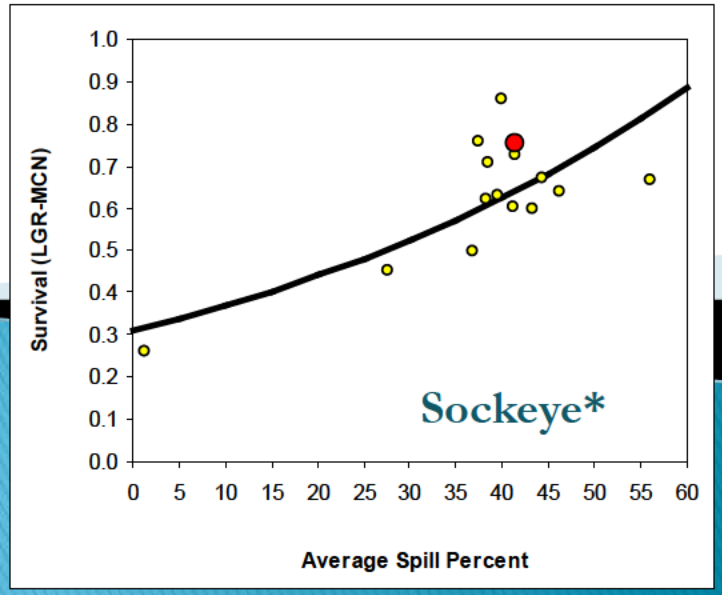
Juvenile Survival (LGR-MCN) vs. Average Spill Percent





* Statistically significant at α=0.05 level

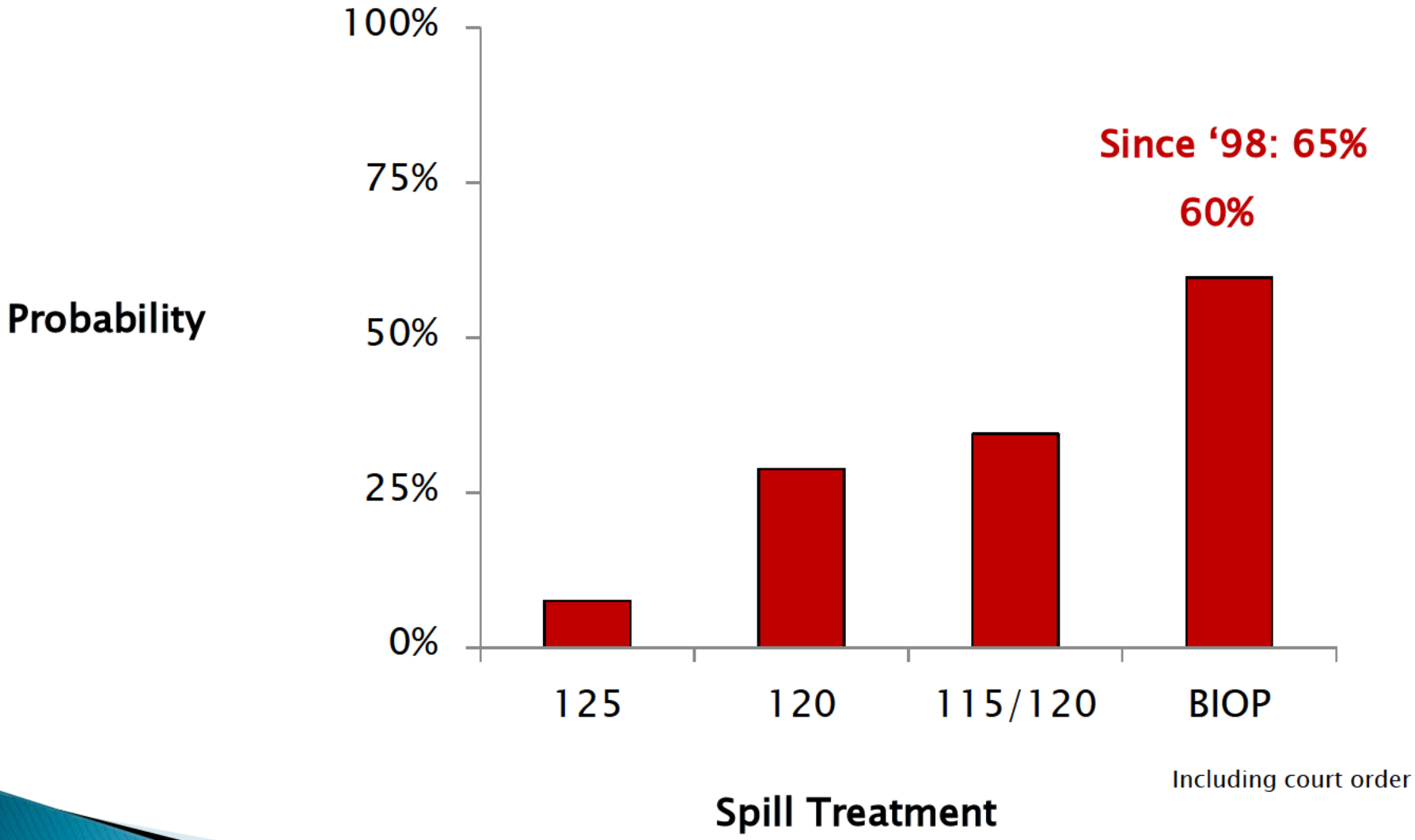




What Are The Fish Saying?

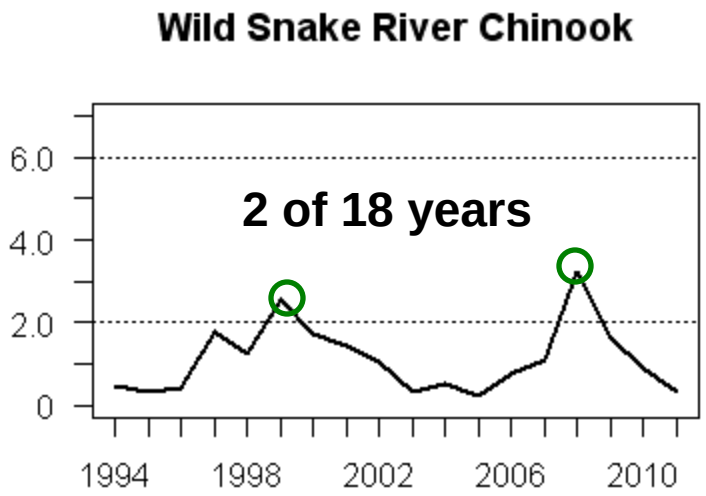
- In the past five years the fish have had additional things to say:
  - Freshwater juvenile passage affects first year ocean and estuary survival. Fresh water route of passage and ocean survival are not independent
  - Fish that pass in spill have a higher smolt to adult survival rate. Fish that pass through powerhouses have higher delayed mortality and lower smolt-to-adult survival rates.
  - Higher levels of spill result in higher adult return rates
  - Spill increases fish survival in low flow years
  - The present combination of fish passage measures is not adequate to meet the 2%-6% smolt-to-adult return rate goal of the NPCC Fish and Wildlife Program

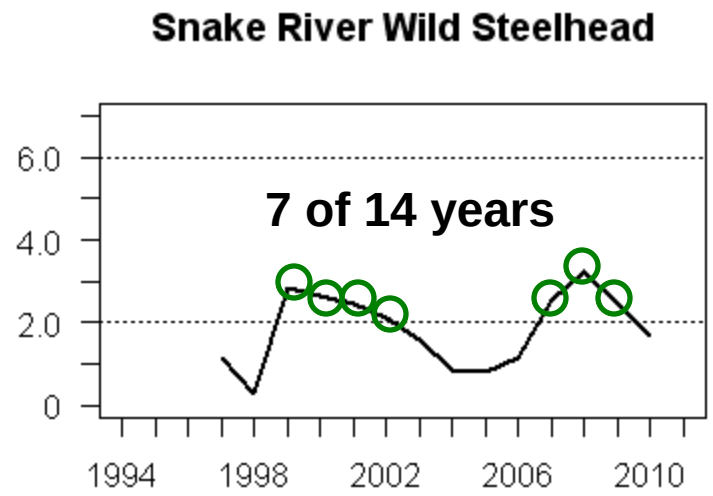
Chinook- Undesirable (< 1% SARS)



Including court order

How Often do Snake River Stocks reach NPCC SAR goals?



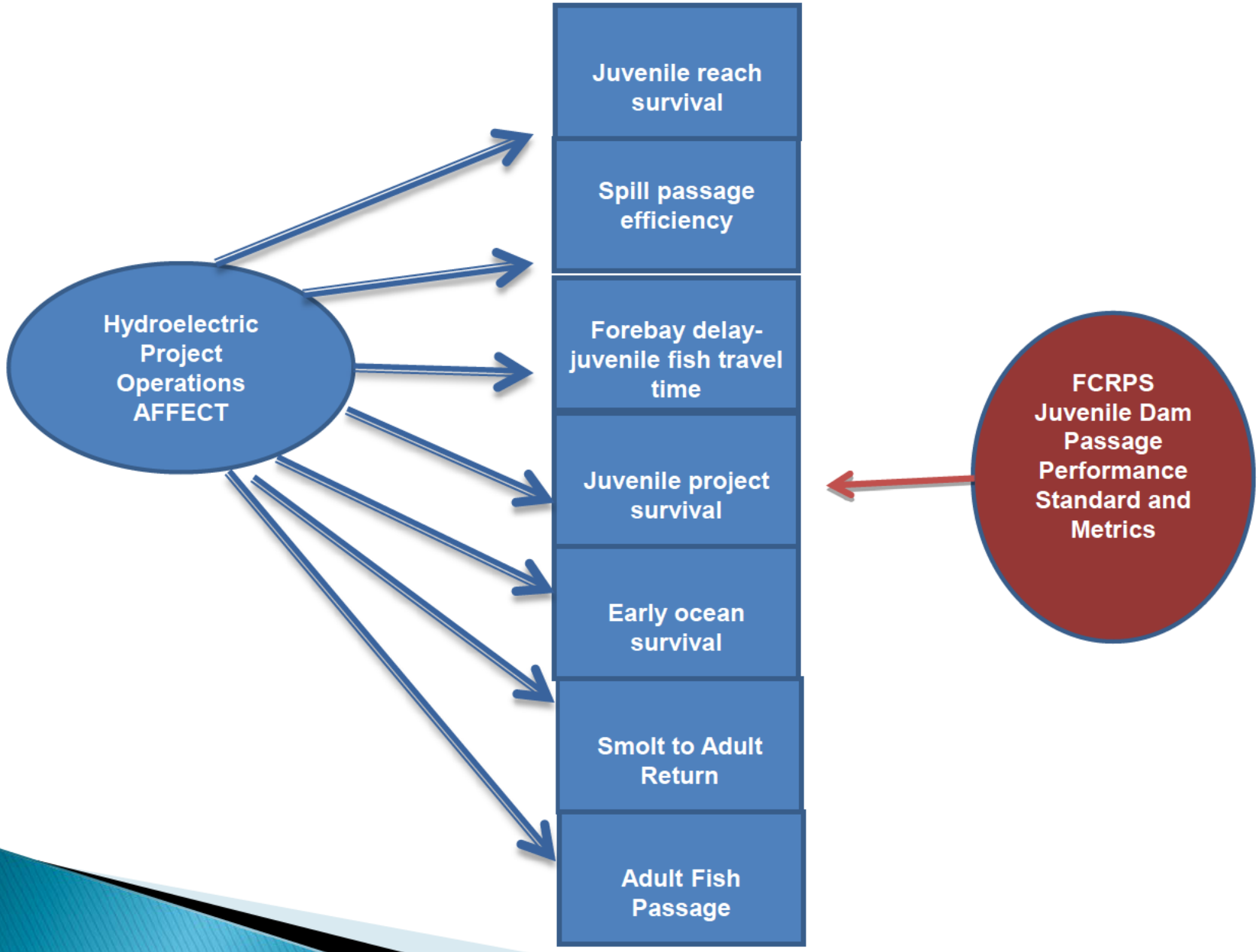


For Hatchery groups across years and stocks:

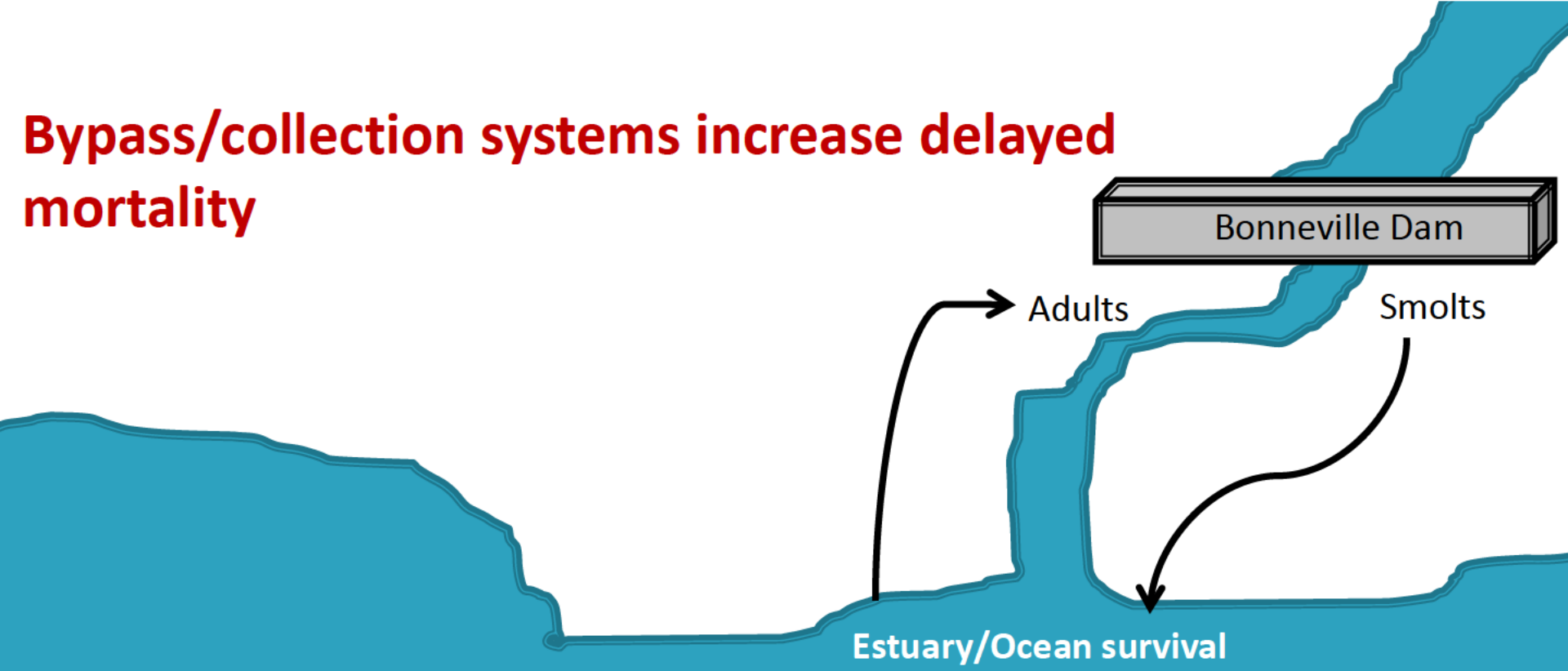
9 Chinook stocks = 11% of estimates in goal range

6 Steelhead stocks = 14% of estimates in goal range

* All SARs are from Lower Granite as smolt to Lower Granite as adult; All Chinook SARs are with jacks.

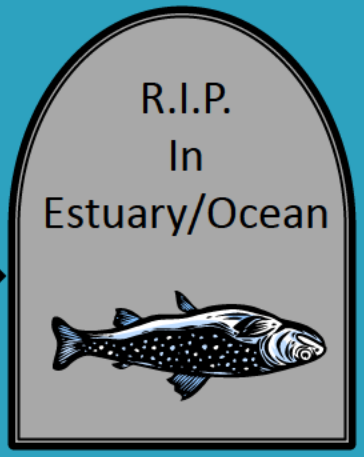

Hydroelectric Project Operations AFFECT
Juvenile reach survival
Spill passage efficiency
Forebay delay-juvenile fish travel time
Juvenile project survival
Early ocean survival
Smolt to Adult Return
Adult Fish Passage
FCRPS Juvenile Dam Passage Performance Standard and Metrics

Bypass/collection systems increase delayed mortality

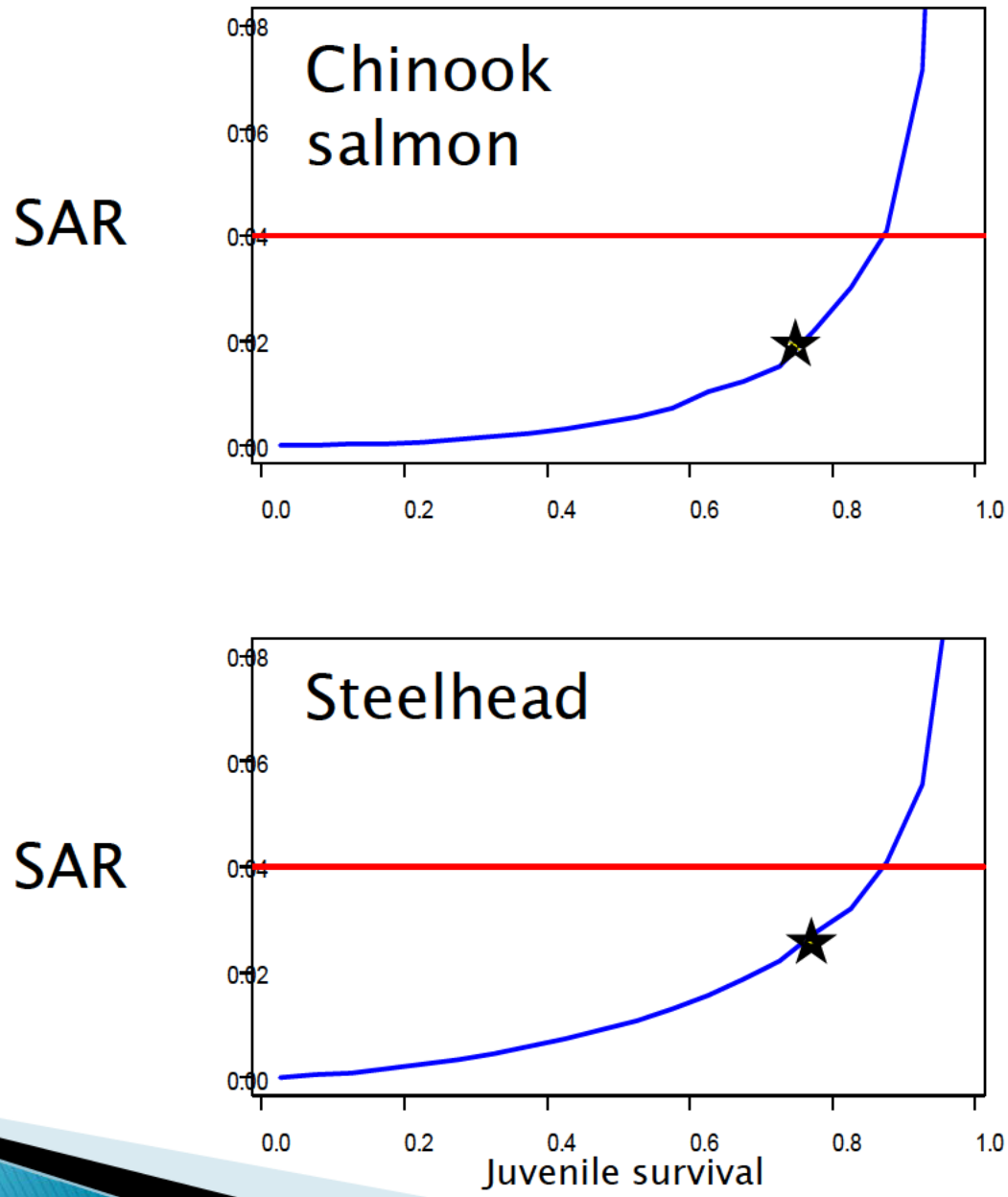


If bypassed at:	Reduction in SAR	
	Chinook	Steelhead
Lower Granite	11%	8%
Little Goose	11%	8%
Lower Monumental	11%	8%
Ice Harbor	11%	8%
McNary	11%	**18%**
John Day	11%	**18%**

then



Expectations if meeting performance standards (with zero reservoir mortality):



Upriver Bright Fall Chinook Are Talking

- A record 784,100 URB Fall Chinook returned in 2013. The return was predominated by 3 year old fish from the 2011 juvenile migration.

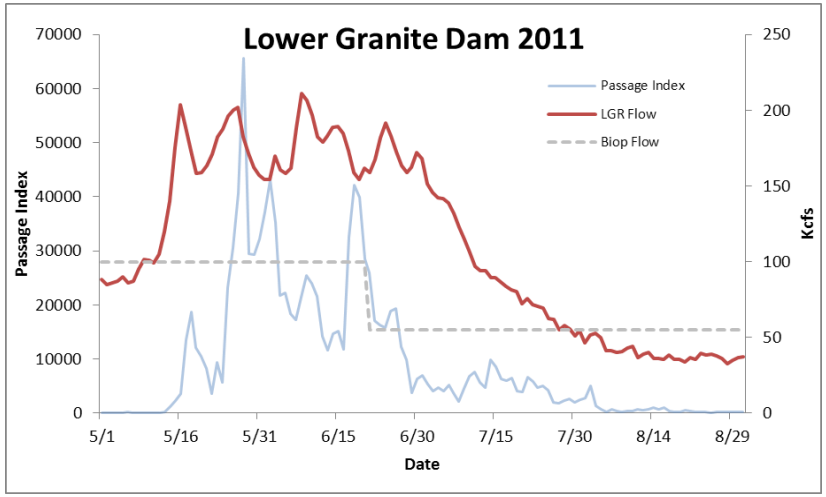
- A new record of 972,300 are predicted for 2014. The return is expected to be predominated by 4 year old fish from the 2011 juvenile migration.

- Outstanding juvenile migration conditions in 2011, coupled with good ocean conditions, lead to the record 2013 returns and new predicted record 2014 returns.

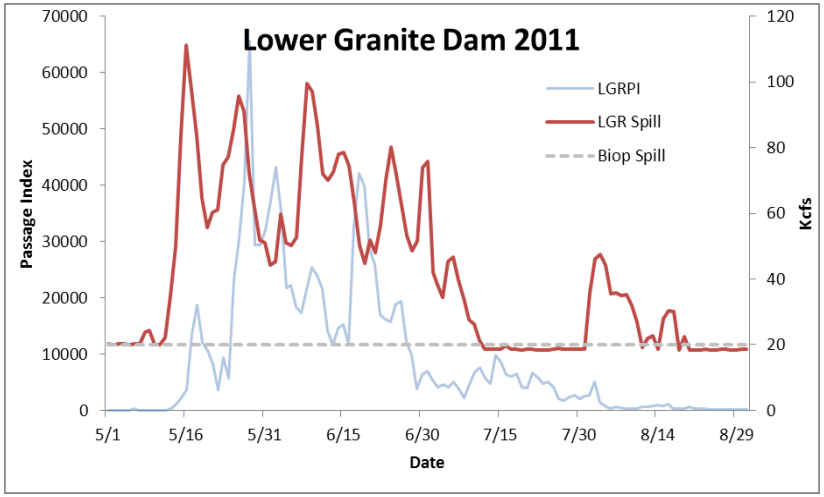
Lower Granite Dam 2011

Fall Chinook Juvenile Migration Conditions

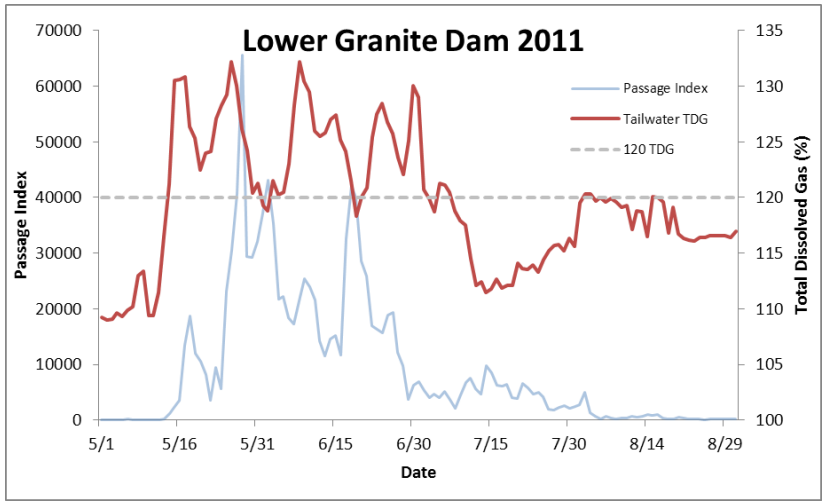
Flow



Spill



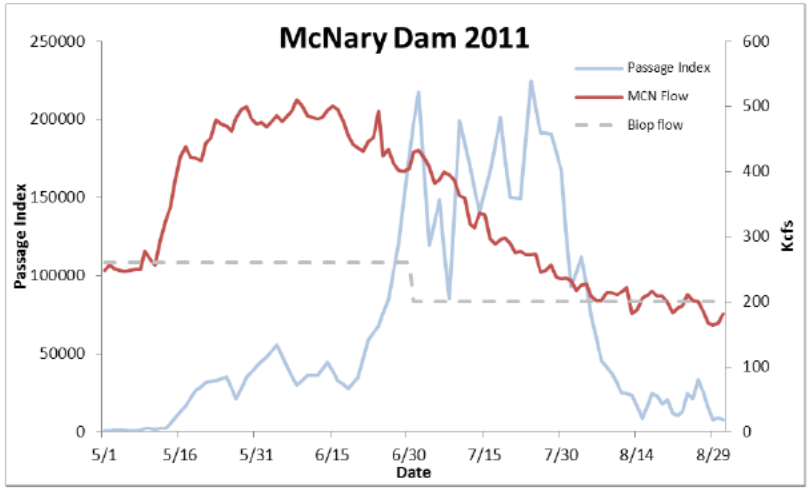
TDG



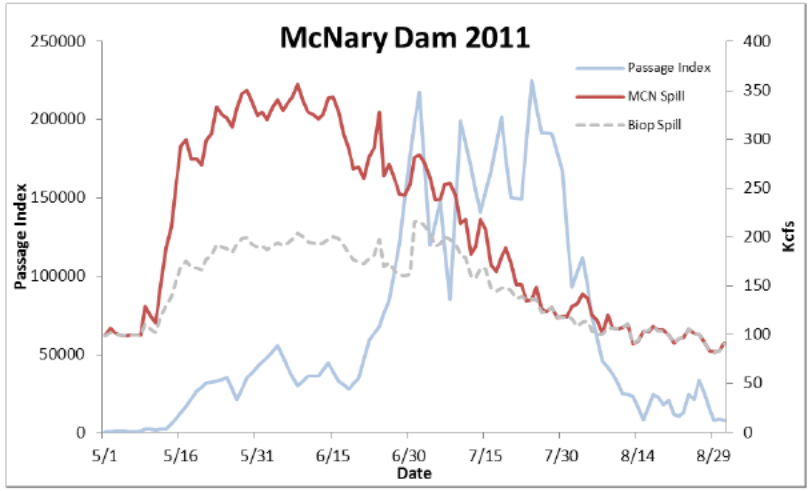
McNary Dam 2011

Fall Chinook Juvenile Migration Conditions

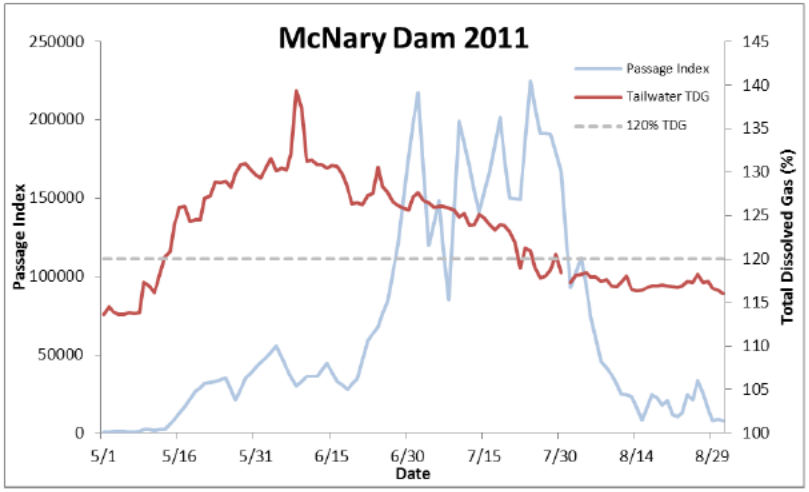
Flow



Spill



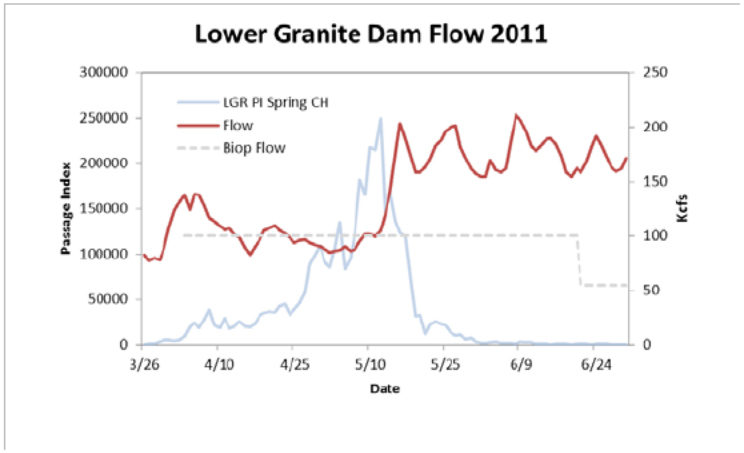
TDG



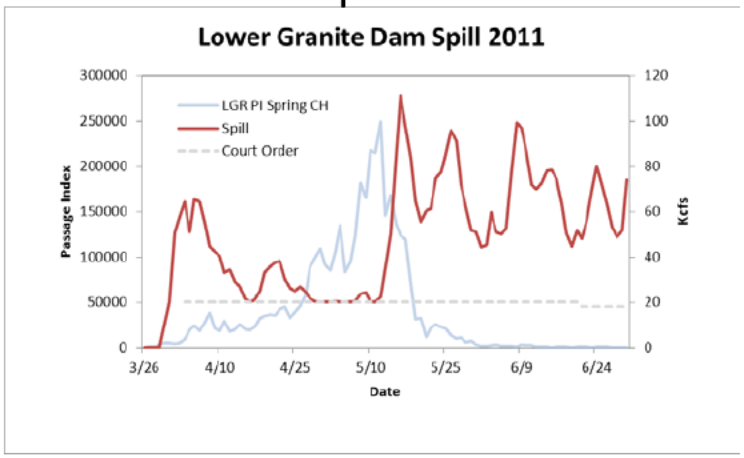
Lower Granite Dam 2011

Spring Chinook Juvenile Migration Conditions

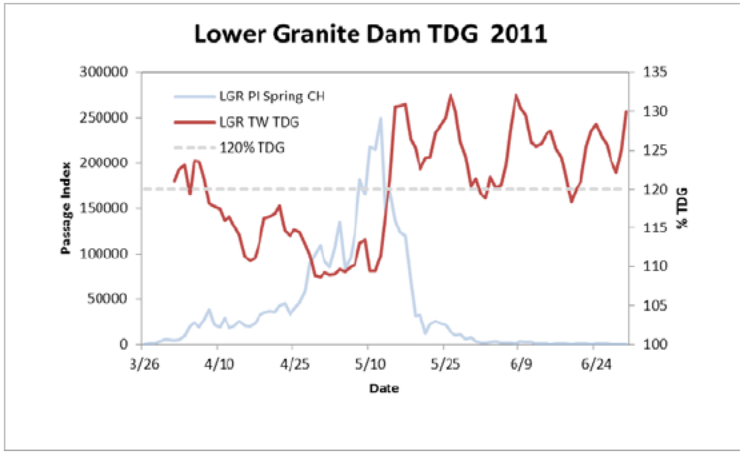
Flow



Spill



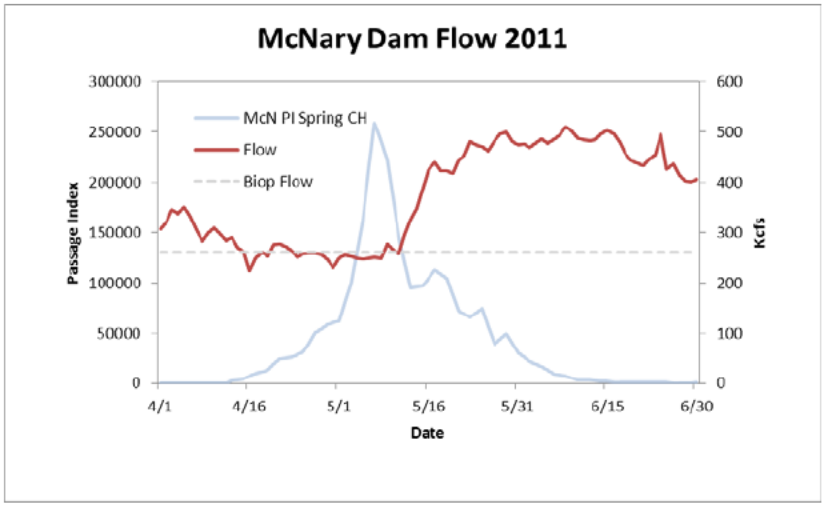
TDG



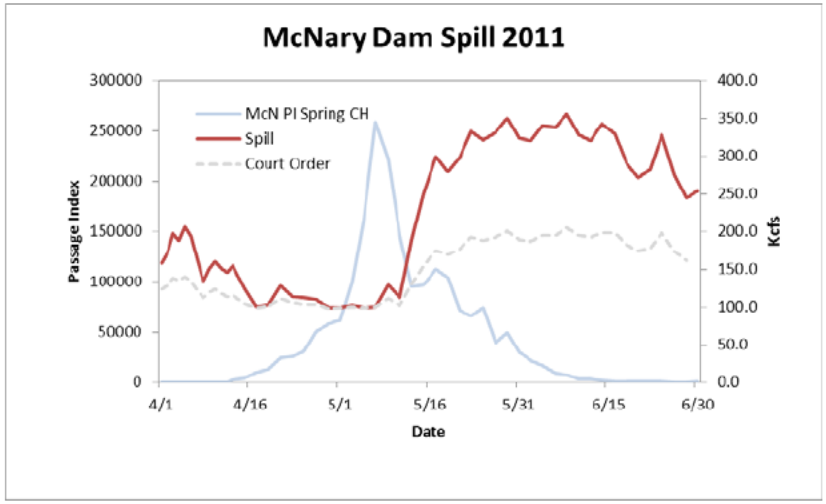
McNary Dam 2011

Spring Chinook Juvenile Migration Conditions

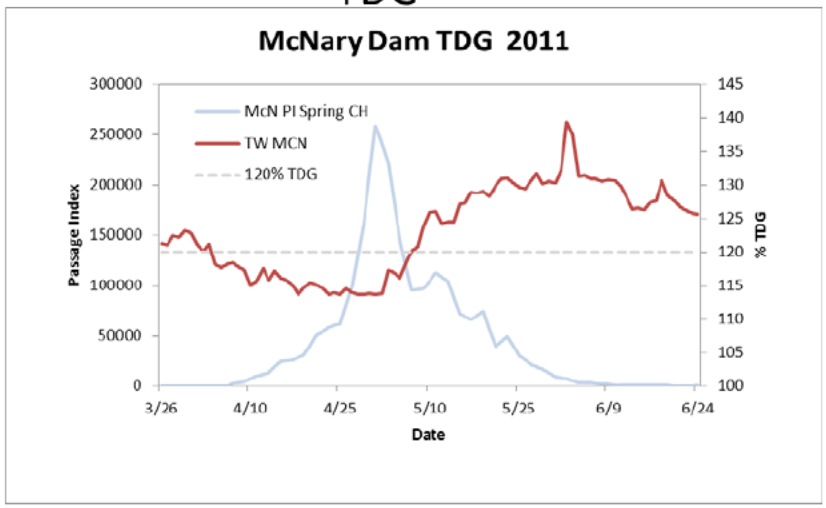
Flow



Spill



TDG



Are We Listening? NO!

- New data shows that performance standards in the 2008 BIOP underestimate adverse impacts – However the 2014 BIOP maintains the same standards – ignoring recent data and analyses
- Updated analyses shows that spill results in higher adult returns –However the new BIOP reduces spill for fish passage from the Court Ordered spill levels implemented since 2005.
- The new BIOP reduces spill for Upper River Bright Fall Chinook
- The 2014 BIOP increases smolt transportation

Are the Action Agencies Listening? NO!

- Recent data and analyses indicate that current fish passage operations can be improved
- Adaptive Management language in BIOPS and other agreements could support operation improvements based upon recent data and analyses
- State, federal and tribal fishery managers have recommended operation changes based on recent data and analyses which have been rejected by the action agencies

Death of a Thousand Cuts

- *"A major negative change which happens slowly in many unnoticed increments is not perceived as objectionable"*

– Until it is too late –

Adverse Increments

- Bonneville Dam
  - Serious descaling of juvenile fish at Bonneville 2
    - The fishery managers recommend increasing spill to the gas cap
    - The actions agencies refuse to increase spill and instead increase flow through Bonneville 1
- Ice Harbor Dam
    - Spill at this project is a test condition from 2006 although no test is being conducted instead of the 45 kcfs/gas cap operation first included in the 2004 BIOP.
    - The 45 kcfs gas cap spill operation has been shown to reduce forebay delay and turbine passage.
    - This operation reduces the overall spill volume at this project. It also increases juvenile fish forebay delay and turbine passage

Adverse Increments

- Lower Monumental Dam
  - The fishery managers have requested a uniform spill pattern at Lower Monumental Dam when flows exceed 60 kcfs
  - A change from the bulk spill pattern to the uniform spill pattern would pass more fish over the spillway, with less delay and lead to lower TDG levels
  - Spill for fish passage at Lower Monumental would not need to be reduced as often due to increased dissolved gas
- Little Goose Dam
  - Spill for fish passage (daytime) is limited to 30% although data and analyses does not support this limit
  - Spill to the gas cap at night "disappeared" from the FOP
  - The Court Order is for spill to the gas cap at Little Goose
  - Although the action agencies have been presented with many technical analyses that show that the 30% cap is not valid, they have refused to implement the court order spill

Adverse Increments

- John Day Dam
  - In 2008 alternating blocks of 30% and 40% spill were tested at John Day Dam
  - Point estimates of survival, forebay delay and tailrace residence time were all improved at the 40% spill level
  - The alternating 30% – 40% test spill blocks continue to be implemented although the 40% spill would improve fish survival and travel time

Reducing Court Order Protections The 2014 BIOP

- The 2014 BIOP reduces protections of the Court Ordered Spill for fish passage
  - Earlier end to Spring spill – Court Order, lower summer spill levels begin on June 21 in the Snake River
  - The BIOP could end spring spill as early as June 4
  - Earlier end to summer spill for fish passage – Court Order summer spill ends on August 31
  - The BIOP could end spill on August 1
- The Fall Chinook have been talking, there is no biological justification for providing less spill or lower survival standards for fall chinook

Reducing Court Order Protections The 2014 BIOP

- At Dam performance standards and testing
  - Performance standards and testing were included in the 2008 BIOP
  - Recent data and analyses indicate that the performance standard approach is flawed and underestimates the impact of the dam passage on salmon and steelhead
  - Technical review and comment shows that performance standard testing does not represent the run-at-large and generates estimates that are biased high
  - Recent data, analyses and comments are not considered
  - There is no biological basis for a lower performance standard for fall chinook

Reducing Court Order Protections The 2014 BIOP

- Increase in smolt transportation
  - Based upon NOAA and other analyses, the start of transportation of smolts has been May 1
  - The 2014 BIOP changes the start date of transportation to as early as April 21
  - There is no data that shows that there is a benefit to transportation before May 1

The Problem

- More spill for fish passage – 125% Gas cap
- Less transportation of juveniles
- More flow at least the BIOP targets
- More summer spill
- Less powerhouse passage
- Performance standards are wrong
- The measures in 2008 BIOP are wrong

The Fish are saying

- Less spill for fish passage in the spring and summer
- More transportation of juveniles
- Reduce court order spill protection
- Less summer spill for fish passage
- More powerhouse passage
- Stay with the performance standards
- Stay with the 2008 BIOP

The Action Agencies are doing

Summary

- The present measures being implemented result in smolt-to-adult return rates that are in the undesirable range (<1%) about 60% of the time, returning to the 2008 BIOP measures would increase that probability
- The 2014 BIOP reduces Court ordered fish protection and returns to the 2008 BIOP measures
- There is a pattern of operations and actions to reduce spill for fish passage in annual Fish Operation Plans
- Recommendations of fish managers are not implemented
- New data and analyses that inform better operations for fish and raise serious doubts about 2008 BIOP measures are not being considered
- Adaptive management language in BIOPs and agreements could allow modifications based upon new data and analyses

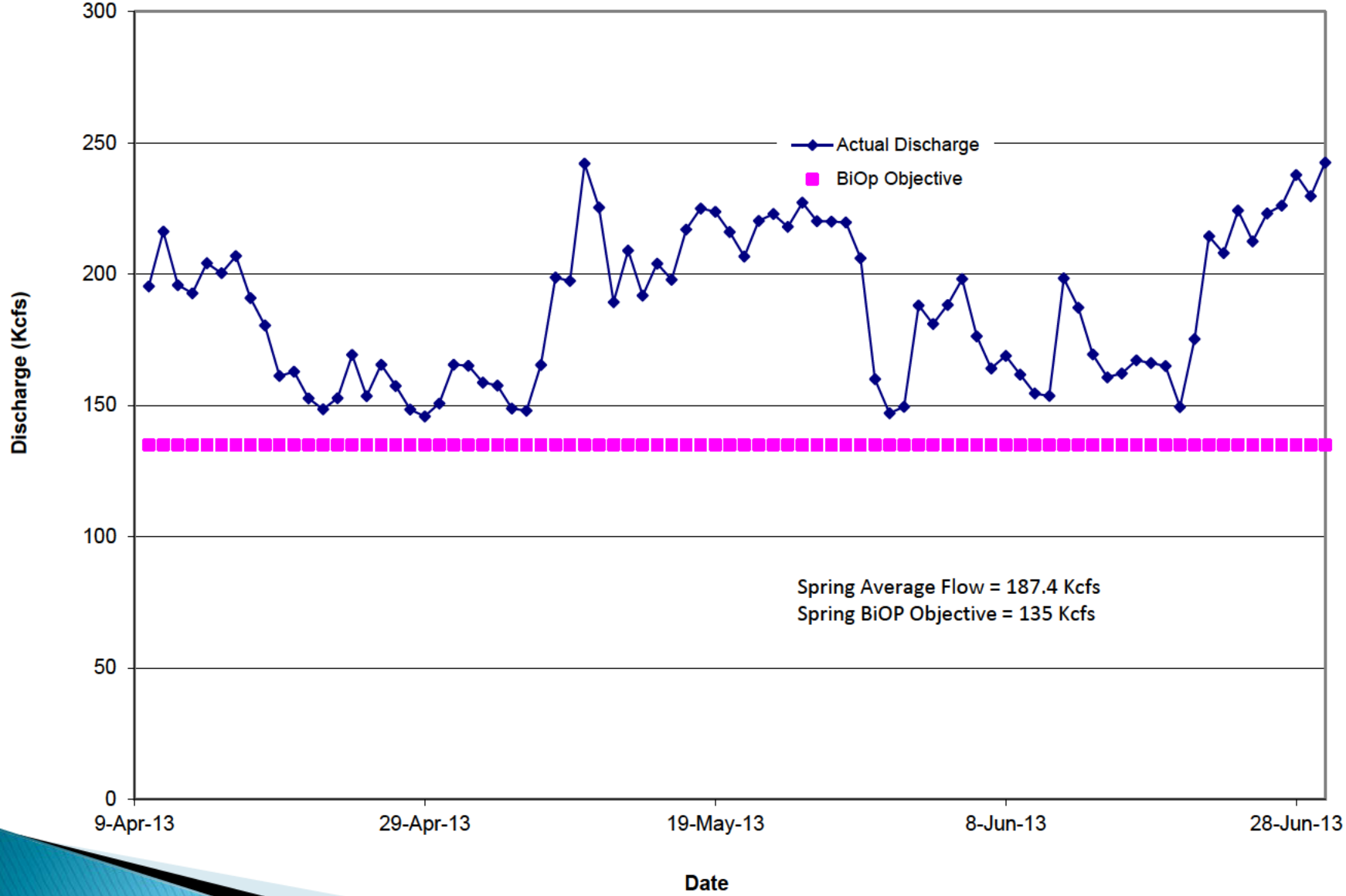
Appendix

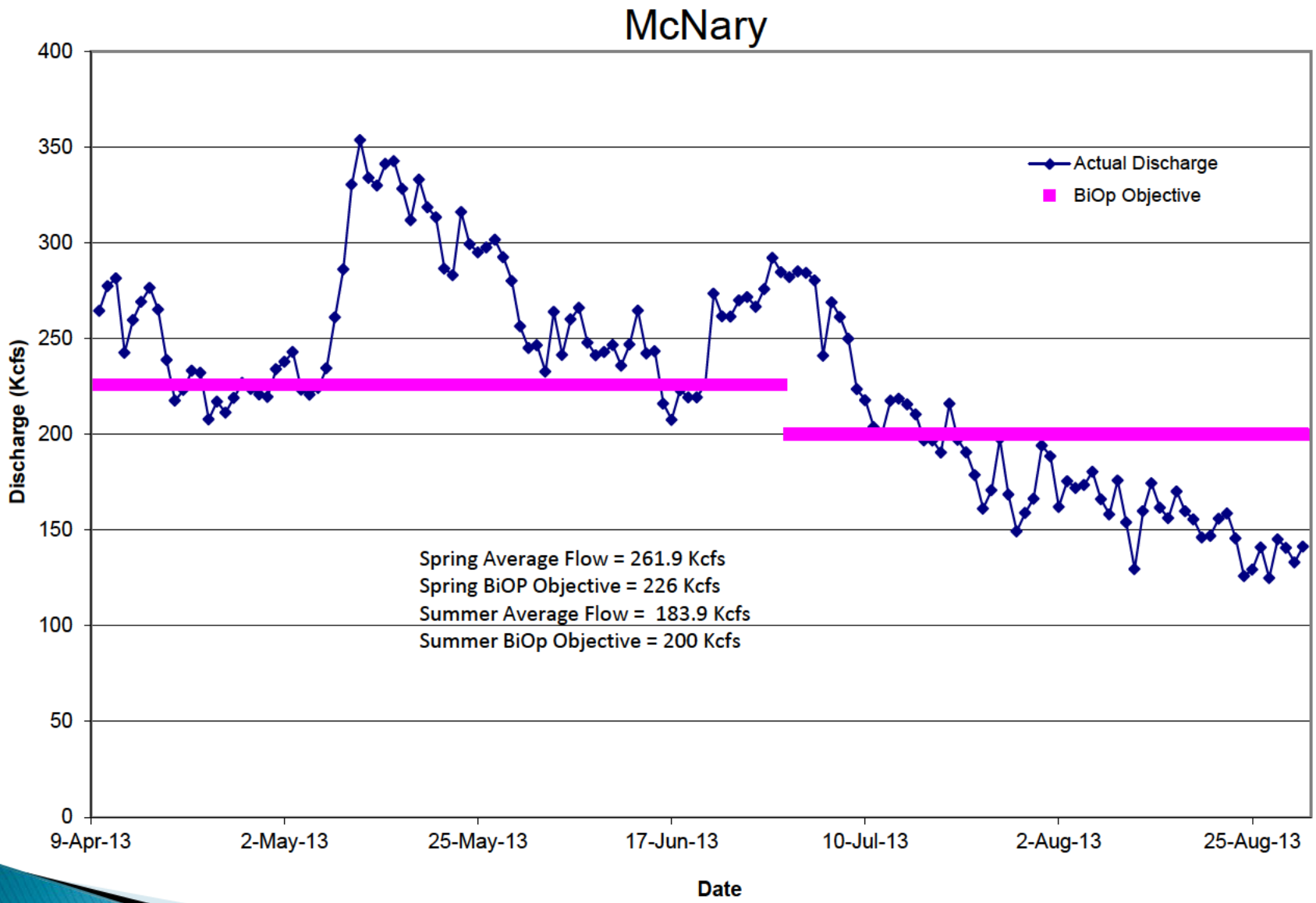
- Only for reference not included in the discussion

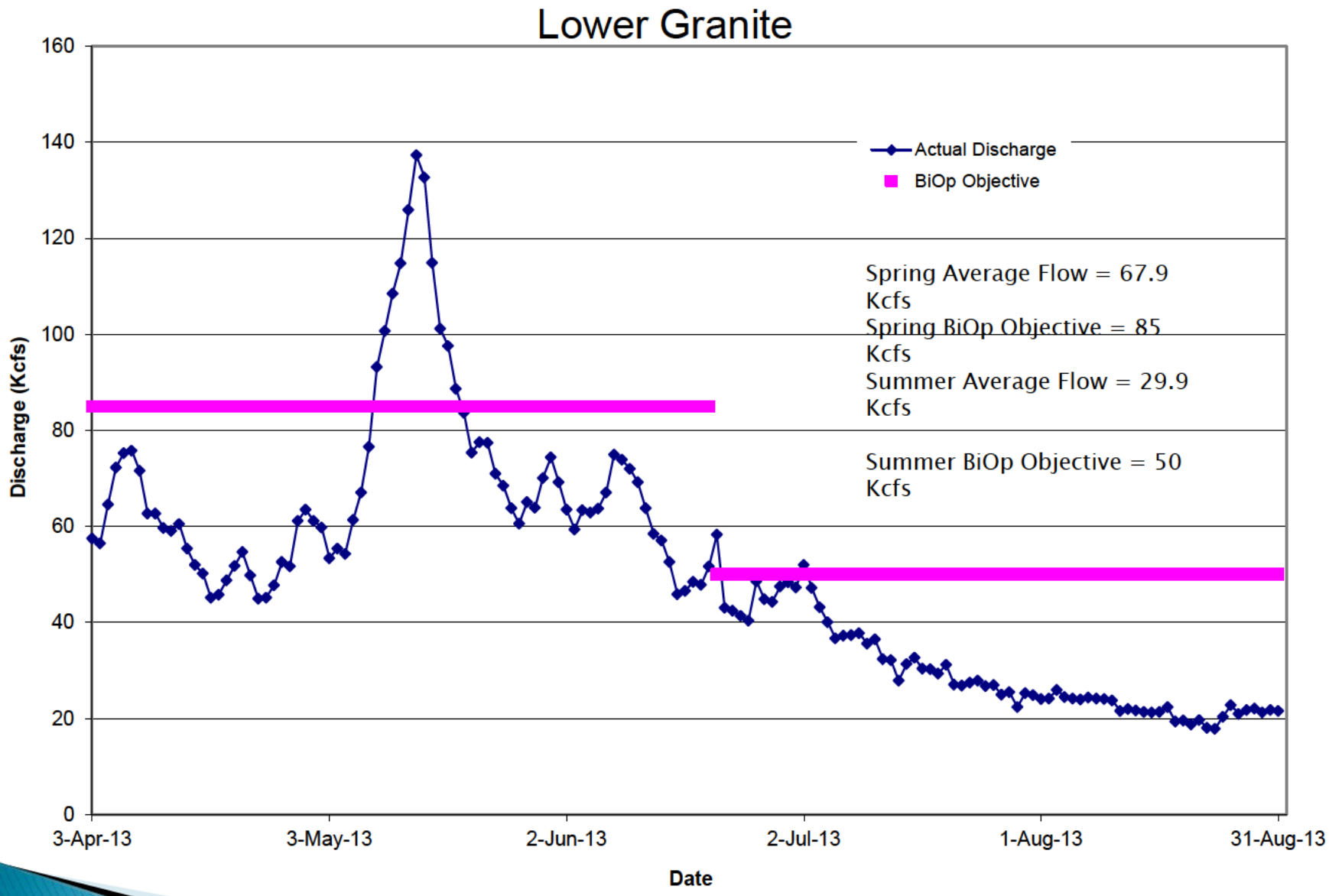
Flow and Spill

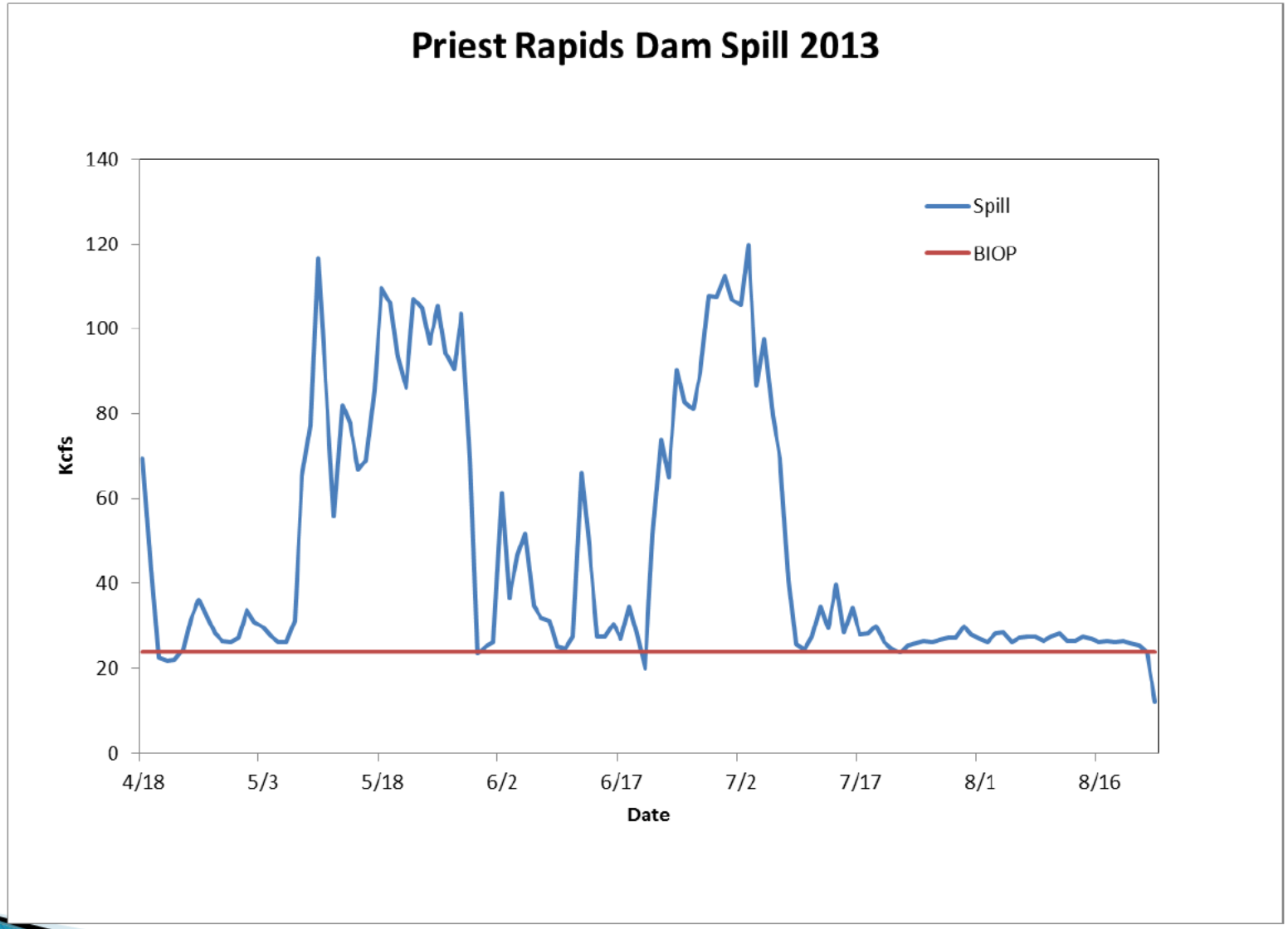
- Priest Rapids and McNary average spring flow met or exceeded the BIOP flow targets
- Summer BIOP target flows were not met at McNary
- Neither spring nor summer BIOP target flows were met at Lower Granite
- Court ordered spill levels were met for spring and summer at McNary and Lower Granite for most of the spring and summer period.

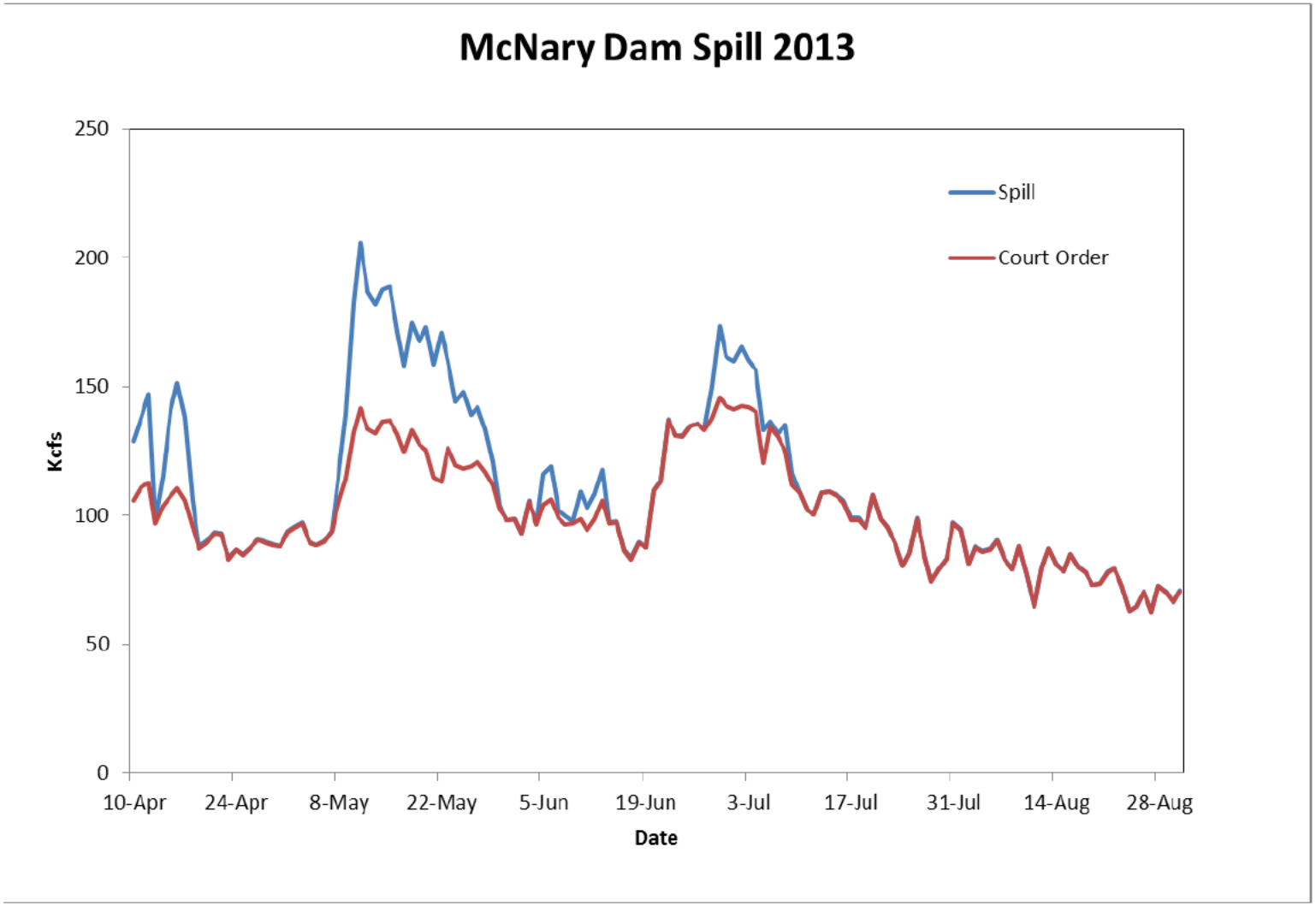
Priest Rapids

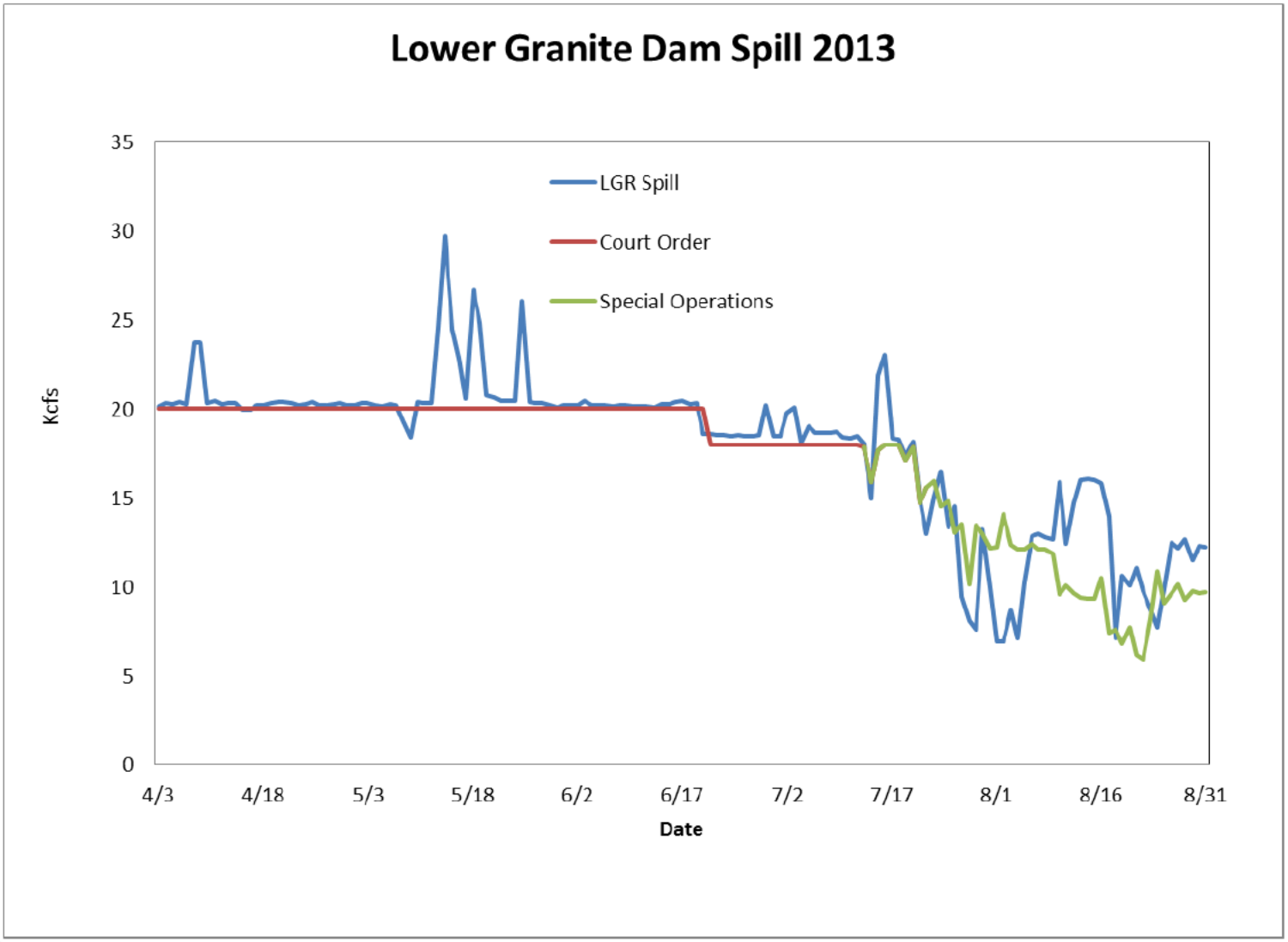



McNary
Discharge (Kcfs)
400
350
300
250
200
150
100
50
0
9-Apr-13
2-May-13
25-May-13
17-Jun-13
10-Jul-13
2-Aug-13
25-Aug-13
Date
Actual Discharge
BiOp Objective
Spring Average Flow = 261.9 Kcfs
Spring BiOP Objective = 226 Kcfs
Summer Average Flow = 183.9 Kcfs
Summer BiOp Objective = 200 Kcfs


Lower Granite
Actual Discharge
BiOp Objective
Spring Average Flow = 67.9 Kcfs
Spring BiOp Objective = 85 Kcfs
Summer Average Flow = 29.9 Kcfs
Summer BiOp Objective = 50 Kcfs
Discharge (Kcfs)
160
140
120
100
80
60
40
20
0
3-Apr-13
3-May-13
2-Jun-13
2-Jul-13
1-Aug-13
31-Aug-13
Date


Priest Rapids Dam Spill 2013
140
120
100
80
60
40
20
0
Kcfs
4/18
5/3
5/18
6/2
6/17
7/2
7/17
8/1
8/16
Date
Spill
BIOP


McNary Dam Spill 2013
250
200
150
100
50
0
Kcfs
Spill
Court Order
10-Apr
24-Apr
8-May
22-May
5-Jun
19-Jun
3-Jul
17-Jul
31-Jul
14-Aug
28-Aug
Date


Lower Granite Dam Spill 2013
LGR Spill
Court Order
Special Operations
Kcfs
35
30
25
20
15
10
5
0
4/3
4/18
5/3
5/18
6/2
6/17
7/2
7/17
8/1
8/16
8/31
Date

From: Zimmer,Pat R (BPA) - DKR-7
To: McNary,Sarah R (BPA) - A-7
Subject: RE: FPC Presentation to CRITFC Commission
Date: Friday, April 04, 2014 3:38:00 PM

Thanks! Looks like building the case for the spill test.

From: McNary,Sarah R (BPA) - A-7
Sent: Friday, April 04, 2014 12:49 PM
To: Zimmer,Pat R (BPA) - DKR-7
Subject: FW: FPC Presentation to CRITFC Commission

Pat – well clearly I'm losing my marbles… I thought I'd put you in the "to " line – sheesh! Here 'tis.
S

From: McNary,Sarah R (BPA) - A-7
Sent: Thursday, April 03, 2014 4:42 PM
To: Ball,Crystal A (BPA) - DKR-7; Klumpp,Elizabeth C (BPA) - DKR-WSGL; Cogswell,Peter (BPA) - DK-7
Cc: Sweet,Jason C (BPA) - KEWR-4; Bodi,Lorri (BPA) - KE-4; Milstein,Michael C (BPA) - KE-4; Barco III,John W (BPA) - A-7; Harwood,Holly C (BPA) - PGB-5
Subject: FPC Presentation to CRITFC Commission

Public Affairs compadres – we are not spreading this all over the landscape, but as most of you know, we learned that the day after Lorri presented to the CRITFC commission last week, Michelle DeHart made this presentation to the Commission. Much of the content is consistent with material presented to the ISAB during their consideration of the CSS-sponsored spill test proposal. However, there are several slides that go beyond that content and are consistent with the recent FPC memo. I have been advised that this presentation was also given to Oregon and Washington. Let's discuss.
Take care,
Sarah

From:	Milstein,Michael C (BPA) - KE-4
To:	Bodi,Lorri (BPA) - KE-4
Cc:	Lut,Agnes (BPA) - KEWR-4; Kerr,Mary K (BPA) - KE-4
Subject:	One pager Spill Test quotes
Date:	Friday, April 04, 2014 5:34:32 PM
Attachments:	OnePagerSpillTestQuotes 4-4-12.docx

Lorri, here's a first stab at a one-pager of quotes from ISAB and Skalski. We have more but I was pretty strict about avoiding jargon and complexity that could lose unfamiliar audiences. Should we be thinking about further material too, Non-Responsive ?

Independent Scientific Advisory Board

Review of the Proposed Spill Experiment, February 20, 2014

"The justification for the proposed test is based on correlative models that do not establish causality."

"There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan."

"It is unlikely that overall changes in SARs can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect."

"The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life."

"Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern."

"There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation."

Non-Responsive

[redacted]

From: Maslen,Bill (BPA) - KEW-4
To: Sweet,Jason C (BPA) - KEWR-4
Subject: Fw: Council and spill test
Date: Tuesday, April 08, 2014 10:41:28 AM

---

fyi

From: McNary,Sarah R (BPA) - A-7
Sent: Tuesday, April 08, 2014 10:39 AM
To: Maslen,Bill (BPA) - KEW-4; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4
Cc: Barco III,John W (BPA) - A-7
Subject: RE: Council and spill test

Very helpful Bill – many thanks for the information!

From: Maslen,Bill (BPA) - KEW-4
Sent: Tuesday, April 08, 2014 10:25 AM
To: McNary,Sarah R (BPA) - A-7; Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4
Cc: Barco III,John W (BPA) - A-7
Subject: Re: Council and spill test

Non-Responsive

[redacted]

I understand that Jim Ruff is participating in CSS processes, and perhaps Nancy Leonard and Erik Merrlll as well as three ISAB members.

From: McNary,Sarah R (BPA) - A-7
Sent: Tuesday, April 08, 2014 08:39 AM
To: Cogswell,Peter (BPA) - DK-7; Bodi,Lorri (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4
Cc: Barco III,John W (BPA) - A-7
Subject: FW: Council and spill test

So what's the scoop? Any more clarity on where the Council is going with this? Also, any insight into who from Council staff might be attending the next CSS workshop (April 23rd)? the draft agenda looks rather routine but I expect they will address the ISAB comments and their planned next steps.
Tx,
S

From: Mainzer,Elliot E (BPA) - A-7
Sent: Monday, April 07, 2014 8:08 PM
To: McNary,Sarah R (BPA) - A-7
Subject: Fw: Council and spill test

From: Bodi,Lorri (BPA) - KE-4
Sent: Monday, April 07, 2014 12:34 PM
To: Cogswell,Peter (BPA) - DK-7; Mainzer,Elliot E (BPA) - A-7; Delwiche,Gregory K (BPA) - D-7; Andrews,Claudia R (BPA) - K-7
Subject: Re: Council and spill test

Non-Responsive [redacted]

From: Cogswell,Peter (BPA) - DK-7
Sent: Monday, April 07, 2014 10:26 AM
To: Mainzer,Elliot E (BPA) - A-7; Delwiche,Gregory K (BPA) - D-7; Andrews,Claudia R (BPA) - K-7
Cc: Bodi,Lorri (BPA) - KE-4
Subject: Council and spill test

Non-Responsive [redacted]

Peter T. Cogswell
Acting Chief Public Affairs Officer
Bonneville Power Administration
(503) 230-5227 (office)
(b)(6) [redacted] (mobile)

From: Richelle Beck
To: Zimmer,Pat R (BPA) - DKR-7
Subject: Customer Group Agenda Items and DamNation Pre-Func info
Date: Friday, April 11, 2014 3:51:50 PM

Hi Pat! Listed below are the agenda items we have for next Wednesday's Customer Group meeting. Please let me know if you need further information on the direction of the discussion.

Non-Responsive [redacted]

3. The spill test
   a. More ideas on how best to message against this proposal
   b. Sharing information and perspectives on the ISAB presentation (awful) and the FPS presentation (worse). How or should we respond?
   c. Whether BPA thinks they may get asked to provide funding to FPC to fix the test proposal given the ISAB response yesterday – and how they would respond

Non-Responsive [redacted]

Thanks Pat! Hope you get to enjoy the sunshine this weekend!

Richelle

Richelle Beck
NW RiverPartners
Communications and Technical Specialist
503-274-7792 (Office)
(b)(6) [redacted] *(Cell)*

Northwest Power and Conservation Council Meeting

Spokane, Washington; April 8-9, 2014

Non-Responsive

[redacted]

Non-Responsive

[redacted]

Non-Responsive

[redacted]

<u>Briefing</u> on the Independent Scientific Advisory Board Review of the Proposed Spill Study: ISAB Members Greg Ruggerone, Vice-chair, and Alec Maule; Jim Ruff, ISAB Ex Officio; and Erik Merrill, ISAB Coordinator

Ruggerone briefed the Council on the ISAB's review of the proposed spill study. He said the ISAB wasn't "completely sure of the study hypothesis" because it hadn't received a study plan from the proposers. However, he said the proposers did claim a "3 ½ - fold increase" in chinook smolt-to-adult returns with spill at 125 percent Total Dissolved Gas. The projection relies on correlation, he said, and "a study is unlikely to be able to isolate spill as a casual factor [as opposed to a factor that's correlated with SARS]." The ISAB had many criticisms of the proposal, including use of old (2006) data. Spillway weirs installed at many of the dams since then have decreased fish travel time, changed passage routes and improved survival past the dams, he said.

Maule reviewed studies of gas bubble trauma in fish and mortalities in macroinvertabrates, tadpoles, and frogs found at high levels of TDG. Most data show no significant issues, he said. However, even during periods of high flow and involuntary spill, TDG has never exceeded 125 percent for 2 ½ months, as proposed for the spill test. Any spill test of that duration should include monitoring for TDG at least every other day, Maule said, compared to the weekly monitoring that the Fish Passage Center does currently. Delayed mortality and the effect on sturgeon and lamprey are also unknowns.

Non-Responsive

[redacted]

From:	Zimmer,Pat R (BPA) - DKR-7
To:	Miller,Lori E (CONTR) - DKR-7
Subject:	Notes from April 8-9 Northwest Power and Conservation Council meeting
Date:	Friday, April 11, 2014 4:38:00 PM
Attachments:	NPCC_04_08_14.docx

Hey. Hope you're much better Monday. Please send out. Thanks.

Attached are notes from the Northwest Power and Conservation Council's meeting April 8-9, 2014, in Spokane, Washington. If you have questions, please ask Pat Zimmer.

Pat Zimmer
Regional Relations
Bonneville Power Administration
503-230-3502

Northwest Power and Conservation Council Meeting

Spokane, Washington; April 8-9, 2014

Non-Responsive

[redacted]

Non-Responsive

[redacted]

Non-Responsive

[redacted]

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Non-Responsive

[redacted]

From: Klumpp,Elizabeth C (BPA) - DKR-WSGL
To: JT Austin
Subject: journal"s coverage of ISAB review of Ore. spill proposal at NPCC meeting last week
Date: Monday, April 14, 2014 11:48:00 AM

JT,

I've intentionally avoided sending you federal materials interpreting the ISAB's review of the Oregon Spill Proposal. That said, I'm looking forward to our presentation on the 21st because it describes what the federal agencies are currently do to support salmon and our performance to date against BiOp performance benchmarks. (We're doing well, but not 100% and it's the populations that swim above the mid-Columbia that appear to need more assistance. But, we've invested millions of dollars into the greater Okanogan region in last several years to create and preserve better habitat and in-water stream levels.)

Instead of sending you our federal materials, I'm copying an article from Friday's NW energy/fish publication called, Clearing Up. It's a subscription publication so I doubt you can access this link where the story is, http://www.newsdata.com/cgi-bin/viewpdf.cgi?iss=cup1641&cid=VraXt5zDHq8s. I've copied Clearing Up's coverage of the science panel's review of the proposal for your reference. I think Clearing Up stories are typically objective (they relentlessly published stories about BPA's top 2 executives getting walked out of the building last summer because of our hiring practices). I added yellow highlights.

I think the biggest data points for me, which are not mentioned below, is that the smolts that swim downstream and the smolts that we barge to below Bonneville dam have pretty similar returns – that appear to correlate to good water/ocean conditions. That is, the barged fish don't benefit from higher spill in the obvious sense, but higher spill seems to correlate with overall conditions that better support fish – both the smolts that swam downstream and the smolts that we barged.

I hope you were able to take some time over spring break with your son. My older sister was visiting from Norway for a couple days last week and we got to see the tulips in full bloom; her timing was great.

Thanks!

Liz

360-943-0157

Science Panel Explains Problems, Possibilities

With Oregon's Spill Proposal

The Independent Scientific Advisory Board presented its recent review of a controversial spill proposal to the Northwest Power and Conservation Council at its April 9 meeting. The proposal has been pushed by Oregon, the Nez Perce Tribe and some fishing and conservation groups as a potential amendment to the region's latest fish and wildlife plan, and a way to triple fish returns. It faces significant hurdles before it could pass scientific muster, said the review, which still found some merit in the idea.

The region's independent science panel briefed the Northwest Power and Conservation Council April 9 on its review of Oregon's spring spill proposal, a controversial action proponents claim could boost ESA-listed salmon and steelhead stock returns by 350 percent and reach recovery levels set by the region's fish and wildlife program.

The proposal calls for a 10-year test that boosts spring spill at federal dams on the lower Snake and Columbia rivers enough to raise total dissolved gas levels to 125 percent or gas caps in dam tailraces, and then monitors survival compared to the current court-ordered spill program. Current levels are limited.

The proposal has already been panned by National Marine Fisheries Service and BPA consultants for confounding correlations between freshwater and ocean survival, but its supporters—the state of Oregon, the Nez Perce Tribe and some environmental groups—have pushed it as a new amendment to the region's fish and

wildlife program.

The review by the Independent Science Advisory Board (ISAB) that came out in late February echoed many of the previous criticisms that were voiced to the Council in January by the Corps of Engineers and John Skalski, a University of Washington statistician and BPA consultant (CU No. 1630 [14]). Even NMFS dissed the spill idea and explained why in its 2014 hydro BiOp that also came out in January. The ISAB report found the proposal lacked an adequate hypothesis and detailed study plan, and failed to consider the effects of ocean factors and how many years were required to produce robust statistical results. Critics like Skalski said it would take many decades before any real results might be produced, depending on what kind of controls were developed.

The spill test would not be cheap. BPA estimates it will cost about $110 million a year to implement, a financial hit that would increase the direct fish and wildlife budget by nearly 50 percent.

But despite the board's critical findings, ISAB member Greg Ruggerone told the Council April 9 that if the spill advocates satisfied critics by developing a study plan and a design that maximized learning potential, the "experiment" could enhance knowledge about spill, salmon survival, and adult returns.

But those are big "ifs," said some stakeholders who listened to the presentation in Spokane and groused later that the ISAB muted its own criticisms of the spill test.

Bo Downen of the Public Power Council said he was surprised the ISAB soft-pedaled the serious questions raised about the proposal in its own report.

Another ISAB member, U.S. Geological Survey researcher Alec Maule, explained potential problems to fish encountering higher spill and increased gas supersaturation, and how the current smolt monitoring system examines fish for signs of gas bubble disease.

His presentation also included information from the Fish Passage Center that showed 2011 TDG levels at Lower Granite Dam in the Snake River were over 125 percent for a six-week period, when many fall Chinook smolts were migrating downstream. The FPC also noted the 748,000 upriver bright return two years later.

"Subsequently, in 2013, as you know, we had a record return of fall Chinook salmon, and many of those fish would have been migrating during these very high gas supersaturation conditions that occurred in the Snake River. The one thing that we don't know, though, is perhaps we would have had even higher returns had there not been high gas at that time."

No one mentioned that the spring spill test is aimed at improving spring Chinook returns, but juvenile survival

of spring Chinook in 2011 was below average, compared to other recent years with lower flows and spill levels. Maule said some yet-unpublished research suggests that smolts subjected to gas supersaturation below Bonneville Dam in 2011 suffered higher mortality rates in the Columbia River plume. Maule said if the spill proposal is put in place, then increased monitoring would be needed.

Council members, who will ultimately vote whether or not to include the spill proposal in their updated F&W program, peppered Ruggerone with questions after the presentation.

NPCC Chair Bill Bradbury, one of Oregon's members, asked what it would take to develop a hypothesis of the experiment, a process he had been told would take six to eight months (the amended F&W plan is expected to come out in draft form by the end of April and be adopted by late summer). Ruggerone said peer review by the UW's Skalski and others could take a lot of time. "Depending on who you are talking to," said Bradbury, "the spill experiment is the worst idea ever invented, or a really sound experiment with only a few questions left to be answered."

Oregon's other Council member, Henry Lorenzen—who served on his state's water quality commission in the 1990s, when dissolved gas issues were hotly debated—

raised issues about the current accuracy of the gas bubble monitoring program.

Noting that only 5-10 percent of the juvenile fish are passing through turbines now, Washington Council member Tom Karier questioned how fish returns would double or triple by simply adding more spill. “For us, it’s not just a matter of a good experiment. We have to have some sense of a likelihood that the theory is true—because you don’t do a billion-dollar experiment if it’s a long shot.”

Corps of Engineers’ fish survival data presented to the Council in January showed evidence that more fish are passing most dams via spill with less volume of water than previously thought. It’s nearly a 2:1 ratio in most cases, but a point that is disputed by spill proponents, whose own Comparative Survival Study (CSS) analysis still maintains that fish passage and water volume follow a 1:1 proportion, an assumption nearly everyone accepted in the 1990s before extensive dam modifications began.

According to results from the 2013 CSS workshop, the juvenile survival model used by spill proponents indicates spill levels of 55 to 65 percent “may” achieve 85-percent juvenile in-river survival over a range of flow conditions, which would achieve a 4-percent SAR, putting it firmly in recovery range. That’s why the CSS proposal calls for increasing spill to 125 percent TDG or gas caps, which is the level they have estimated is needed to get 60 percent or so of the fish over the spillways.

Idaho member Bill Booth also questioned whether the correlation/causation issue could ever be settled through this experiment. When ocean conditions are good, freshwater conditions usually are as well, making it especially hard to separate effects on fish survival.

On April 8, the Council heard from several utilities on the impact that implementation of the spill proposal would have on their rates. Steve Eldrige, general manager and CEO of the Umatilla Electric Cooperative, said any reduction from BPA will likely require his utility to replace it with fossil-fired generation and have an 8-percent to 10-percent rate impact on its wholesale cost of power. Fred Rettenmund, from Inland Power and Light, said 15 percent of his utility's total cost already goes to fund BPA's F&W program, and "We would suggest that there's as much opportunity for looking at what we already have and how we can do it better and more efficiently, and not at the margin looking at what new things can be added to the program as well"

Liz Klumpp

Western Washington Liaison

Bonneville Power Administration

360-943-0157; c. 360-485-2392

Petersen,Christine H (BPA) - KEWR-4

From: Pinney, Chris A NWW <Chris.A.Pinney@usace.army.mil>
Sent: Thursday, April 17, 2014 1:55 PM
To: Petersen,Christine H (BPA) - KEWR-4
Subject: RE: 2013 KMP update (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Christine,
Why is FPC so confident that 2014 adult returns will be 4 yr olds from 2011 outmigration, when the 2013 adult returns were dominated by 3 yr olds from 2011 outmigration? Kind of loose with their a priori assumptions? Also, I see a lot of inverse relationship in the graphs when FPC alluding to positive with spill and excessive TDG? We need to see reach survivals in 2011 instead of smolt index at LGR only because their adult records are total Columbia and Snake fall Chinook returns, and they still do not finish the analysis of the specific Snake River adult response to 2011 smolt samples, ie SARs, PIT histories, etc.
Thanks,
Chris

-----Original Message-----
From: Petersen,Christine H (BPA) - KEWR-4 [mailto:chpetersen@bpa.gov]
Sent: Thursday, April 17, 2014 12:55 PM
To: Pinney, Chris A NWW; Jule,Kristen R (BPA) - KEWR-4
Cc: Wertheimer, Robert H NWP
Subject: [EXTERNAL] RE: 2013 KMP update (UNCLASSIFIED)

Julie, Agnes, maybe Scott and I plan to attend CSS, although we have to pin down who might attend 'future of the salmon' at the convention center.

BTW, I was talking to a couple of people about this observation of subyearling run timing that FPC put up yesterday. Perhaps they will present this at the CSS meeting. They are highlighting that there was high TDG during the early part of the summer season, but we are seeing high abundances from the 2011 fall-run cohort.

http://www.fpc.org/documents/memos/50-14.pdf

Attached is the chart of the NOAA in-river survival study for yearlings (unfortunately no subyearlings). Reading the recent pattern of high/moderate survival rates, it seems easy for everyone to come up with their own story for what explains the best conditions for outmigration. Why was 2009 so great for steelhead etc.

cid:image001.png@01CF596A.F3CE4220

-----Original Message-----
From: Pinney, Chris A NWW [mailto:Chris.A.Pinney@usace.army.mil]

Sent: Thursday, April 17, 2014 12:10 PM
To: Jule,Kristen R (BPA) - KEWR-4
Cc: Wertheimer, Robert H NWP; Petersen,Christine H (BPA) - KEWR-4
Subject: RE: 2013 KMP update (UNCLASSIFIED)

Classification: UNCLASSIFIED

Caveats: NONE

Kristen,

Non-Responsive

[redacted]

Thanks,

Chris

-----Original Message-----

From: Jule,Kristen R (BPA) - KEWR-4 [mailto:krjule@bpa.gov <mailto:krjule@bpa.gov>]

Sent: Thursday, April 17, 2014 8:39 AM

To: Pinney, Chris A NWW

Cc: Wertheimer, Robert H NWP; Petersen,Christine H (BPA) - KEWR-4

Subject: [EXTERNAL] 2013 KMP update

Hi Chris,

Hope you are well!

Non-Responsive

[redacted]

Cheers,

Kristen

Kristen Jule

Fish Biologist

Policy & Planning - KEWR

Environment, Fish & Wildlife

Bonneville Power Administration

Office: 503.230.3588

Cell: (b)(6) [redacted]

P Please consider the environment before printing this e-mail.

Classification: UNCLASSIFIED

Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

From: Maslen,Bill (BPA) - KEW-4
To: Klumpp,Elizabeth C (BPA) - DKR-WSGL
Subject: Link to ISAB Review of Experimental Spill
Date: Thursday, April 17, 2014 1:31:36 PM

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http://www.nwcouncil.org/fw/isab/isab2014-2/

From: Kerr,Mary K (BPA) - KE-4
To: Stier,Jeffrey K (BPA) - KE-4; Milstein,Michael C (BPA) - KE-4
Subject: FW: Administrator"s Conf. Call - 4/7/14
Date: Wednesday, April 09, 2014 6:55:44 AM
Attachments: image001.gif

FYI.

From: Sharpe,Joseph C (BPA) - KEP-4
Sent: Tuesday, April 08, 2014 5:53 PM
To: Bodi,Lorri (BPA) - KE-4; Dondlinger,Gregory J (BPA) - KEW-4; Grimm,Lydia T (BPA) - KEC-4; Maslen,Bill (BPA) - KEW-4
Cc: Kerr,Mary K (BPA) - KE-4; Hugill,Stuart G (BPA) - KEP-4; Smith,Philip W (BPA) - KEP-4
Subject: Administrator's Conf. Call - 4/7/14

Non-Responsive

[redacted]

Non-Responsive

What I reported for Bill and Lydia

- Northwest Power and Conservation Council's meeting in Spokane on Tuesday and Wednesday.
  - Notable agenda items include:
    - a spill proposal with a presentation by ISAB and responses from Customers

Non-Responsive

[redacted]

Joseph Sharpe - KEP-4
Manager, Pollution Prevention & Abatement
(503) 230-3654 ☎, (b)(6)

From: Maslen,Bill (BPA) - KEW-4
To: Lut,Agnes (BPA) - KEWR-4; Bodi,Lorri (BPA) - KE-4; Klumpp,Elizabeth C (BPA) - DKR-WSGL; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7
Subject: RE: BPA meeting with Wash leads on fish accomplishments and smart spill
Date: Tuesday, April 22, 2014 1:45:26 PM

Non-Responsive

[redacted]

From: Lut,Agnes (BPA) - KEWR-4
Sent: Tuesday, April 22, 2014 1:32 PM
To: Bodi,Lorri (BPA) - KE-4; Klumpp,Elizabeth C (BPA) - DKR-WSGL; Maslen,Bill (BPA) - KEW-4; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7
Subject: RE: BPA meeting with Wash leads on fish accomplishments and smart spill

Liz,

Non-Responsive

[redacted]

Non-Responsive

[redacted]

And lastly, the ISAB's review (pg 11, top paragraph) did identify new research coming out of Cornell University that suggested "that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality."

Thanks, Liz. I really appreciated being there yesterday. I learned a lot.
Agnes-

From: Bodi,Lorri (BPA) - KE-4
Sent: Tuesday, April 22, 2014 8:32 AM
To: Klumpp,Elizabeth C (BPA) - DKR-WSGL; Maslen,Bill (BPA) - KEW-4; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7
Subject: Re: BPA meeting with Wash leads on fish accomplishments and smart spill

Non-Responsive

[redacted]

From: Klumpp,Elizabeth C (BPA) - DKR-WSGL
Sent: Monday, April 21, 2014 05:48 PM
To: Bodi,Lorri (BPA) - KE-4; Maslen,Bill (BPA) - KEW-4; Lut,Agnes (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Cogswell,Peter (BPA) - DK-7; Ball,Crystal A (BPA) - DKR-7
Subject: BPA meeting with Wash leads on fish accomplishments and smart spill

Non-Responsive

[redacted]

Liz Klumpp

Western Washington Liaison

Bonneville Power Administration

360-943-0157; c. (b)(6)

From:	McNary,Sarah R (BPA) - A-7
To:	Bodi,Lorri (BPA) - KE-4; Lut,Agnes (BPA) - KEWR-4; Petersen,Christine H (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4; Maslen,Bill (BPA) - KEW-4; Milstein,Michael C (BPA) - KE-4
Cc:	Klumpp,Elizabeth C (BPA) - DKR-WSGL; Ball,Crystal A (BPA) - DKR-7; Warner,Joshua P (BPA) - DKR-7
Subject:	Re: CSS Report Out
Date:	Thursday, April 24, 2014 11:17:44 AM

Just FYI. Ritchie mentioned yesterday that he too was perplexed by the lifecycle model presentation and it's relationship to Zabel's work

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From: Bodi,Lorri (BPA) - KE-4
Sent: Thursday, April 24, 2014 11:13 AM Pacific Standard Time
To: Lut,Agnes (BPA) - KEWR-4; Petersen,Christine H (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4; Maslen,Bill (BPA) - KEW-4; Milstein,Michael C (BPA) - KE-4; McNary,Sarah R (BPA) - A-7
Cc: Klumpp,Elizabeth C (BPA) - DKR-WSGL; Ball,Crystal A (BPA) - DKR-7; Warner,Joshua P (BPA) - DKR-7
Subject: Re: CSS Report Out

Was this just a presentation not a discussion? This is the first I have heard about a dueling lifecycle model to NOAAs. Is that in the scope of work we fund?

Bill and Jason, what are your recommendations on what we should do to respond technically and effectively?

From: Lut,Agnes (BPA) - KEWR-4
Sent: Thursday, April 24, 2014 11:03 AM
To: Petersen,Christine H (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4; Maslen,Bill (BPA) - KEW-4; Bodi,Lorri (BPA) - KE-4; Milstein,Michael C (BPA) - KE-4; McNary,Sarah R (BPA) - A-7
Cc: Klumpp,Elizabeth C (BPA) - DKR-WSGL; Ball,Crystal A (BPA) - DKR-7; Warner,Joshua P (BPA) - DKR-7
Subject: CSS Report Out

The main themes presented by FPC at yesterday's CSS presentation are below. In summary the three main points presented were the decreased benefit of transportation, the need to increase SPE, spill test up to 125% TDG, and the future ability of the CSS model (once they fully incorporate their Life Cycle component) to be able to identify the tradeoffs between management actions on the Hydro system versus habitat investments. Please note that Christine Petersen also provided a summary below.

They made it a point to state that increased spill up to 125% would not impact reservoir levels so tribal harvest and irrigation would not be impacted by the spill test. I thought this was a strange point to make yesterday, but it makes sense today given the Columbia-Snake Irrigators Association requesting the God Squad: http://www.jdsupra.com/legalnews/calling-on-the-god-squad-26643/

Next Steps for the Spill Proposal:
ODFW and Nez Perce stated they would like to further develop the spill proposal with the CSS team, and NSIA can deliver thousands of signatures to move the proposal forward.
They referenced providing public comment on the NWPCC Amendments in mid-May.

Spill Passage Efficiency:

They stated the spillway weirs are promising and have high survival, thus the Region should evaluate if we need more of them to improve SPE. They made it a point to say that spill will not increase water velocity. They talked about SPE several times in relation to SARS and delayed mortality, and stated they have up to date SPE data that shows an increase in SARS with more spill and improved SPE. However, NOAA has evaluated and compared CSS's SPE to NOAA's and they are very different. I have this data and have shared it with Jason and Michael. I believe Michael presented it to Lorri. There was mention of having 93% of the fish passing thru the spill way or surface passage as the goal moving forward.

A concept for the future was discussed to have an SPE target, not a volumetric or % spill target.

Water Travel Time discrepancy:

FPC presented data that showed travel time from Lewiston to BON was 2 days prior to the dams. This is different than the data we have in our Smart Spill materials from Muir Williams that states prior to the dams the travel time was 10 – 21 days from LGR to BON prior to the dams. They did not provide a data source. They stated that the current travel time ranges from 10-20 days (Lewiston to BON).

Transportation Program:

They stated that the current transport benefits are decreasing as in-river survival is increasing, and that at 60% spill levels that transportation would actually be harmful to the species.

They made the point several times that the effectiveness of the current transport program is questionable, considering only 4 of the 9 TIR groups showed a benefit to transport.

Adaptive Management:

They made the point several times that we are in an Adaptive Management situation and that the Region is "learning by doing and monitoring", and that spilling up to 125% is a good example of this strategy.

CSS model and the addition of the Life Cycle component:

WDFW thinks this model update and integration of the Life Cycle component will provide an All-H analysis of the system, including benefits and tradeoffs.

Date smolts are moving through the system was added as a significant factor in determining juvenile survival.

The Life Cycle component of the CSS model will be calibrated and ready to answer management questions in a couple of years. They intend to use it to evaluate a long term Recovery Strategy under various management scenarios, and to predict trade-offs in invests between the Hydro system and habitat restoration, in addition it will predict the benefits of the spill program and any proposed spill tests.

Recovery Goals:

They stated that there are several stocks that are below the Minimum Abundance Threshold (MAT) and that updates to CSS especially including the Life Cycle component will help identify management strategies to meet MAT goals.

SARS:

They stated that MCN – BON SARS are biased high because they don't take into account the reduced Upper Columbia SARS, RIS – MCN, thus a large lifecycle component of the MCN-BON SARS is not accounted for.

Please let me know if you have any questions. Christine's summary follows below.

Agnes-

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Wednesday, April 23, 2014 3:03 PM
To: Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Shields,Barbara A (BPA) - KEWM-4; Lut,Agnes (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4
Subject: CSS reflections

The annual presentation slides aren't posted yet, because they probably want to transcribe the Q&A. But I imagine we might regroup to share some thoughts later?

The second to last talk by Bob Lessard introducing their lifecycle model was the new material this year. Haeseker's second segment did get into spill experiment policy, and invited a lot of comments, although it is pretty much the material we are familiar with already. Sue Camp agreed that the font on some of the slides was rather small and we need to see the posted copy later.

I thought that the perceptions of some people in the audience were important. There was a comment from someone with the NSIA (? Sportsfishing?) where they really embraced Haeseker's presentation and asked if he needed 1000 signatures from anglers to support a spill experiment, and Nez Perce tribe and a couple other parties were also positive. Paul Wagner is reasonable, and to me he said he thought the TIRs were most important to look at – where transported yearlings still benefit more than the in-river group, but they could not expect survival to ever rise above the T group or the C(0) (always spilled) SAR – so unless additional outside factors are considered they could never hope to double SARs by attempting to spill more juveniles. Also, he said that the coastal plankton trawls done out of Newport aren't looking very great in March so this might be a moderate ocean survival year (not updated on the website yet http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/g-forecast.cfm#Table2)

From: Lut,Agnes (BPA) - KEWR-4
To: Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4 (jcsweet@bpa.gov)
Subject: RE: CSS Report Out
Date: Thursday, April 24, 2014 1:30:00 PM

Jason, Barco

Adding a life-cycle component to the CSS model was first mentioned in the ISAB's 2012 DRAFT CSS annual review:
http://www.nwcouncil.org/fw/isab/isab2012-7/

and referenced more explicitly as an area of future work in the ISAB's 2013 DRAFT CSS Annual review:
http://www.nwcouncil.org/fw/isab/isab2013-4/

"The ISAB suggests five topics for further CSS review:
1. hypotheses on mechanisms regulating smolt-to-adult survivals (SARs)
2. life-cycle modeling questions and Fish and Wildlife Program SAR objectives
3. data gaps
4. rationalization of CSS's Passive Integrated Transponder (PIT)-tagging, and
5. publication of a synthesis and critical review of CSS results"

From: Bodi,Lorri (BPA) - KE-4
Sent: Thursday, April 24, 2014 11:14 AM
To: Lut,Agnes (BPA) - KEWR-4; Petersen,Christine H (BPA) - KEWR-4; Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4; Maslen,Bill (BPA) - KEW-4; Milstein,Michael C (BPA) - KE-4; McNary,Sarah R (BPA) - A-7
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WDFW thinks this model update and integration of the Life Cycle component will provide an All-H

analysis of the system, including benefits and tradeoffs.
Date smolts are moving through the system was added as a significant factor in determining juvenile survival.
The Life Cycle component of the CSS model will be calibrated and ready to answer management questions in a couple of years. They intend to use it to evaluate a long term Recovery Strategy under various management scenarios, and to predict trade-offs in invests between the Hydro system and habitat restoration, in addition it will predict the benefits of the spill program and any proposed spill tests.

Recovery Goals:
They stated that there are several stocks that are below the Minimum Abundance Threshold (MAT) and that updates to CSS especially including the Life Cycle component will help identify management strategies to meet MAT goals.

SARS:
They stated that MCN – BON SARS are biased high because they don't take into account the reduced Upper Columbia SARS, RIS – MCN, thus a large lifecycle component of the MCN-BON SARS is not accounted for.

Please let me know if you have any questions. Christine's summary follows below.
Agnes-

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Wednesday, April 23, 2014 3:03 PM
To: Bettin,Scott W (BPA) - KEWR-4; Barco III,John W (BPA) - A-7; Sweet,Jason C (BPA) - KEWR-4; Shields,Barbara A (BPA) - KEWM-4; Lut,Agnes (BPA) - KEWR-4; Skidmore,John T (BPA) - KEWL-4
Subject: CSS reflections

The annual presentation slides aren't posted yet, because they probably want to transcribe the Q&A. But I imagine we might regroup to share some thoughts later?

The second to last talk by Bob Lessard introducing their lifecycle model was the new material this year. Haeseker's second segment did get into spill experiment policy, and invited a lot of comments, although it is pretty much the material we are familiar with already. Sue Camp agreed that the font on some of the slides was rather small and we need to see the posted copy later.
I thought that the perceptions of some people in the audience were important. There was a comment from someone with the NSIA (? Sportsfishing?) where they really embraced Haeseker's presentation and asked if he needed 1000 signatures from anglers to support a spill experiment, and Nez Perce tribe and a couple other parties were also positive. Paul Wagner is reasonable, and to me he said he thought the TIRs were most important to look at – where transported yearlings still benefit more than the in-river group, but they could not expect survival to ever rise above the T group or the C(0) (always spilled) SAR – so unless additional outside factors are considered they could never hope to double SARs by attempting to spill more juveniles. Also, he said that the coastal plankton trawls done out of Newport aren't looking very great in March so this might be a moderate ocean survival year (not updated on the website yet
http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/g-forecast.cfm#Table2)

From: Energy NewsData
To: Milstein,Michael C (BPA) - KE-4
Subject: Latest Northwest Fishletter now available
Date: Thursday, April 24, 2014 2:56:19 PM

FISHWIRE ADVISORY: A new issue of NW Fishletter (No. 331-April 24, 2014) is now online. Fishletter in Summary is a quick-read feature of this advisory notification. Subscribe/unsubscribe instructions are at the end of this message. Fishletter's full text is available at http://www.newsdata.com/fishletter/

>//////> >//////> >//////> >//////> >//////> >//////>
~~~~~~
::NW FISHLETTER 331 IN SUMMARY::

Non-Responsive

[redacted]

[3] ISAB EXPLAINS PROBLEMS, POSSIBILITIES WITH OREGON'S SPILL PROPOSAL
The region's independent science panel briefed the Northwest Power and Conservation Council April 9 on its review of Oregon's spring spill proposal, a controversial action proponents claim could boost ESA-listed salmon and steelhead stock returns by 350 percent and reach recovery levels set by the region's fish and wildlife program.
http://www.newsdata.com/fishletter/331/3story.html

Non-Responsive

[redacted]
~~~~~~

Non-Responsive

[redacted]

FishWire is an Energy NewsData fish & wildlife news service reporting on salmon recovery in the Pacific Northwest. It previews each issue of NW Fishletter and is a feature of FishWEB, a public service guide to NW salmon recovery.

> //////>   >//////>   >//////>   >//////>   >//////>   >//////>
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To change, add, or cancel your Energy NewsData Dispatch news services, click this link:
http://www.newsdata.com/cgi-bin/dispatch.cgi?CompanyID=bpa6793
~~~~~~

Petersen,Christine H (BPA) - KEWR-4

From: Camp, Susan <scamp@usbr.gov>
Sent: Friday, April 25, 2014 9:47 AM
To: Petersen,Christine H (BPA) - KEWR-4
Cc: Shields,Barbara A (BPA) - KEWM-4
Subject: Re: Tomorrow

Hi Chirstine,

Non-Responsive

[redacted]

Later,
Sue

On Fri, Apr 25, 2014 at 9:30 AM, Petersen,Christine H (BPA) - KEWR-4 <chpetersen@bpa.gov> wrote:

Thanks. It was nice to meet you!

Did you have any high level impressions from the Future of our Salmon conference?

Yes – we are waiting for them to put slides online, particularly for Bob Lessard's new lifecycle model. Steve Haeseker didn't really even go through the ten steps of logic to argue that you could double Chinook and steelhead adult returns via spill, and he was essentially citing his presentation from last year. Paul Wagner from NOAA was saying afterwards that they think that the SAR of the transported group, or the C(o) group (the undetected group which are currently going out through spill) would be the upper limit of what you could get via hydropower improvements – and especially for Chinook these SARs aren't that much higher than juveniles in the bypasses.

Have a nice weekend,

Christine

From: Camp, Susan [mailto:scamp@usbr.gov]
Sent: Friday, April 25, 2014 7:59 AM
To: Shields,Barbara A (BPA) - KEWM-4

Cc: Petersen,Christine H (BPA) - KEWR-4
Subject: Re: Tomorrow

Hi Barb and Christine,

Non-Responsive [redacted]

Sue

On Tue, Apr 22, 2014 at 6:40 PM, Shields,Barbara A (BPA) - KEWM-4 <bashields@bpa.gov> wrote:

Non-Responsive [redacted]

Barbara A. Shields

Project Manager, KEWM-4
Bonneville Power Administration
905 NE 11th Avenue
Portland, OR 97232

work: 503/ 230-4748
cell: 503/ 757-0906
e-mail: bashields@bpa.gov

Personal cell: (b)(6) [redacted]
Personal e-mail: (b)(6) [redacted]

From: Petersen,Christine H (BPA) - KEWR-4
Sent: Tuesday, April 22, 2014 5:34 PM
To: 'scamp@usbr.gov'; Shields,Barbara A (BPA) - KEWM-4; Gislason,Jeff (BPA) - KEWR-4
Subject: Re: Tomorrow

Non-Responsive

[redacted]

Christine Petersen
(503)7532020

From: Barco III,John W (BPA) - A-7
Sent: Tuesday, April 22, 2014 04:38 PM Pacific Standard Time
To: Camp, Susan <scamp@usbr.gov>
Cc: Petersen,Christine H (BPA) - KEWR-4
Subject: RE: Tomorrow

Non-Responsive

[redacted]

From: Camp, Susan [mailto:scamp@usbr.gov]
Sent: Tuesday, April 22, 2014 3:32 PM
To: Barco III,John W (BPA) - A-7
Subject: Tomorrow

Hi John,

Non-Responsive

[redacted]

--
Sue Camp

Fish Biologist

Bureau of Reclamation, Pacific Northwest Region

1150 N. Curtis

Boise, ID 83709

208-378-5030

--

Sue Camp

Fish Biologist

Bureau of Reclamation, Pacific Northwest Region

1150 N. Curtis

Boise, ID 83709

208-378-5030

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Sue Camp
Fish Biologist
Bureau of Reclamation, Pacific Northwest Region
1150 N. Curtis
Boise, ID 83709
208-378-5030

BONNEVILLE POWER ADMINISTRATION

Implementation of the 2008-2018 All-H Strategy: Recent Hydro Improvements and Benefits of Smart Spill

BPA Spring All Manager's Meeting
April 29, 2014

Non-Responsive

Non-Responsive

Non-Responsive

Non-Responsive

Non-Responsive

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Non-Responsive

[redacted]

- The NW Power and Conservation Council's Independent Science Advisory Panel (ISAB) recently reviewed the Oregon proposal
  - Confirmed many of BPA and the AA's concerns
  - Left the door open for further refinement of the high spill proposal

Non-Responsive

[redacted]

Non-Responsive

From: Lut,Agnes (BPA) - KEWR-4
To: Barco III,John W (BPA) - A-7; Maslen,Bill (BPA) - KEW-4
Subject: FW: Giorgi Comments on CSS annual review for 2013
Date: Wednesday, April 30, 2014 9:14:49 AM
Attachments: CSS Annual Review- comments.docx

Bill, Barco
Attached are Al Giorgi's notes from the annual CSS review that took place last week. I have not forwarded these to Sarah or Lorri, but did want to keep you both in the loop. Please note that Al also states in his notes that "Given that Oregon (Bowles) and the sport fishing group voiced support for developing a formal Spill Experiment, the region may soon be seeing a CSS study plan for review."

From: Al Giorgi [mailto:al.giorgi@bioanalysts.net]
Sent: Tuesday, April 29, 2014 5:56 PM
To: Lut,Agnes (BPA) - KEWR-4
Cc: Bettin,Scott W (BPA) - KEWR-4; Sweet,Jason C (BPA) - KEWR-4; Petersen,Christine H (BPA) - KEWR-4; Shields,Barbara A (BPA) - KEWM-4; Geiselman,Jim (BPA) - KEWR-4
Subject: Giorgi Comments on CSS annual review for 2013

Agnes, et al.- The attached memo addresses select issues from the CSS presentations, which may be of interest to the BPA Hydro and RME groups.

Al

Albert Giorgi, Ph.D.
Bioanalysts, Inc.
al.giorgi@bioanalysts.net

16541 Redmond Way, PMB #339
Redmond WA 98052-4482

Mobile Phone: 206-660-5398
Business Phone: 425-883-8295

Bioanalysts Home office address:
4725 N. Cloverdale Rd., Suite 102
Boise, ID 83713

Memo

To: **Agnes Lut**

From: **Al Giorgi**

Cc: **Petersen, Shields, Geiselman, Sweet, Bettin**

Sub: **CSS Presentations 23 April, 2014; Observations and comments**

Date: **29 April, 2014**

Here are some comments and observations regarding select topics that were presented at the CSS Annual Review. Some of them may provide points to discuss, if and when the "Spill Experiment" gets legs. It was clear at the close of the meeting that some parties (Oregon, and the sport-fisher's coalition) were indeed anxious for CSS to develop a cohesive experimental design and a formal proposal. Some of my other comments address matters not directly related to the spill experiment, but may have implications to broader FCRPS monitoring activities. Comments are organized following the sequence of agenda topics. It may be advantageous to revisit the details in the 2013 CSS Annual Report, in light of the presentations and questions raised by the attendees.

Introduction (Tuomikoski)-

This general overview of the CSS Program provided a foundation for ensuing talks. One point that may be worth noting was the graph that depicted how the number of PIT-tagged index populations has increased dramatically over the years since the CSS/SMP program began. In many analyses ESU responses to hydro operations are often referenced as composite indices for either wild or hatchery fish in the ESU, or the combination of those. This is the case for many SMP/CSS and NOAA-BiOp analyses. The addition of stocks (H & W) certainly yields a broader representation for the ESU at large. However the continued change in the composition of the composite index without regard to appropriate weighting of tag numbers, may affect ESU-level SAR values.

Individual population units can exhibit population-specific SAR that may differ substantially from others. Depending on the stocks added through time, the composition and thus performance of the ESU could be reflected in ESU-level SARs over the years. This dynamic could contribute to some of the variability in ESU SAR indices over time. The relative weighting of each population within the composite ESU index may have bearing as well. Consider that the composition and weighting of stock-market indices are often altered to maintain suitable criteria specific to each market index. Perhaps our regional ESU indices should adopt a similar strategy. This would involve revisiting the current ESU composite index, based on PIT-tagged populations included and their relative weight in terms of abundance within the ESU. Then guidelines for including stocks and numbers of tagged fish from each could be established.

This issue may or may not currently be problematic or contribute much to the observed variability in ESU-level SARs, but it may be worth evaluating the situation in a systematic manner.

Juvenile survival, FTT, and environmental effects (Haeseker)-

Steve noted that CSS monitors smolt responses (in-river survival, mortality rate, FTT etc.) and predictor variables (river conditions and FCRPS ops/configurations) to develop a more cohesive model framework for each species. They find that spill level is an important variable that explains much observed variability for most/all species (Snake ESUs focus). The fall Chinook model/analyses may deserve a closer look, since NOAA has in the past suggested that this species cannot be effectively modeled under the COMPASS framework.

CSS and NOAA model/analytical camps are still at odds on a number of issues. In my opinion the continued, and at times acerbic, debate is not serving the region well. Often workshops are held focusing on participation from constituents. Regional collaboration is catch phrase, not a practice. Nearly two decades ago PATH was established to convene all parties in a common analytical forum, to foster collaboration, clearly air differences and points of agreement, identify and tackle key assumptions, and identify a path forward. It was not necessarily a smooth ride, but in the end I think it was productive and enlightening. Both NOAA and CSS refocused monitoring efforts, refined parameters, and developed model frameworks to digest the monitoring data. It may be time to reconvene the state and federal parties, and bring existing tools, analyses, and assumptions into a mediated collaborative forum once again.

Annual SAR, TIR, D (Petrosky)-

This new effort to associate monitored SARs with prevailing indices of population productivity is long overdue and a welcomed development. Presumably this initial CSS effort is the start of a more expansive assessment. The take home message was that when SARs are < 1%, productivity (indexed as spawner abundance) decreases. But at SARs of 1-2%, and >2% a positive abundance index was noted, more so for the higher SAR class (>2%). This provides a firmer foundation for using SAR indices as surrogates for general productivity, and may assist in formulating more meaningful target SARs. Subsequent CSS presentations focused on >2% as the preferred state. These initial findings suggest the NPCC SAR targets (2-6%) may need re-assessment.

Upper Columbia Chinook & steelhead (Ehlke)-

WDFW reviewed PIT-tag based indices for UC stocks, including smolt responses and SARs. Ehlke indicated that overall there is room to improve monitoring of these populations by installing additional PIT tag detectors at some UC dams, and increasing PIT tagging at UC hatcheries. However, the expected improvement in monitored responses was not quantified. This may be an opportunity for the AA/NOAA to employ the newly developed "UW PIT Detection model" to quantify changes in precision of survival indices associated with various detector installations and/or numbers of tagged fish being released in the UC. This could be framed as a feasibility assessment to help direct future monitoring actions, in terms of proposed detector installations and numbers of tagged fish.

Snake River fall Chinook (McCann)-

This presentation raised two issues that may be of immediate concern for AA & NOAA; an assessment of the need to tag more SRFC juveniles, and the CSS characterization of transport effects on this species. CSS contends that SRFC receive no consistent benefit from transportation. It may be useful to revisit the original study design in the multi-agency Collaborative Fall Chinook Study, and examine guidelines for

analyzing and reporting results. Surely there are assorted caveats and qualifications attending the CSS analysis and conclusion, but they were not readily apparent in the presentation.

There remains some uncertainty with regard to the level of tagging effort needed for this ESU in the future. The large scale tagging effort associated with the multi-agency transport study ended in 2012. If it has not yet occurred, the AA and NOAA in consultation with CSS may want to establish tagging guidelines for future monitoring of this ESU. In addition to general passage monitoring needs, passage models will require certain types and quality of data for both calibration and validation.

The SAR may not be as informative an index for fall Chinook as it is for yearling Chinook and steelhead, since marine & freshwater harvest rates are high for falls and may vary annually by stock (SR, UC, Hanford). It is not clear that the 2-6% NPCC target has relevance for fall and fall-summer Chinook populations. The AA & NOAA may want to delve into this, given the regional fixation on SARs and associated target values.

Life-cycle Modelling (Lessard)-

The development and introduction of this new life-cycle model will require scrutiny on the part of the AA & NOAA, particularly if it is adopted as a tool of choice in future CSS analyses. This tool appears to be still in early stages of development.

2013 CSS workshop review and update (Haeseker & Schaller)-

This was a succinct recap of how CSS analyses have been tailored in response to both the 2011 & 2013 CSS workshops. The result is a complex of analyses that led to the "spill experiment" concept now in development. The presentation stressed taking FCRPS actions (increased spill) that can in their view likely yield SAR > 2% with more frequency than spill levels prescribed in the BiOp. They downplayed the merits of spill levels that their analyses predict SARs of 1-2%, even though that level should yield positive productivity (a desirable state), according to previous results in the Petrosky presentation. They did not address the matter where the BiOp Spill spreads the risk across transport & in-river migrants and the attending contribution to SAR for all fish entering the ocean. It was not clear that the SAR contribution from transported fish were reflected in some important graphs that were used to support their arguments. This may need to be sorted out by close inspection of the Annual Report.

Items to note-

- The CSS analyses are Snake-centric. They feel spill benefits will accrue for UC and MC ESUs as well.
- Preliminary CSS analyses appear to suggest that SARs near 2%, and perhaps even 1-2%, are adequate to promote positive productivity for Snake ESUs, or select populations therein. This finding could bring into question the relevance of the NPCC SAR targets of 2-6%.
- CSS contends that TSWs are not particularly effective for yearling Chinook. This should be examined further by AA/NOAA.
- Given that Oregon (Bowles) and the sport fishing group voiced support for developing a formal Spill Experiment, the region may soon be seeing a CSS study plan for review.

From: Reller,Mark D (BPA) - DKR-MSGL
To: Zimmer,Pat R (BPA) - DKR-7; Swedo,Robert L (BPA) - DKR-SPOKANE; Klumpp,Elizabeth C (BPA) - DKR-WSGL; Williams,John J (BPA) - DKR-BOISE; Warner,Joshua P (BPA) - DKR-7; Ball,Crystal A (BPA) - DKR-7; Marker,Douglas R (BPA) - DKR-7
Subject: Coucil program amendment excerpt.
Date: Wednesday, May 21, 2014 3:24:37 PM

Pat and CAEs
In case you are not reading the Council's F&W amendments at bedtime, thought you might be interested in the following excerpt on spill experiments.
Mark

http://www.nwcouncil.org/fw/program/2014-03/

From page 64:

- **Spill and other passage experiments.** The Council continues to recognize the value of an experimental approach to salmon recovery in the Northwest. The Council supports the development of adaptive management experiments that address critical uncertainties related to species survival.

  Proposals for such experiments must be based on the best available science, have appropriate study designs, be subject to review by the independent science panels, and address issues raised by independent scientific review and peer review. Proposed experiments will also need the necessary regulatory approvals consistent with all federal and state laws. This includes approval by the agencies with jurisdiction over the Endangered Species Act (as spill affects listed species) and the Clean Water Act. Experiments should not pose unnecessary risks to salmonids or other aquatic life in the Columbia River. And finally, the Council will take into account the compatibility of an experiment with other research taking place and future fish passage improvements at the dams in the Columbia Basin as well as the effect on the adequacy, efficiency, economics, and reliability of the power system.

  Further work on proposals for mainstem spill experiments should fully engage the technical expertise in the region, including scientists from NOAA Fisheries, universities in the Northwest, fish and wildlife managers, federal agencies, and private consultants. The Council is interested in seeing future proposals for improving spill and other mainstem operations that meet these criteria and contain all the elements of a viable experiment as identified by the ISAB in report 2014-2.

From:	Sweet,Jason C (BPA) - KEWR-4
To:	Milstein,Michael C (BPA) - KE-4
Subject:	70% SPE COMPASS vs CSS.pptx
Date:	Thursday, June 12, 2014 11:10:34 AM
Attachments:	70% SPE COMPASS vs CSS.pptx

The following slides show SPE at the dams as calculated using NOAA's COMPASS model (top graphic) and CSS (bottom graphic).

The COMPASS SPE curves are predictions and season averaged SPE active tag studies conducted 2006-2011. Labels indicate average river volume (Kcfs) during the active tag study period. NOAA is currently updating these curves to incorporate more recent data >2011. As of today they have not completed this task. NOAA will provide us with the updated SPE curves as soon as they are available.

The CSS SPE curves were provided to Ritchie Graves after the Jan 14, 2014 ISAB present by FPC.

The following is the actual email exchange that took place:

From: Ritchie Graves - NOAA Federal [mailto:ritchie.graves@noaa.gov]
Sent: Monday, February 10, 2014 3:30 PM
To: Harwood,Holly C (BPA) - PGB-5
Subject: Re: spill presentations

They have some graphics in the PP files I sent you that show where the JDPS study results are compared to their estimates.
Trevor is now telling me the CSS SPE curves look pretty different from what is in COMPASS...
Like everything, this might take some time to run to ground. We are thinking about next steps.

-Ritchie

Ritchie Graves
Columbia Hydropower Branch
Interior Columbia Basin Office
NOAA Fisheries, West Coast Region
phone: 503-231-6891
cell: 503-730-5148

On Tue, Feb 4, 2014 at 2:02 PM, Harwood,Holly C (BPA) - PGB-5 <hcharwood@bpa.gov> wrote:
Thanks Ritchie, this is really important to get right and not talk past each other on this so I appreciate your efforts. I'm still a bit confused though. Does this mean that they did not rely on a 1:1 relationship then but instead are using the data from our PS tests re: route specific passage in their modeling? You said it is not fair to characterize their analysis as ignoring the recent improvements – do you know, are the modeled relationships they are using based on the latest PS test data then?

From: Ritchie Graves - NOAA Federal [mailto:ritchie.graves@noaa.gov]
Sent: Tuesday, February 04, 2014 10:02 AM
To: Peters, Rock D NWD; Feil, Dan H NWD; Sweet,Jason C (BPA) - KEWR-4; Harwood,Holly C (BPA) - PGB-5; Mike Ford - NOAA Federal; Michael Tehan - NOAA Federal; Bruce Suzumoto; Puckett, Kathryn J; McNary,Sarah R (BPA) - A-7; Lori Thompson; Richard Zabel - NOAA Federal
Cc: Paul Wagner; Gary Fredricks; Bill Hevlin; Trevor Conder; Steven Smith - NOAA Affiliate; James Faulkner - NOAA Federal; Eitel, Michael (ENRD); Mark Eames - NOAA Federal
Subject: Fwd: spill presentations

All:

As most of you are aware, following the Jan 17 ISAB meeting, I agreed to meet with some of the Comparative Survival Study technical staff to better understand how, and to what extent, they have incorporated SPE etc. changes resulting from the installation of surface passage structures at the mainstem dams into their analysis. Paul and I met with them on January 24, and Steve Haeseker (FWS) kindly walked us through their analysis methodology (see the attached spreadsheets).

Part of the confusion (from NOAA's perspective) appears to have been caused by a miscommunication between myself and a CSS member at their April 2013 workshop. The 2013 CSS report's heavy reliance on references to earlier materials (workshop results, earlier reports, etc.) regarding methodologies also seems to have contributed to our misunderstanding of how this information has been incorporated into the report.

The attached PowerPoint presentations summarize the CSS methodology for estimating detection probabilities and derived SPE estimates for their models for both yearling Chinook and steelhead. I've not had the time to compare this to the SPE estimates used in COMPASS (which we'll be working to update again in the coming year or so) or get any review from our Science Center.

(I can say that we had shared versions of the COMPASS SPE curve estimates with Steve Haeseker in the past, and he considered this information in building his relationships.)

Long story short... it is clear that the CSS group has done a substantial amount of work to try and incorporate and update spill relationships that have changed as a result of surface passage routes being added to many of the mainstem dams for the observed ranges of data.

Thus, their work should not be characterized to others as having ignoring the effect of these configurational improvements.

The CSS group has pointed this out in their latest comments to the ISAB (Theme 2: Criticism of the CSS Analysis - "The implementation and operation of surface passage structures and available acoustic tag data have all been incorporated into the CSS analyses spill metric").

I would strongly urge you to contact Steve Haeseker or Michele DeHart if you have additional questions about the analysis or would like to organize a meeting to discuss this information further with the CSS group.

Best Wishes,
Ritchie

Ritchie Graves
Columbia Hydropower Branch
Interior Columbia Basin Office
NOAA Fisheries, West Coast Region
phone: 503-231-6891
cell: 503-730-5148

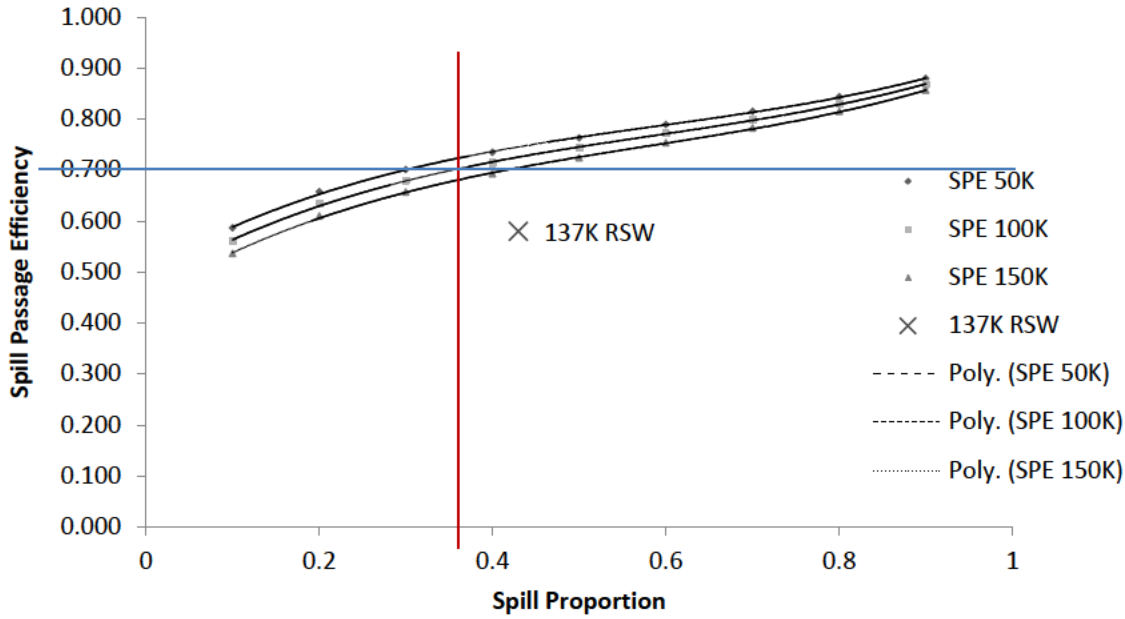
LGR spring spill: 20 kcfs

LGR
STH+W

COMPASS

SPE = ~ 75% - 70% @ current spring spill
SPE = ~ 80% - 75% @ 60% spill

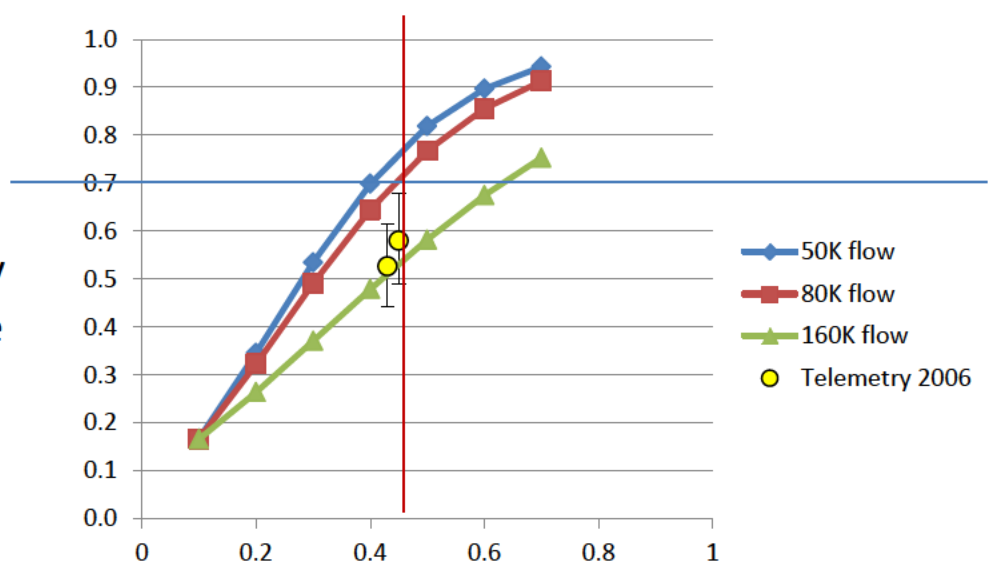
LGR STH SPE



CSS

SPE = ~ 72% - 50% @ current spring spill
SPE = ~ 90% - 68% @ 60% spill

Spillway
passage

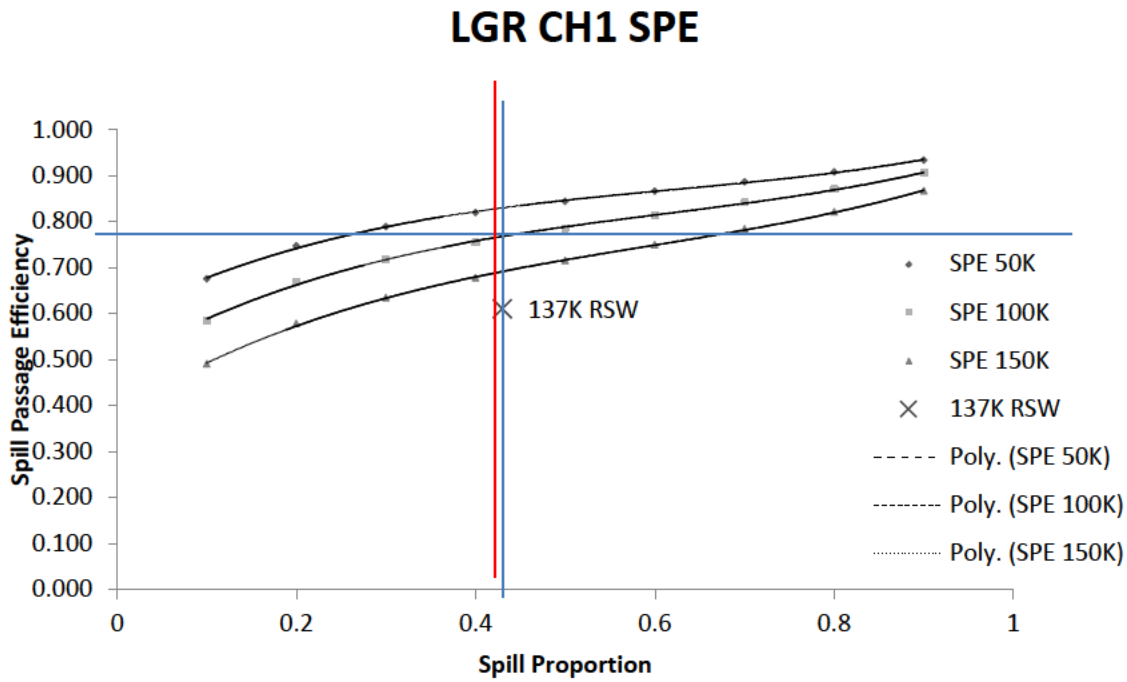


Spill proportion

LGR spring spill: 20 kcfs

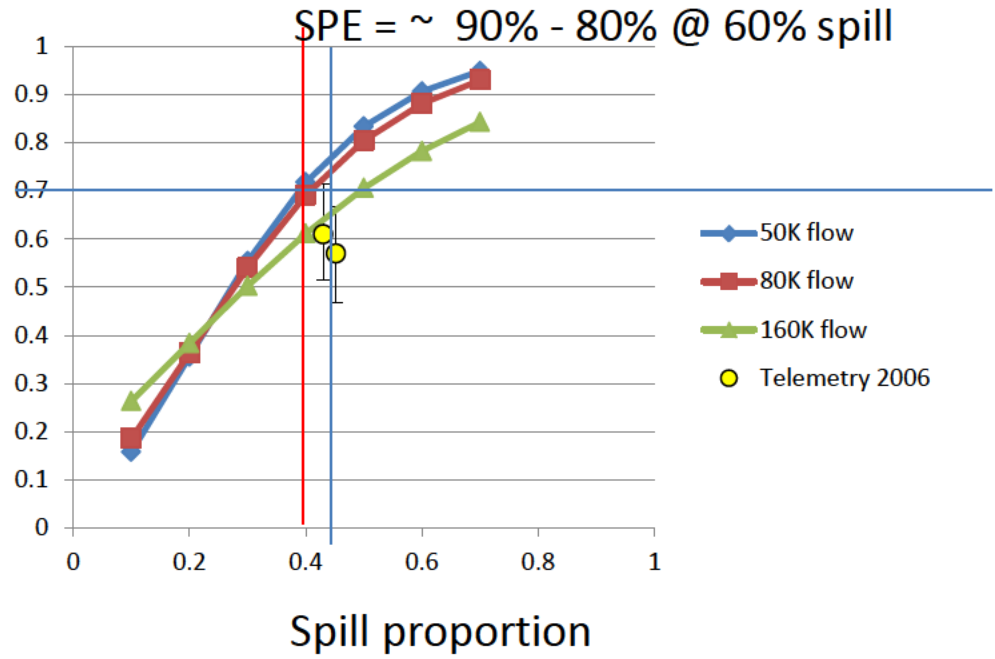
LGR
CH1H+W

COMPASS SPE = ~ 82% - 70% @ current spring spill
SPE = ~ 88% - 76% @ 60% spill



CSS SPE = ~ 78% - 62% @ current spring spill
SPE = ~ 90% - 80% @ 60% spill

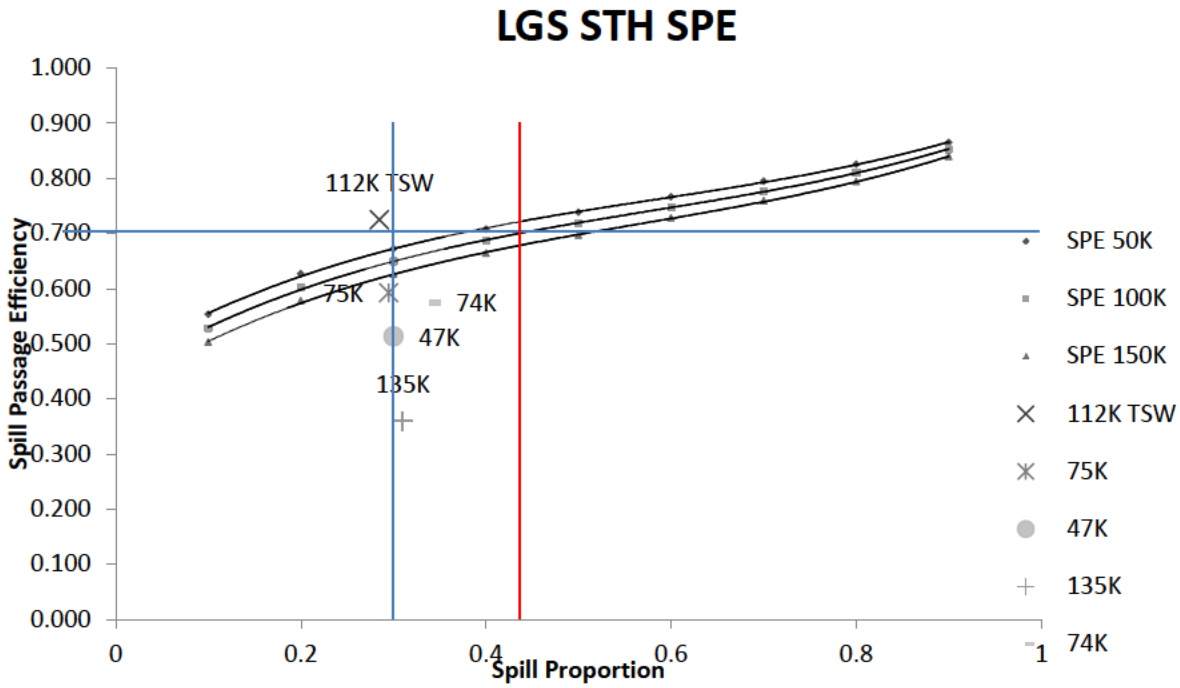
Spillway
passage



LGS spring spill: 30%

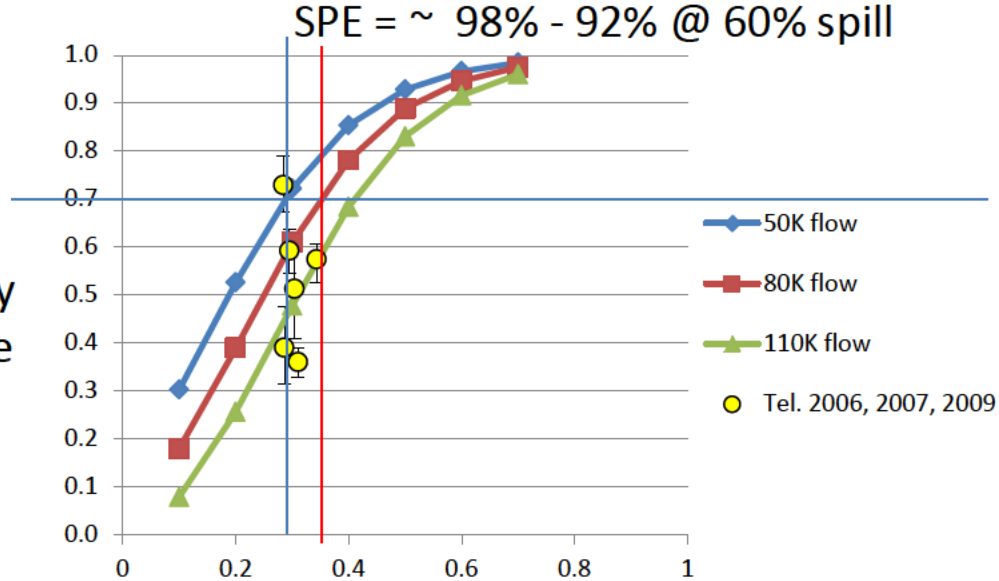
LGS
STH+W

COMPASS SPE = ~ 68% - 62% @ current spring spill
SPE = ~ 78% - 72% @ 60% spill



CSS SPE = ~ 76% - 50% @ current spring spill
SPE = ~ 98% - 92% @ 60% spill

Spillway
passage

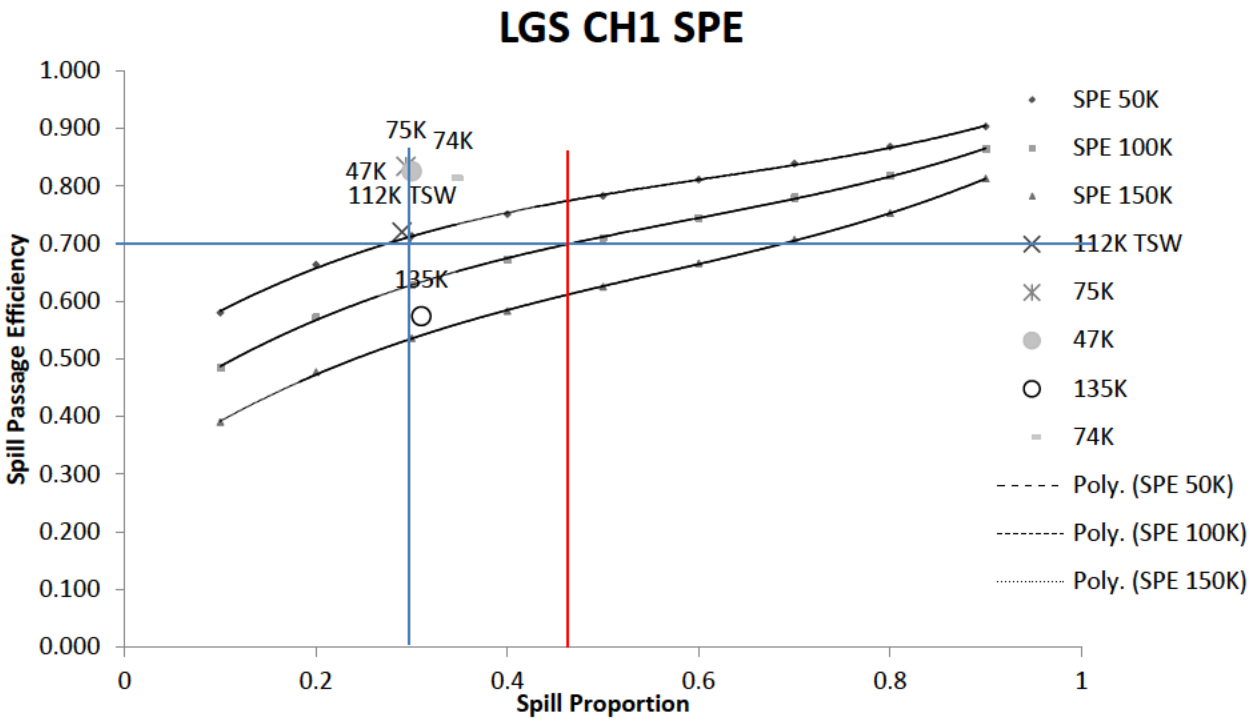


Spill proportion

LGS spring spill: 30%

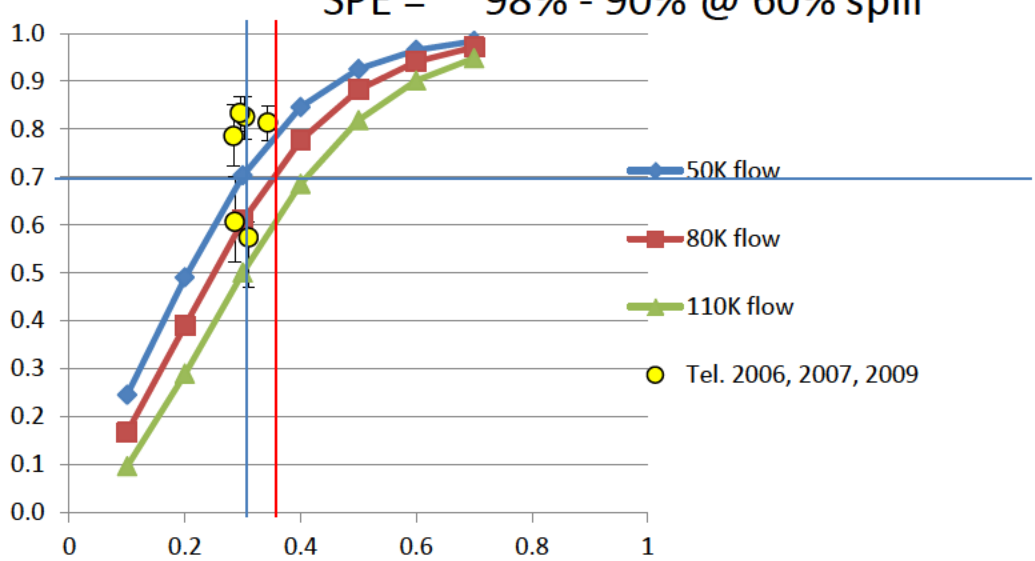
LGS
CH1H+W

COMPASS SPE = ~ 72% - 55% @ current spring spill
SPE = ~ 82% - 68% @ 60% spill



CSS SPE = ~ 70% - 52% @ current spring spill
SPE = ~ 98% - 90% @ 60% spill

Spillway passage



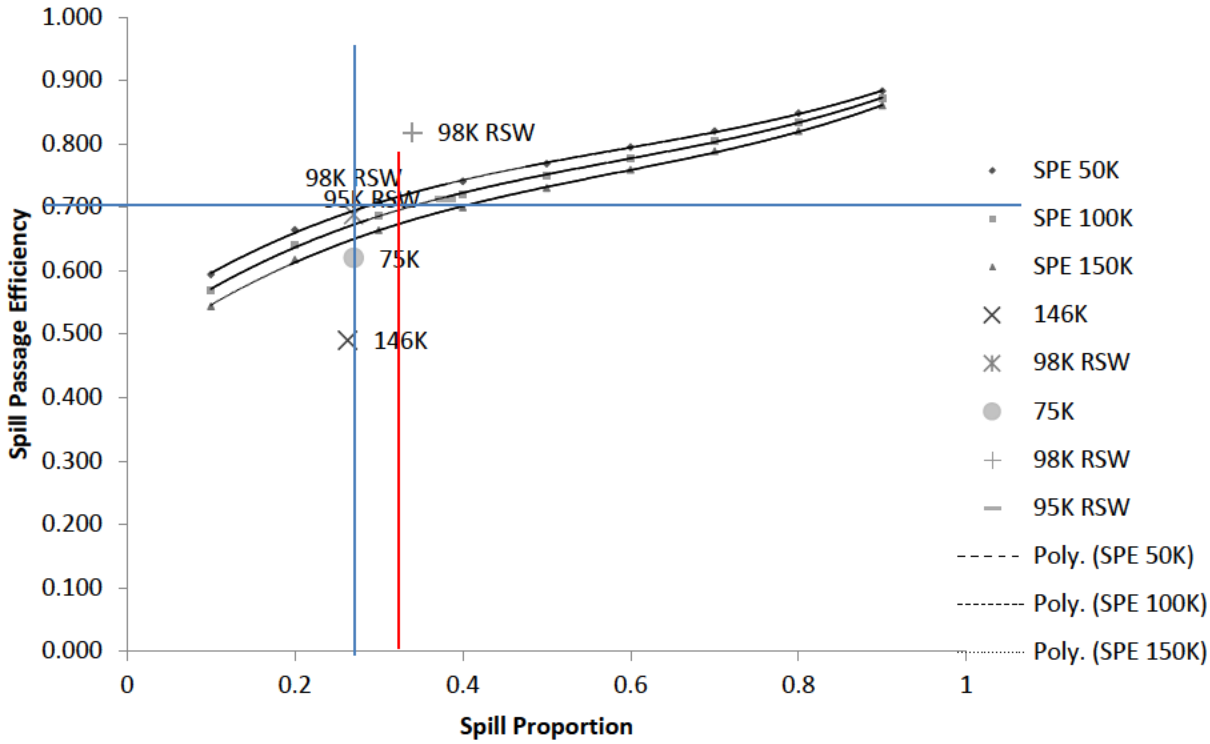
Spill proportion

LMO spring spill: gas cap bulk pattern (~27 kcfs)

LMO
STH+W

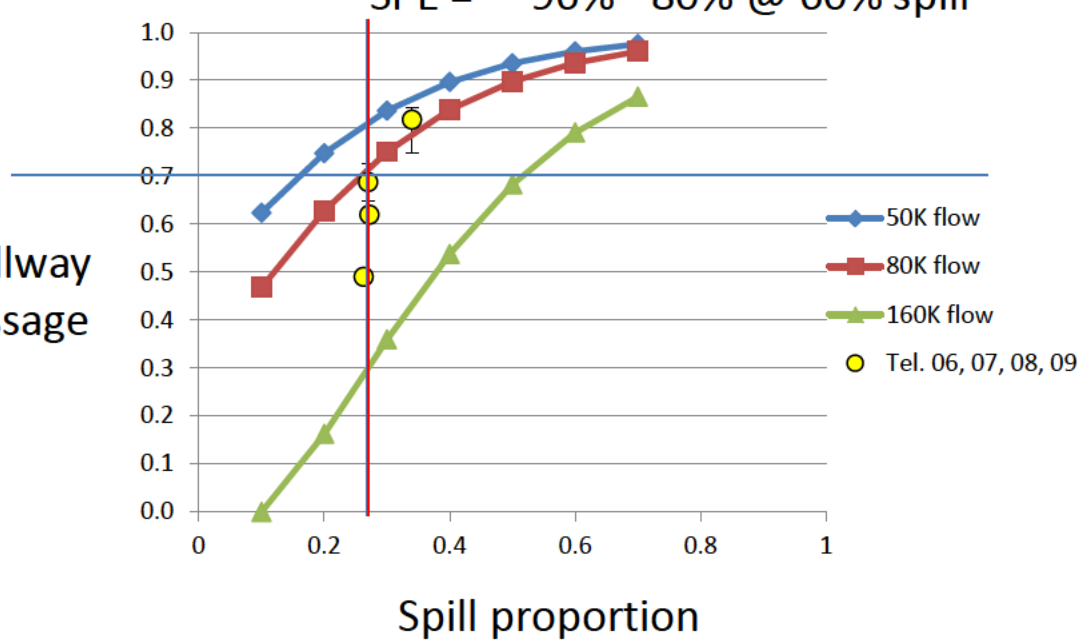
COMPASS SPE = ~ 70% - 64% @ current spring spill
SPE = ~ 80% - 75% @ 60% spill

LMN STH SPE



CSS SPE = ~ 80% - 32% @ current spring spill
SPE = ~ 96% - 80% @ 60% spill

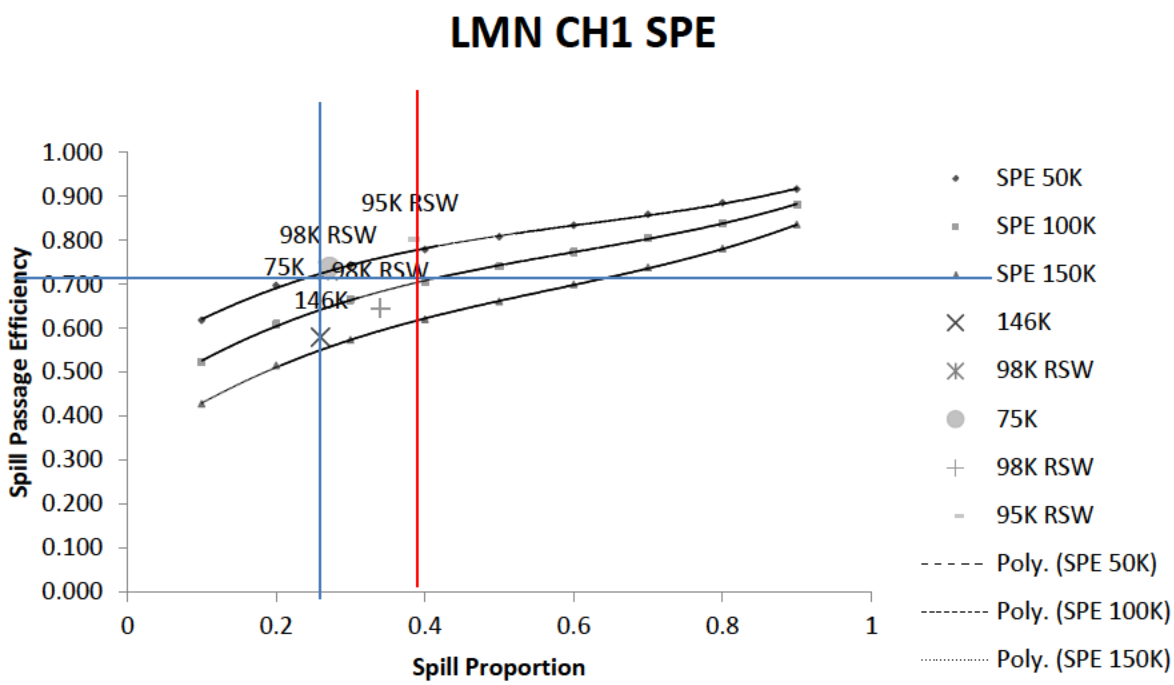
Spillway
passage



LMO spring spill: gas cap bulk pattern (~27 kcfs)

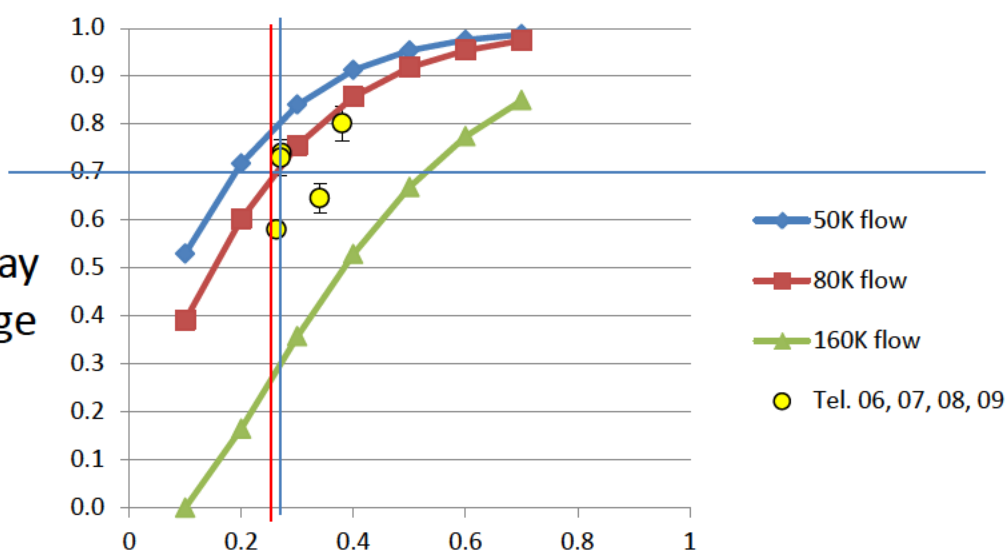
LMO
CH1H+W

COMPASS SPE = ~ 74% - 58%



CSS SPE = ~ 80% - 30%

Spillway passage

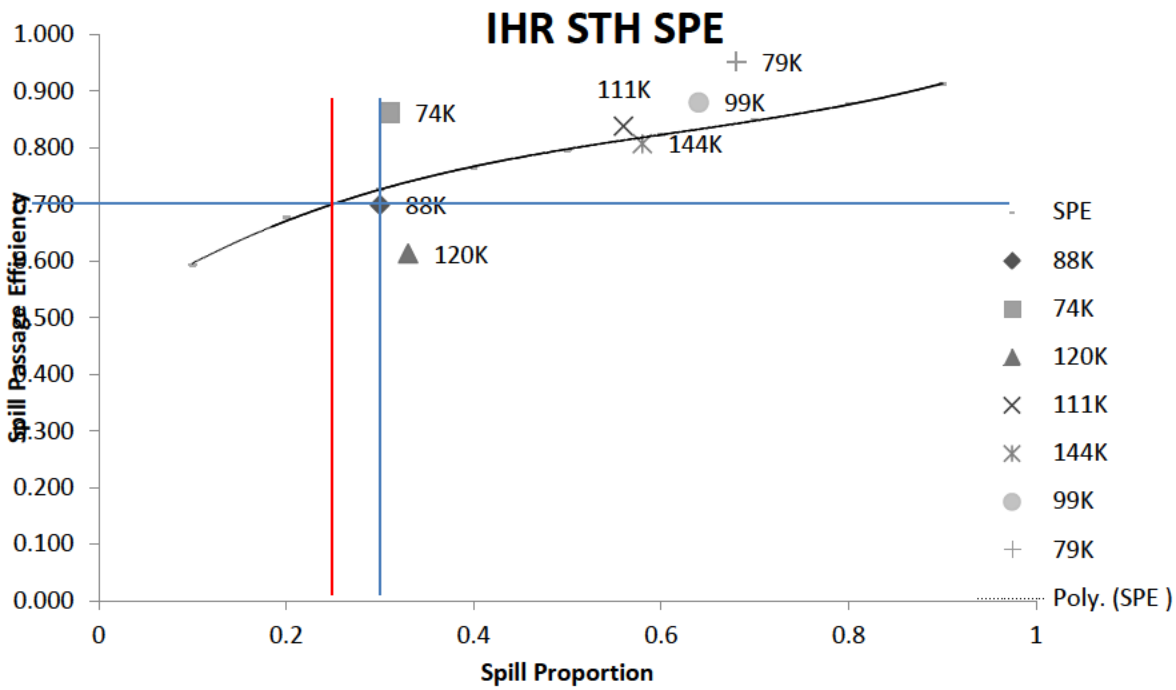


Spill proportion

IHR spring spill: 30% and 45 kcfs/gas cap

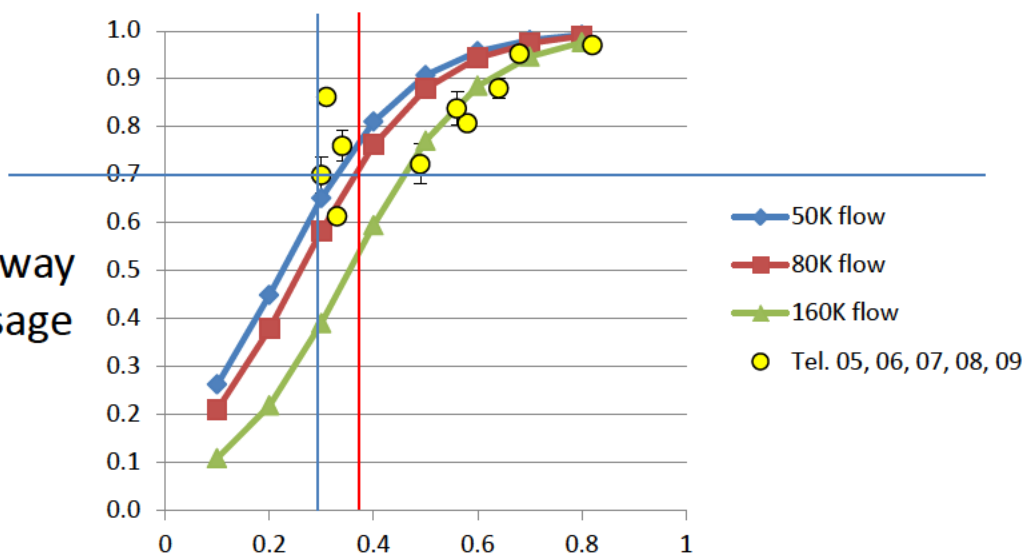
IHR
STH+W

COMPASS SPE = ~ 72%



CSS SPE = ~ 68% - 40%

Spillway
passage

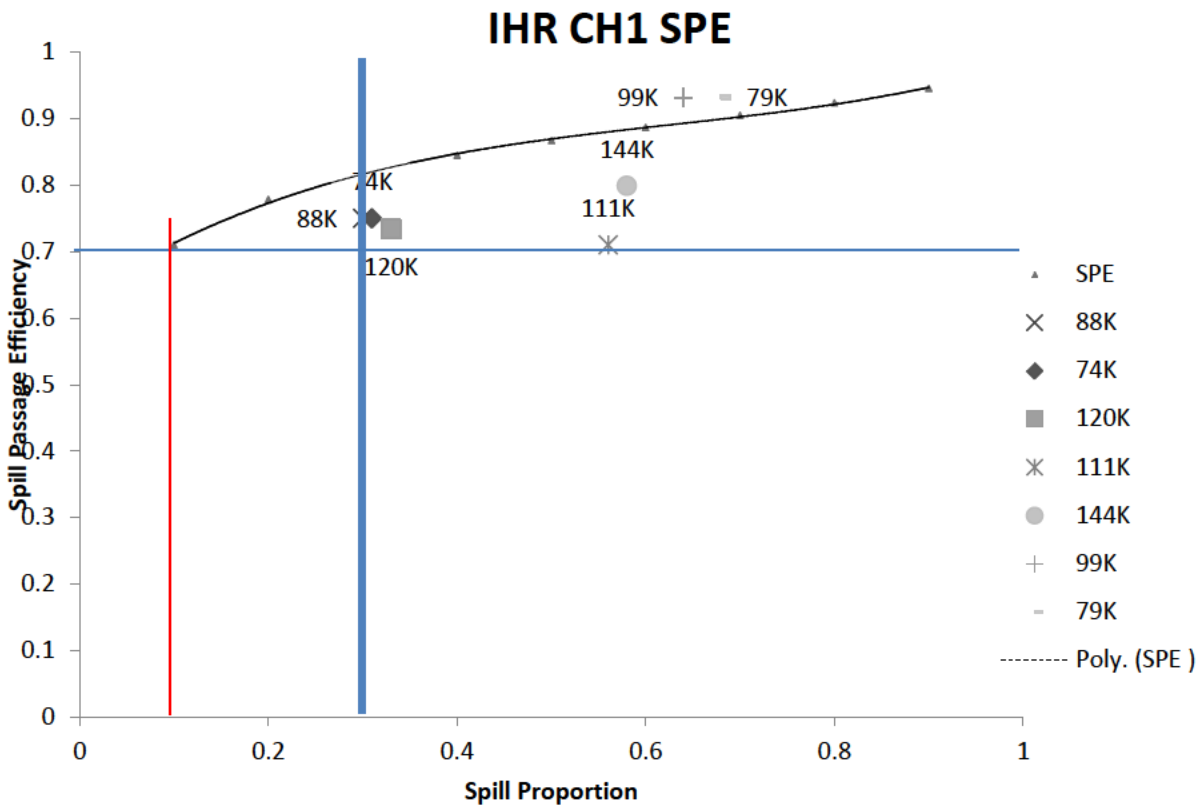


Spill proportion

IHR spring spill: 30% and 45 kcfs/gas cap

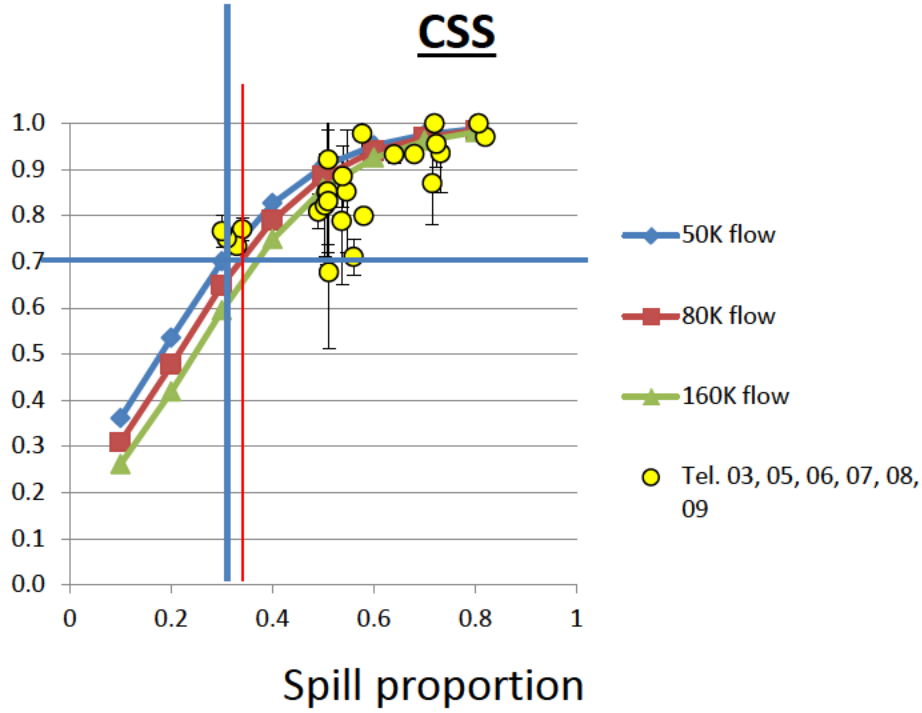
IHR
CH1H+W

COMPASS



CSS

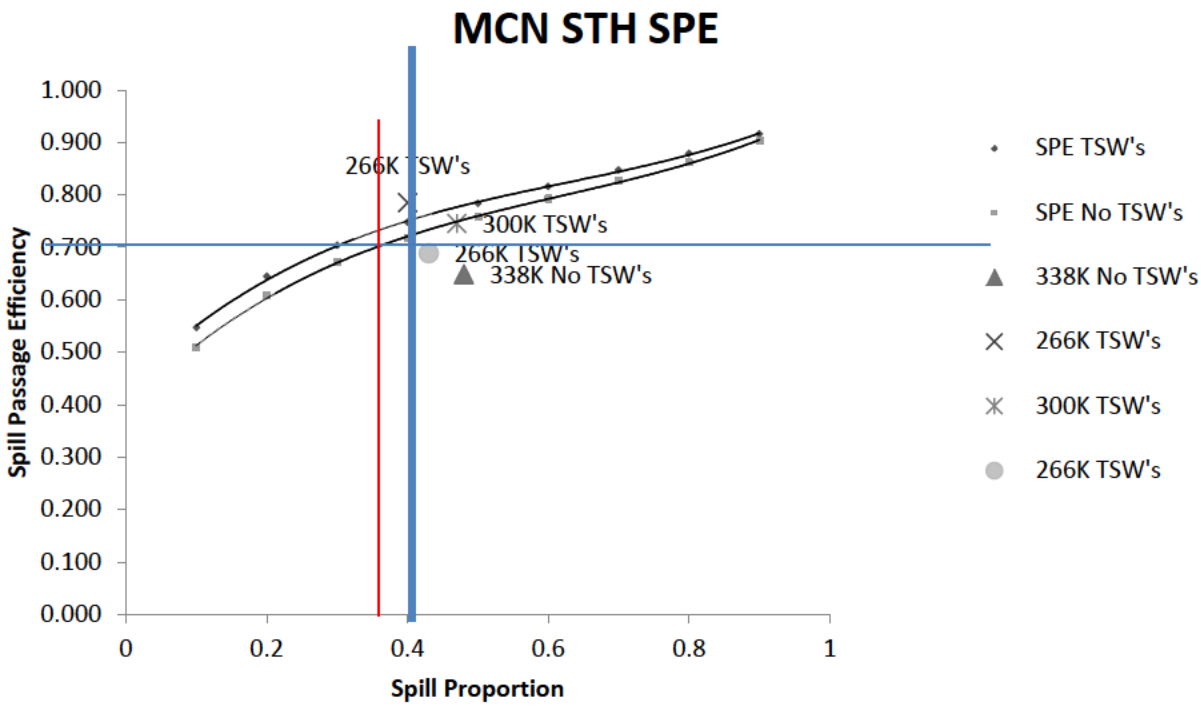
Spillway passage



MCN spring spill: 40%

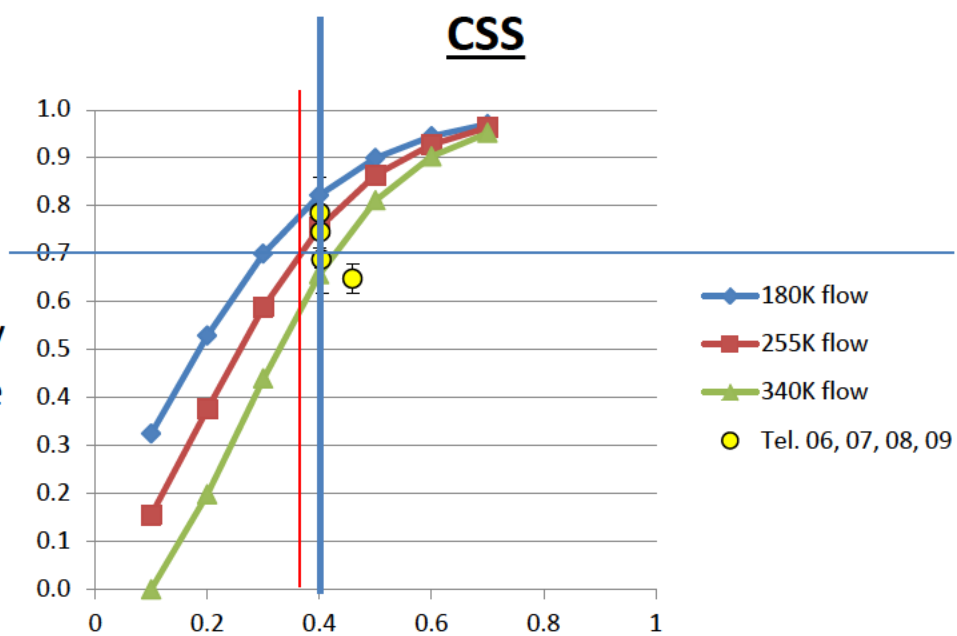
MCN
STH+W

COMPASS



CSS

Spillway passage

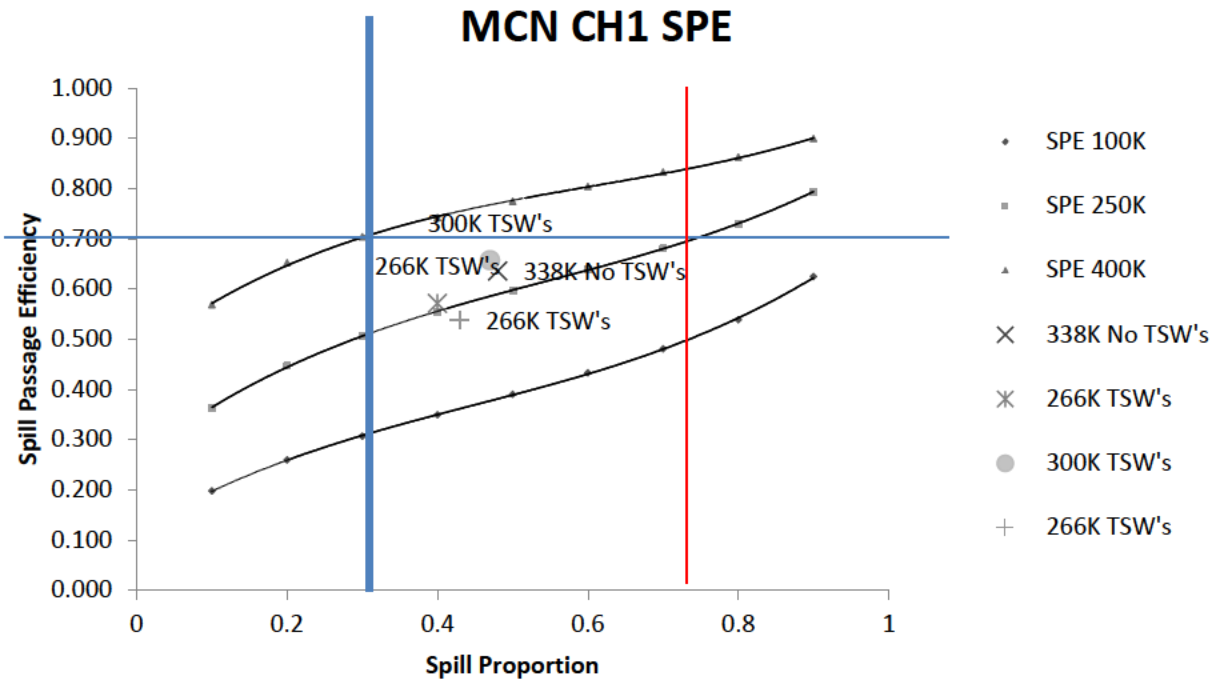


Spill proportion

MCN spring spill: 40%

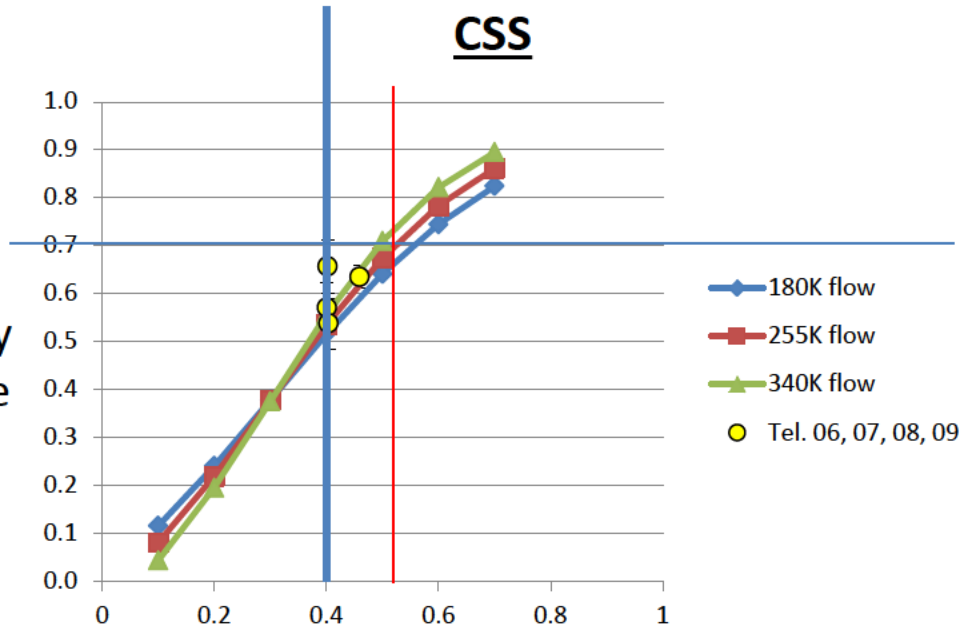
MCN
CH1H+W

COMPASS



CSS

Spillway passage

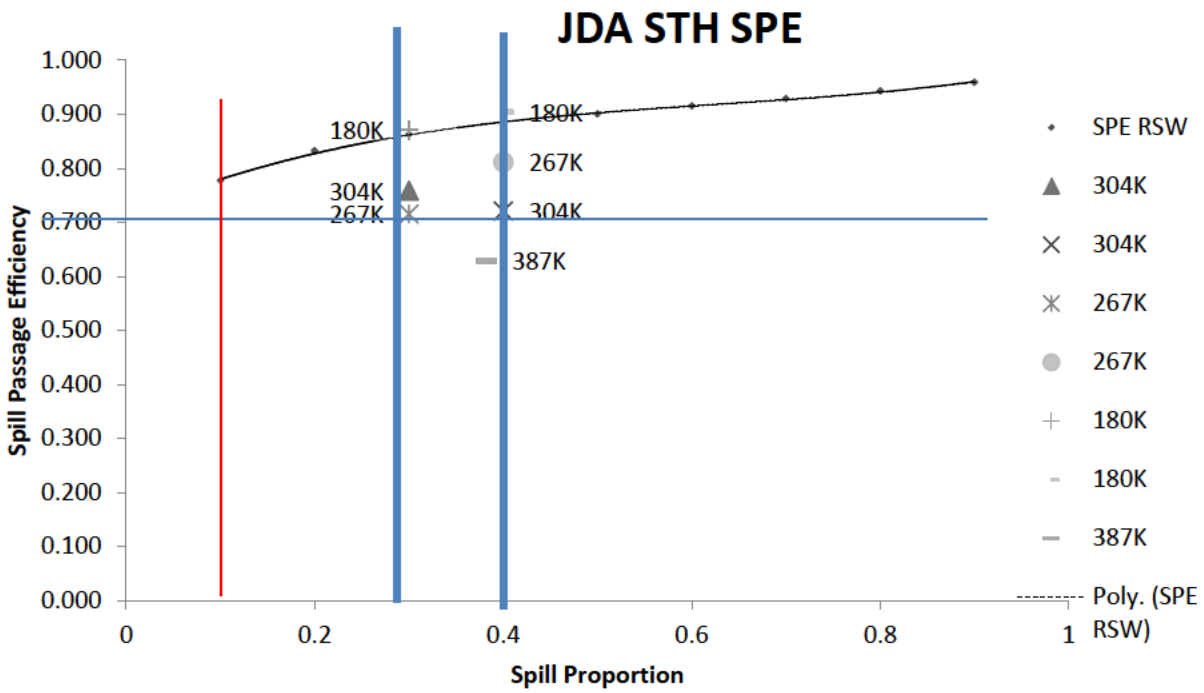


Spill proportion

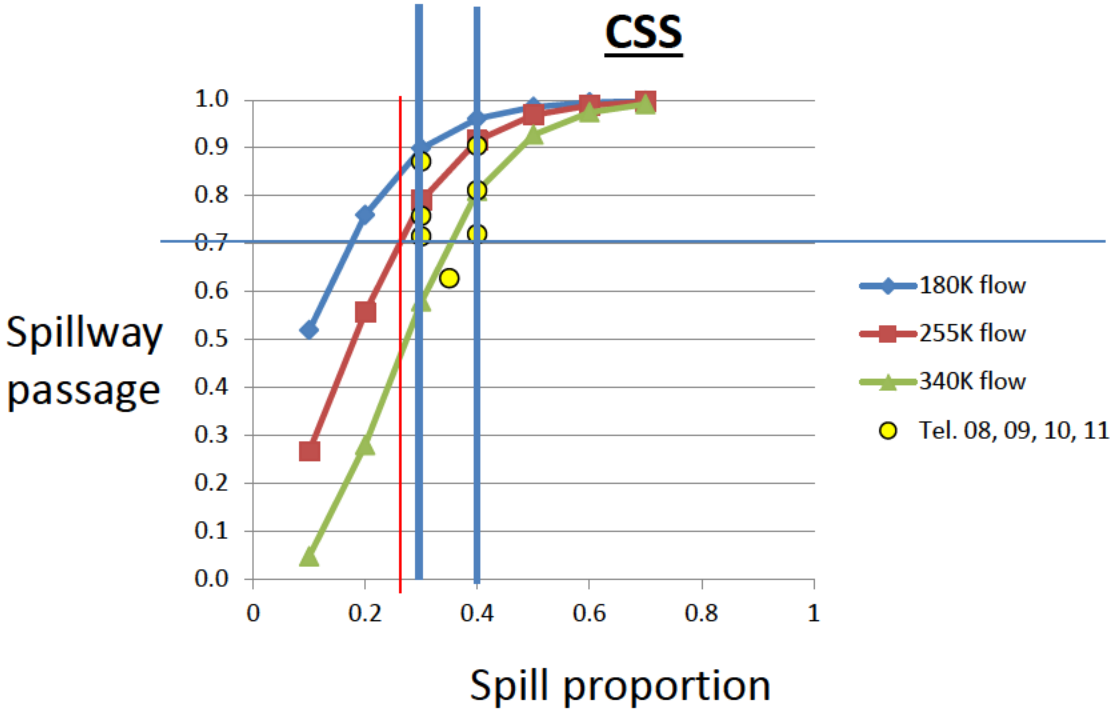
JDA spring spill: 30% and 40%

JDA
STH+W

COMPASS

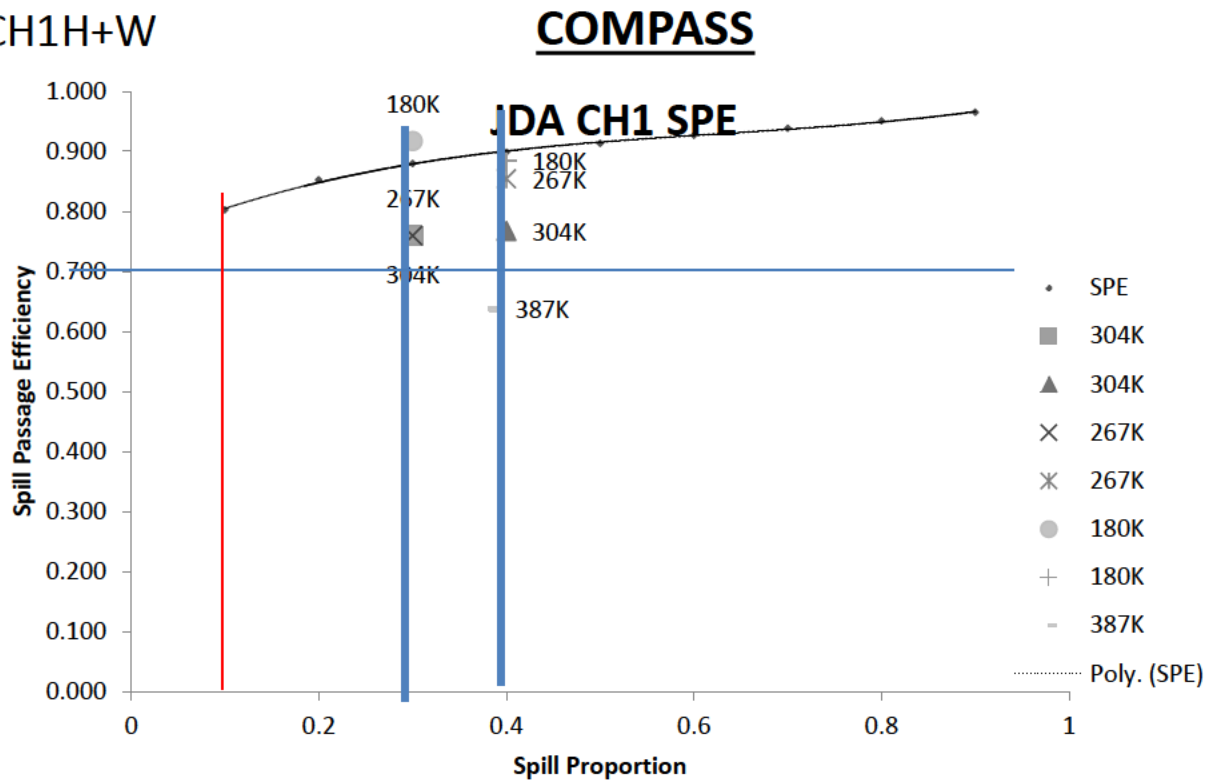


CSS

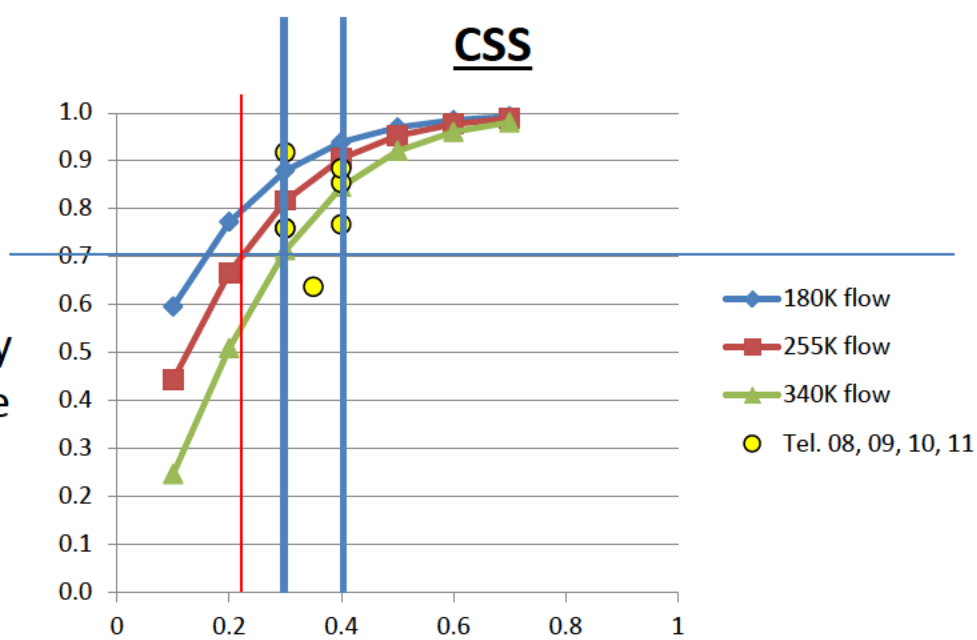


JDA spring spill: 30% and 40%

JDA
CH1H+W



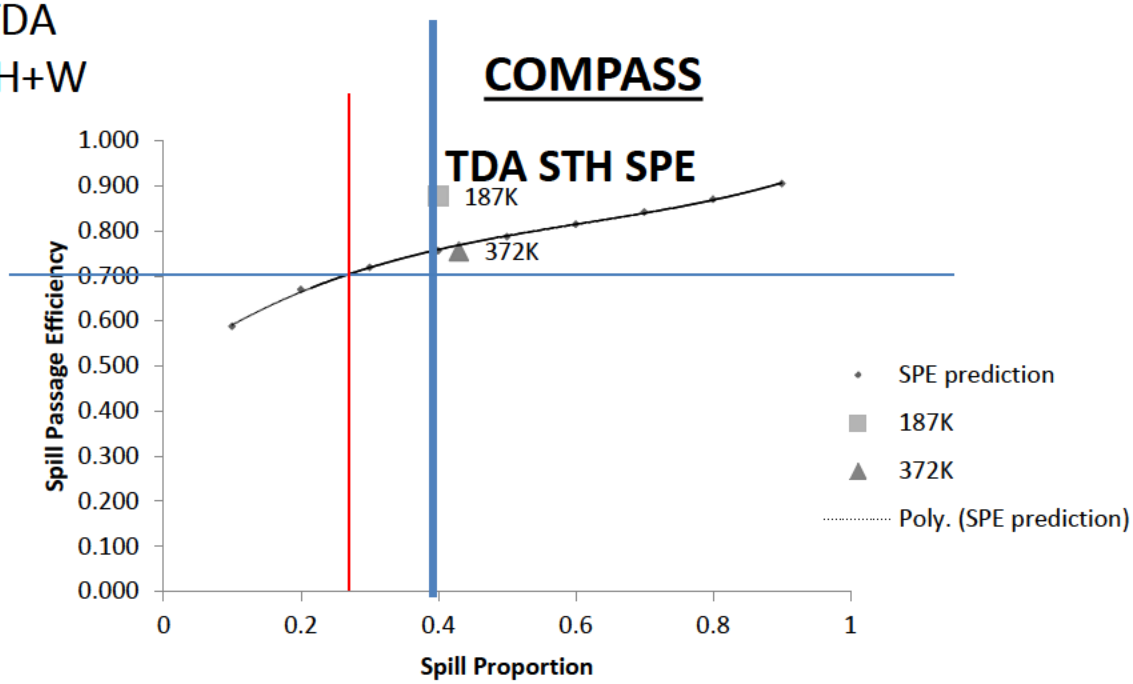
Spillway
passage



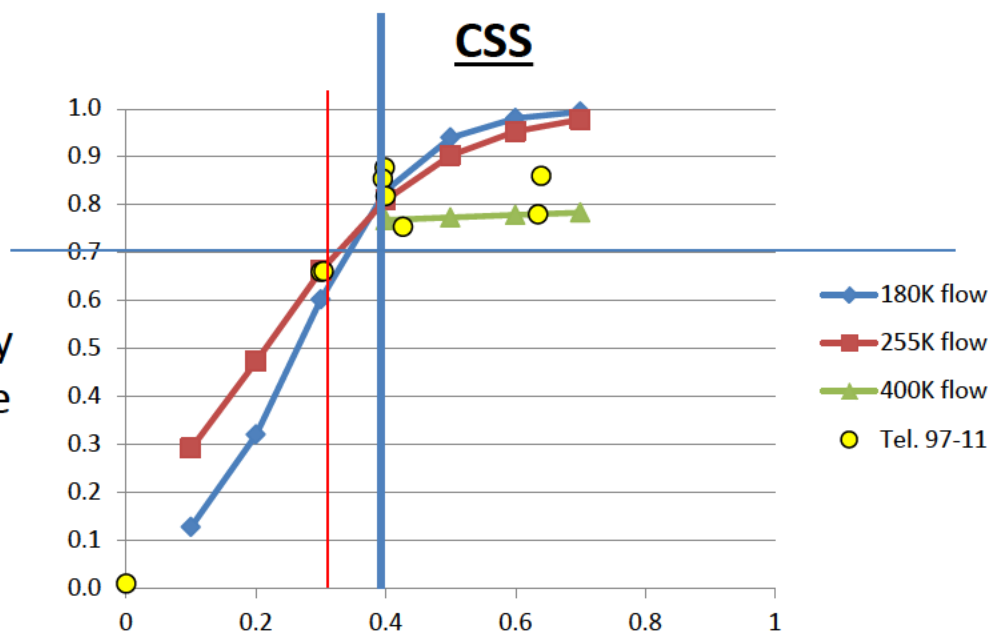
Spill proportion

TDA spring spill: 40%

TDA
STH+W



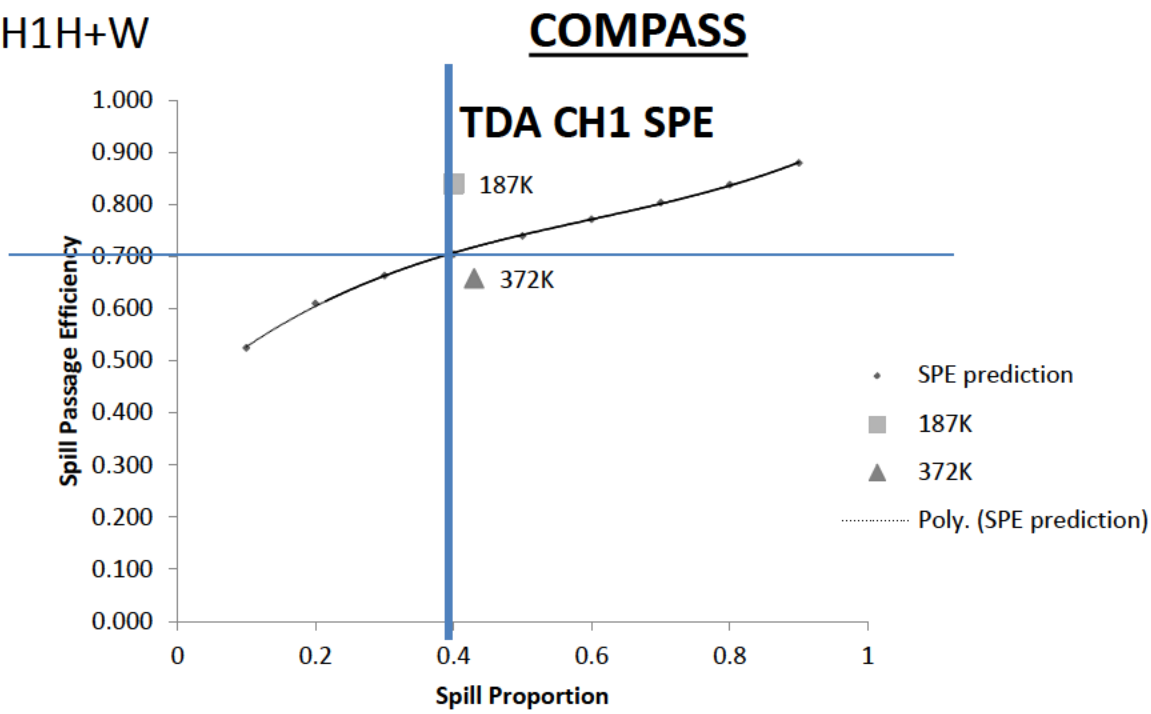
Spillway
passage



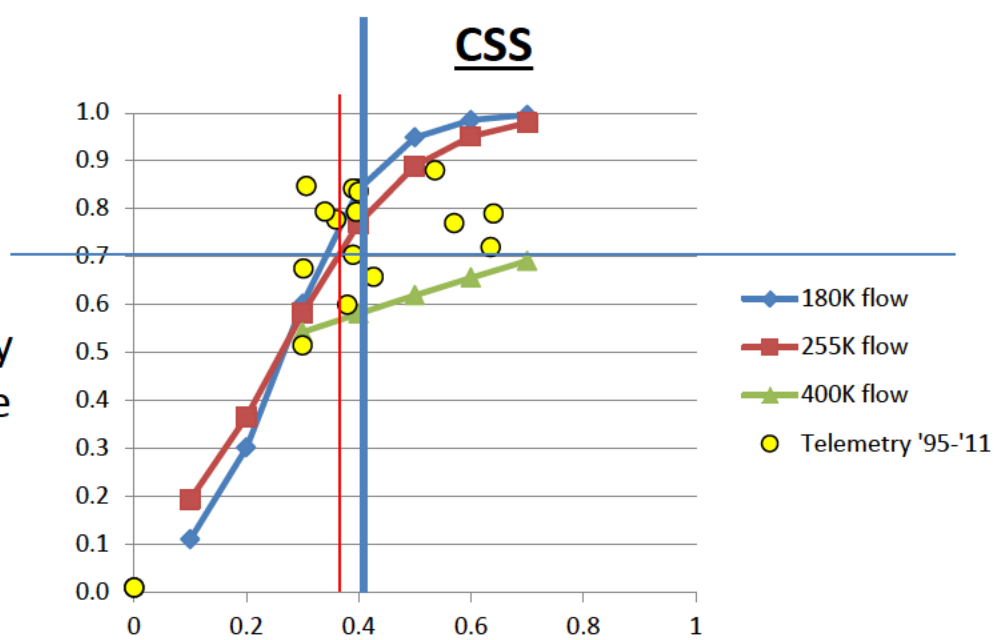
Spill proportion

TDA spring spill: 40%

TDA
CH1H+W



Spillway
passage

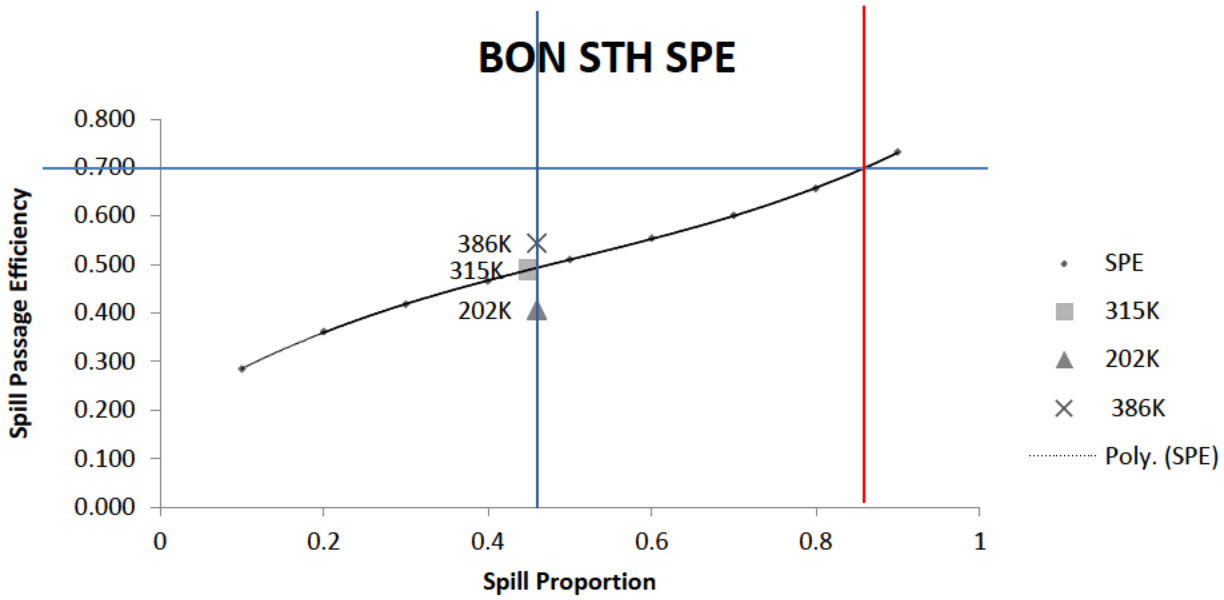


Spill proportion

BON
STH+W

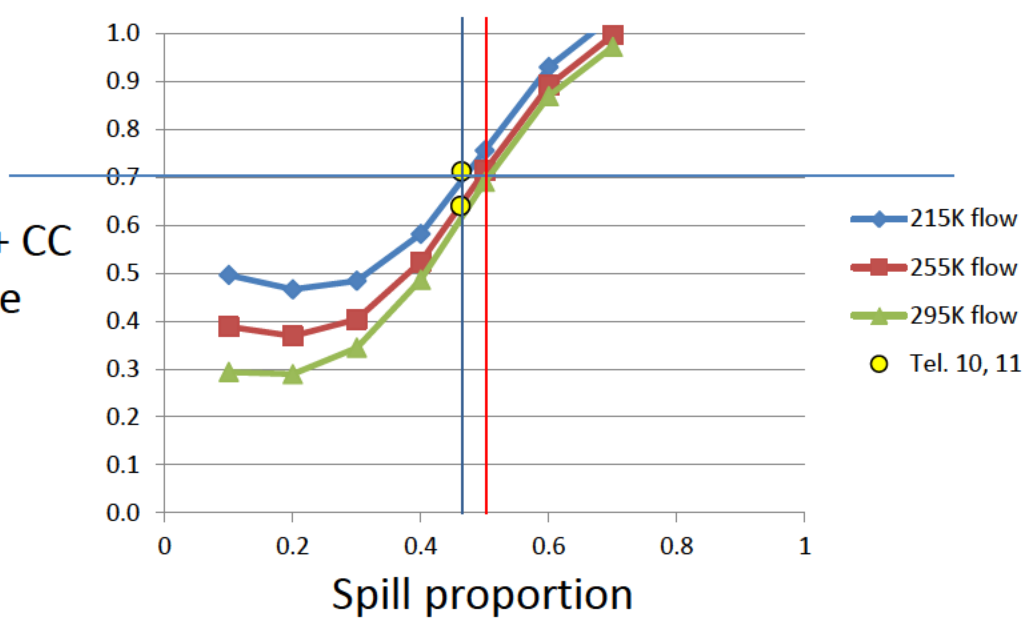
BON spring spill: 100 kcfs

COMPASS



CSS

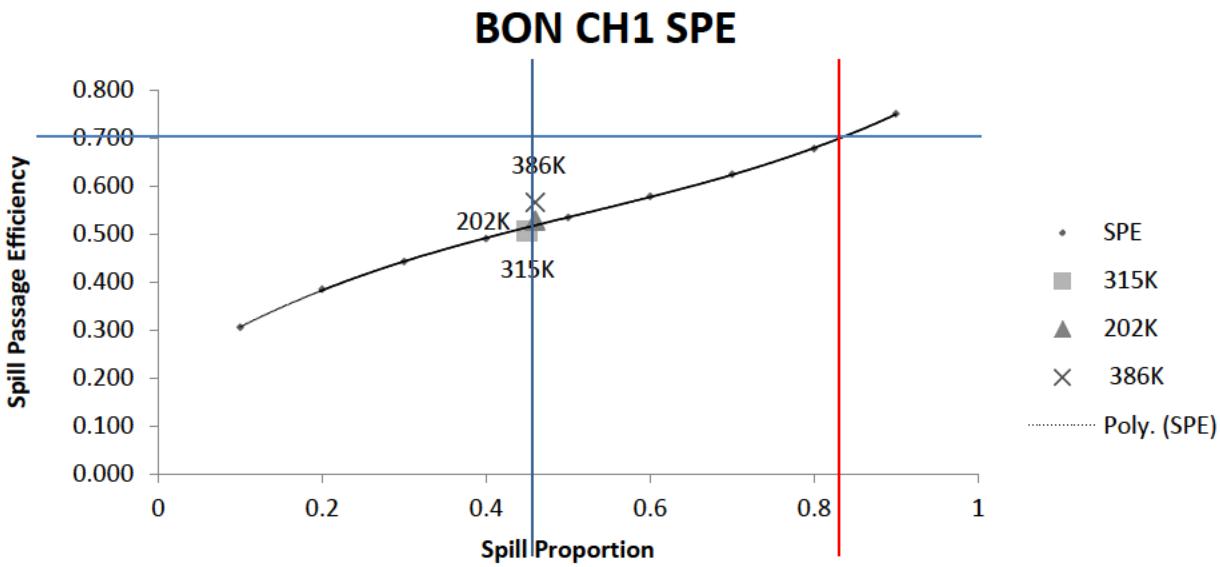
Spillway + CC passage

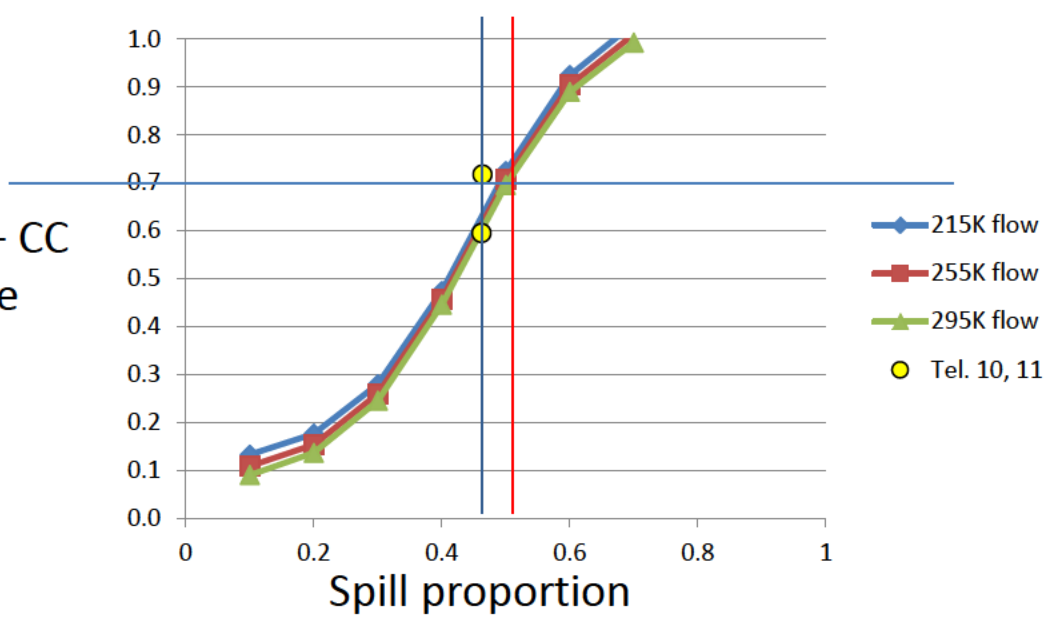


BON
CH1H+W

BON spring spill: 100 kcfs

COMPASS



CSS

Spillway + CC passage