FINAL

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ANCHOR QEA

Memorandum

Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: October 25, 2021

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the August 31, 2021, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, August 31, 2021, from 1:00p.m. to 4:10p.m. Attendees are listed in Attachment A to these meeting minutes.

I. Welcome

A. Agenda

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and read the list of attendees (shown in Attachment A). The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the coronavirus disease 2019 (COVID-19) pandemic. The focus of today's meeting is to continue the discussion on hatchery production recalculation data sources.

II. Joint HCP-HCs and PRCC HSC

B. Hatchery Production Recalculation: Data Source Review (continued)

Smolt-to-adult Return Data

Tracy Hillman provided an overview of the discussions to date on smolt-to-adult return (SAR) data used in the Biological Assessment and Management Plan (BAMP) calculation to compensate for juvenile mortality at hydroprojects by determining the number of adult equivalents that should be replaced by juvenile production. Hillman projected Table 4 from the 2013 Recalculation Notes assembled by the PUDs, which shows the data sources for the SAR values, whether derived from passive integrated transponder (PIT)-tag detections or coded-wire tag (CWT) recoveries. Based on a review of meeting notes from the last recalculation effort, PIT-tag-based estimates of adult returns were used where they were available. Where they were not available, estimated CWT recoveries were used to estimate adult returns. CWTs may require 3 to 4 years for a "mature" dataset to be available for analysis. A SAR calculated with PIT-detections at a dam will provide a larger SAR than one calculated from CWT recoveries using spawning ground recoveries, which is the source of the disagreement between the HCP-HC and PRCC HSC Parties for calculating SAR. A SAR can be a return rate of the total number of marked fish that return to a specific location (e.g., Chiwawa River), or a survival rate, which includes all returns regardless of where they end up (e.g., Chiwawa River, fisheries, broodstock, and strays).

The HCPs state that No Net Impact (NNI) mitigation consists of two components; one of which is the compensation for Unavoidable Project Mortality (from Section B of HCPs Introduction):

> *"The objective of this Agreement is to achieve No Net Impact (NNI) for each Plan Species affected by the Project on the schedule set out herein and to maintain the same for the duration of the Agreement. NNI consists of two components: (1) 91% Combined Adult and Juvenile Project Survival achieved by project improvement measures implemented within the geographic area of the Project, (2) 9% compensation of Unavoidable Project Mortality provided through hatchery and tributary programs, with 7% compensation provided through hatchery programs and 2% compensation provided through tributary programs. The Parties intend these actions to contribute to the rebuilding of tributary habitat production capacity and basic productivity and numerical abundance of Plan Species."*

The definition of Combined Adult and Juvenile Project Survival is given in Section 13.3 of the HCPs:

> *"Combined Adult and Juvenile Project Survival" means that 91% of each Plan Species (juvenile and adult combined) survive Project effects when migrating through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect, and delayed mortality wherever it may occur and can be measured (as it relates to the Project) given the available mark-recapture technology."*

This may help set the bounds for calculating project effects. Measuring SAR using PIT-tag detections at a dam captures survival back to the project. There may be additional project-related mortality not observed in PIT-tag data in the reservoir upstream from the dam, but estimating SARs in tributaries includes additional agents of mortality that are not project related. According to the definition, indirect and delayed mortality must be measurable to be included as a project effect.

Hillman asked the Committees members if this interpretation of the direction given by the HCPs and Priest Rapids Salmon and Steelhead Settlement Agreement is correct. Brett Farman said he has the same understanding in terms of capturing all project-related mortality, whether it occurs upstream or downstream of the projects.

During the last meeting, Hillman asked Keely Murdoch to prepare a flow diagram showing the differences between the use of PIT tags and CWTs in calculating SARs. Prior to this meeting, Hillman asked the PUDs to show exactly how they are calculating SARs and how it fits with the BAMP, with a discussion on the pros and cons of using PIT-tag detections versus CWT recoveries. Hillman stated that it is unlikely the Committees will come to agreement today on which approach to use. Rather, each party will talk about the calculation approaches, then will take the time to think about this before the next meeting to determine whether agreement and approval of the data sources is possible during the September 15, 2021, meeting.

Murdoch noted there is no argument over the objective of the HCP and PRCC Agreements, though there is a need to define whether project mortality includes some mortality after passing through the project.

Calculating Smolt-to-Adult Returns at Tributary Hatcheries

Keely Murdoch reviewed the Yakama Nation's (YN's) position on the use of SAR data in the BAMP. Murdoch reviewed a flow chart prepared to depict the BAMP method for calculating mitigation, that was prepared by Murdoch and distributed by Larissa Rohrbach on August 26, 2021 (Attachment B), at the request of the Committees.

- In the first step, the BAMP calculation estimates the number of natural-origin returns (NOR) that would have returned in the absence of the projects. The second step shows the methods used to calculate the hatchery release necessary to replace those lost adults.
- There is disagreement at this time about using an "in-Basin CWT SAR" versus a "Dam PIT SAR." The CWT SAR is better described as a "full life-cycle SAR" calculated from CWT recoveries anywhere, including strays, pre-spawn mortalities, mortalities in harvest, or other mortalities.
- The Parties have agreed to and selected locations for in-kind, in-basin hatchery mitigation consistent with the section in the HCP about rebuilding tributary populations. The BAMP directs the Parties to use the SAR from the hatchery from which these fish are released. These fish are released at the smolt stage, and all the end uses of the adult fish need to be replaced.
- There are SAR data in the annual reports for each hatchery facility that are approved by the Committees and are intended by the BAMP to be used to calculate NNI, which the YN sees as full life-cycle mitigation.
- PIT-tag data are not necessarily representative of the whole population because fish must meet a certain size and condition criteria to be PIT tagged. If there is high coefficient of variation in fish size, the PIT tags will only represent the survival of the largest fish of that release. Keely Murdoch said Steve Hays had described during the last recalculation effort that there is an incentive to create better hatchery practices to improve SAR. The use of SARs estimated from PIT-tag detections at the dam takes away from that incentive by only measuring the performance of the largest fish.

Calculating Smolt-to-Adult Returns at Hydroprojects

Rod O'Connor reviewed a calculation summary document that was drafted by the PUDs and distributed just prior to the meeting (Attachment C). His review included the following:

- Tying both parts (NORs and SARs) of the BAMP equation to the same location is what allows the algebraic equation to be balanced. This can be calculated at any point in the watershed. This can be done either at a dam or in the tributary depending on the confidence in the data. A mismatch between locations by counting NOR at a dam and SAR in a tributary will result in an overestimate of project effects.
- CWT SAR is an estimate of total returns including fish removed for harvest, broodstock, and those on the spawning grounds. The CWT datasets become more accurate over time as entries are added to the database. There can be major changes in percent returns when the data is queried from one year to the next. Sources of bias in CWT data were summarized.
- PIT tags are easily readable at mainstem dams. There is a high rate of detection at dams, which allows hatchery programs to use fewer detections overall to obtain reliable results for these types of efforts.
- Each method (CWT vs. PIT) can be used appropriately as long as the assumptions are well understood around them.
- The proposed approach to use the combined CWT and PIT Project SAR was developed to best account for the hydroproject effects, using the best datasets that are available. These datasets have evolved since the last recalculation effort.
- PIT-tag based conversion rates for spring Chinook salmon and steelhead can inform potential reservoir effects. The average per-project conversion rate from Priest Rapids Dam to Wells Dam across several years was greater than 99%.
- The PUDs would like to see a match in the location were NOR and SAR are measured (i.e., for the analysis to be correct, both NOR and SAR need to be measured at the same location).
- Todd Pearsons noted that a key component of the figures in the PUDs summary is to show the boundaries of the PUDs' responsibility for project mortality (if the NORs are measured at the dams), and to show that the PUDs are not responsible for mortality in the tributaries or non-project mortality.
- Tracy Hillman summarized the PUDs' two key points that are based on the algebra used in the BAMP calculation: 1) the NOR and SAR values should be estimated at the same location, and 2) the responsibility of the PUDs is project mortality and not mortality that occurs outside the project boundaries.

Discussion

Keely Murdoch noted appreciation for the PUDs summary of BAMP calculation and stated that the YN position is that the BAMP does not calculate mitigation for project effects. The mitigation replaces fish lost due to project mortality and the intent of the calculation is to replace them in locations where they would have returned. The different perspectives between replacing fish to the dam or to the hatchery is a difference in philosophical perspective. Replacing fish only to the dam feels like a twisting of the original intent of the BAMP, which was to replace fish to the tributaries. If the end use is that adult fish are to be harvested downstream of the dam—which is captured by SAR at the dam—but the benefit to the resources is upstream of the dam, the fish are not being replaced for the whole life cycle and there is some picking and choosing for which functions are being replaced.

Murdoch said, regarding the bias in using CWTs, work done to characterize carcass recovery bias can be used to adjust SAR estimates. The PUDs did not address bias associated with PIT-tagged fish. Mike Tonseth said he is also concerned with playing up the biases described in using CWT data without recognizing the significant biases that also occur with PIT-tag data.

Tonseth said he is also in agreement that calculating returns back to the dams would not fulfill the NNI obligations. At a minimum, calculating SARs back to at least the tributary of origin is more accurate. There are effects of the dams that occur later as they migrate out of the project area into the tributaries. Todd Pearsons asked what the boundary would be for constituting return to a tributary. Tonseth said he considers that boundary to be the mouth of rivers, outside the reservoir inundation zone. Pearsons reiterated the project survival rate per project is 99.5%. Tonseth said this assumes there is no bias in the PIT-tag data; especially in the earliest years of PIT tagging these groups. The PIT-tagged fish do not necessarily represent the whole population. Pearsons said the data shown were from run-of-the-river PIT-tag detections from all sources and he did not know whether the PIT-tagged fish were larger than the average size for the total population. One could also speculate that if the fish that are PIT tagged are bigger, those PIT-tagged fish typically return at earlier ages and those fish may have a lower adult survival than bigger/older fish. Regardless, there was over 99% per-project survival on average from Priest Rapids Dam to Wells Dam. Murdoch said, when calculating SAR with PIT tags, there is always bias that is not reflected in the conversion rates. When PIT tagging wild fish there is a large size bias; there are many fish that are too small to PIT tag when captured in smolt traps. What is shown is not the SAR—these are conversion rates of fish that have already proven themselves to be able to survive back to dams. Murdoch said the BAMP always used the CWT SAR. PIT-tag data were not available at the time. Other methods for calculating SAR were not called out in the BAMP. Murdoch said she remembers when it was proposed that PIT-tag data would be used during the last recalculation effort but was not able at that time to characterize why this didn't seem appropriate; now she has a better understanding of that math and feels that PIT-tag data from dams should not have been used. Pearsons said the PUDs are trying to use the best estimates that are available. Back when the BAMP was written, estimates that could be pinpointed back to the project using PIT-tag detections were not available.

Pearsons said the point of showing conversion rates was to demonstrate that there are no large sources or areas of mortality during reservoir migration. Once they pass one dam, they have very good conversion from one project to another. That is not the case in the tributaries—there is a fair amount of mortality in tributaries. We have not been shown evidence that that mortality is a result of passage through hydroprojects. That mortality could be the result of habitat effects and should not be the responsibility of the PUDs. Murdoch said she understands there are other sources of mortality in tributaries and can see how those mortalities are part of the SAR calculated at hatcheries, but that is the SAR that is needed to get the full number back to their end destination.

Pearsons said the opening text of the Priest Rapids Salmon and Steelhead Settlement Agreement for defining NNI includes mitigation with a hatchery component and tributary habitat component. Pearsons said, in my view, the hatchery component should be mitigating for the hydroproject effects on juveniles. The habitat component is intended, in part, to fund mitigation for mortality to adults. Pearsons said his interpretation is that all of these actions are meant to contribute to the rebuilding of productivity of a population.

Catherine Willard asked, if SAR from the tributaries is used, wouldn't the spawning escapement to the tributaries be used instead of dam counts for calculating NOR? Murdoch disagreed, stating that those NOR returns at the dam allow for the count of the fish to be replaced.

Kirk Truscott said both the YN and PUDs have points of merit and he would like to spend more time thinking on the issue. His concern is whether PIT tagging at the hatcheries truly represents the population at large. It would be helpful to have similar data to those used for the survival studies describing which fish are included or excluded from PIT tagging to identify any substantive bias. Willard said the fish size data exist and there is a minimum size for PIT tagging; however, by the time the fish are tagged, nearly all are of an adequate size. Truscott said he is interested in seeing a length-frequency distribution of fish that were tagged verses the total population at large. Willard agreed that could be prepared.

Willard noted another consideration is there are no CWT data for steelhead, so the PIT-tag data would be preferred. It is also important to consider that for the years to be analyzed for recalculation, complete CWT datasets may not yet be available.

Truscott said he is concerned about the potential project effects. For some species the travel time between projects is fast. For other upper river-bound fish, depending on the water temperatures in tributaries, some fish hold in confluences (e.g., confluence of Wenatchee River) before they move into tributaries. Truscott asked, can it be assumed that delayed mortality would not be related to the hydroproject? Delayed mortality can occur over days following fish moving out of reservoirs. Tom Kahler asked, by what mechanism would mortality occur among fish that are holding in the reservoir? Truscott said fish are subject to fisheries when avoiding higher temperatures in the tributaries. Kahler said this would occur whether or not a dam exists. Truscott said the difficulty is determining where the indirect effect of the project ends, and it may not be a foregone conclusion that it ends after the fish enter the tributary. Kahler said, it is not only where the effect of the hydroproject ends, but how you would measure that and by what mechanism that mortality is occurring. Truscott said he is not advocating that all mortality would be attributed to the project itself.

Brett Farman said he would caution against the concept of trending toward solely using CWT or PIT tags. From the biological perspective, he sees the YN's point; from the legal perspective, he sees PUDs' point. There is tributary survival information and dam survival information, and the discussion needs to focus in the area in between. There is mortality that occurs above the dams that is not related to the hydroprojects and is not within the discretion of the PUDs. Fish conversion from the dam to the mouth of the tributary does not necessarily account for all the project effects. Fish can arrive at the mouth of the tributary but, if hypothetically they are delayed by several days, this could affect whether they spawn successfully, and this is a loss that is not being mitigated for. There are effects that could be project-related and how we can mitigate for that should be discussed further. Regarding the average of annual conversion rates, by definition, in half of the years you are not going to be replacing fish if mitigation is based on an average, and perhaps its more appropriate to use the lowest conversion rates to fully replace fish in all years. There is mortality above the dam unrelated to the project, but there is also mortality that can't be separated from the project effects. How we measure those effects is unclear.

Murdoch said this should not be so complicated. There are a certain number of fish that did not come back to their end destination whether it's a downstream fishery, upstream fishery, spawning ground, or some other place. The objective is to replace those fish based on their survival from the hatchery.

Matt Cooper said he would echo that there are benefits to using both tag types for calculating SAR and distributions of stocks. The difficult part is where to cut off indirect project effects. Cooper would like to absorb and listen to the information shared. Murdoch said the BAMP is not supposed to be evaluating project effects—that was measured to be 91% combined project survival. The BAMP is used to determine the replacement for the lost fish with hatchery production. The BAMP uses the survival rate from that hatchery to determine how many to release to replace those adult fish with juveniles. Cooper said there are a variety of SARs reported. SAR declines the farther from the ocean you go upstream, and we need to identify which point of return should be used. Murdoch said the SARs should be used that are reported in the annual reports.

Tom Scribner said Murdoch has laid out the YN philosophy to expand to the entire life cycle. He asked the Joint Fisheries Parties whether what Murdoch is saying makes sense as a way to help the resource. Farman said from a biological standpoint, Murdoch's approach makes sense to replace all fish that would return as a whole but noted he must be cautious in his role with the HCP as to how that relates to project effects. Farman said he is uncomfortable taking the leap—as part of the HCP—that the PUDs would be responsible for mortality outside the scope of their discretion or control.

For instance, an extreme example would be if the state executed a fishery that captured all of the fish in the tributary before they return to the hatchery. Would the PUDs be responsible for replacement of all those fish? That would be hard to argue, and he would like to have this discussion internally with other colleagues. Murdoch said, in your example, there would still be CWTs entered into the database and there would still be a survival rate calculated back to its end use.

Tonseth answered Scribner's question stating that he can agree and disagree with everything that has been said so far but believes strongly that any SAR used should be reflective of a full life-cycle response. To that end, there are sources of mortality that are not fairly attributable to the PUDs responsibility. There is no resolution on the issue right now.

Tonseth noted the HCP language talks about mitigating for survival not just to the projects but through the projects, and using SARs to the tributary mouth at least accounts for any mortality that may occur within those boundaries. Farman said he may be in agreement—survival to the mouth of the tributaries may not account for all project mortality—but project-related mortality upstream of that point may be very small. Tracy Hillman asked if there is a way to estimate SAR at the tributary mouths. Kahler said there is a way to do that in some cases. The challenge is always that the tributary systems do not have the same detection efficiencies as the mainstem arrays that have detection probabilities near 100%. The conversion rate table shows that, for instance, in 1 year all fish that passed Priest Rapids also made it to Wells Dam. It is unknown what could be happening above Wells Dam. The best detection efficiency for Methow spring Chinook salmon detected at Wells Dam and then later in Winthrop National Fish Hatchery traps was 98% for Brood Year (BY) 2010 and 93% for BY 2011. For the rest of the years 2009 through 2013, the conversion rate from Wells Dam to any tributary detection point was over 86% with <100% detection probability at any one of those detection points. Arrays in tributaries provide a lot of opportunity to detect fish. Fish appear to be surviving well from Wells Dam to Methow River detection points. Cooper agreed there are high conversion rates from the dam to detection points at Winthrop National Fish Hatchery and Spring Creek.

Kahler said the HCP Tributary Fund fully mitigates for adult mortality. Adding mitigation to the hatchery component of the HCP feels like double-dipping. In the Biological Opinion for Section 10 Consultation, National Oceanic Atmospheric Administration Fisheries struggled with the recognition of attributing all adult mortality to the PUDs' projects, and their PIT-tag-based conversion estimate was considered very conservative. In Biological Opinion analyses of the original HCP agreements, comparisons were made to other free-flowing systems. Adult migration rates were faster and survival rates were higher through the inundated portions of the river, compared to unmanaged river systems. It would be hard to argue there is mortality that is not accounted for. By signing on to the HCPs, the PUDs have accepted that all juvenile mortality is to be mitigated for, regardless of a significant amount of natural mortality. These fish are very well mitigated for.

Farman said he is not suggesting there are large amounts of mortality occurring above the dams; however, he would caution against the idea that that some adult mortality should not be accounted for.

Greg Mackey said circling back to the calculations flow chart, the top part of Murdoch's calculation is not being disputed. The assumed unavoidable project survival is being applied to the number of NOR adults that return to the dam in order to estimate the number of adults that would have returned absent the dam. The PUDs are trying to replace the same number of adults at the dam by calculating how many hatchery smolts must be produced to achieve this. If those missing adults (those that are missing because the dam exists) had showed up, then the total number of adults at the dam would be identical to the number that would have arrived if the dam did not exist. They would have passed through the project and experienced the same losses, some natural, some that could be attributed to the dams, but this distinction is not measurable. When that same number of replacement fish proceed upstream in a tributary, they would be subject to all the same mortalities as other fish. Therefore, the same number of fish would arrive at the spawning grounds with the dam in place and the population bolstered by mitigation fish, or if the dam was not in place with no mitigation fish.

Truscott said philosophically he likes the life-cycle replacement concept, but this is not the first time that his philosophy does not fit within the HCP, and so he is trying to come up with a reconciliation between the two. Farman agreed and said that as a National Marine Fisheries Service representative to the HCP, he looks at the action, the take, and what can be done to reduce that take. By default, we are looking at something in between the two SAR values to determine the take that is attributable to the project.

Farman said National Marine Fisheries Service would advocate for use of the best available method of detection, which may be a combination of the two detection approaches to determine SARs in this case. Pearsons said one issue that can be resolved is to show how representative the PIT-tag data are of the total population, but if that's not the major issue, this issue will not be resolved. Murdoch said this is a side issue; there may not be the survival data for fish that are not PIT tagged due to small size or poor condition. Pearsons agreed, there is no perfect SAR regardless of the tag used, it is usually an underestimate due to tag loss or imperfect detection rates. Hillman said if PIT-tag data are not suitable for estimating SAR back to the projects, use of those data would need to be examined for potential biases for other survival, travel time, and stray rate estimates. Murdoch said this depends on the purpose for why each of these different metrics are measured. For instance, they can be used for indices of year-to-year differences. The purpose of using SAR in the BAMP is to understand the survival of a certain release from a certain hatchery; it is a very specific purpose.

Murdoch said the Rocky Reach/Rock Island HCP Section 8.4.2. references "adult to smolt survival rates for existing Mid-Columbia River hatcheries," which she interpreted as the survival rates back to the hatcheries, and which at the time this HCP was drafted used CWTs. Willard noted that the HCP also does not explicitly state survival should be measured back to the tributaries. Willard said there is also no CWT data for steelhead. Hillman noted there may need to be a program-by-program review of what data to use.

Other Data Source Concerns

Todd Pearsons said the PUD has put together a fairly large document with a lot of other data in it and would like to know if there are other concerns. Scott Hopkins confirmed that Chelan PUD will use the Tumwater Dam adult counts as the bases for determining spring Chinook salmon NOR spawning escapements.

Tracy Hillman noted that he has not heard any objections to the other data to be used in recalculation. Keely Murdoch and Kirk Truscott said they would continue to review the datasets prior to the September meeting.

Truscott said for Rock Island spring Chinook salmon there were two different approaches used—one was based on back-calculating the number of fish (monitoring and evaluation report method), and one using the nadir method—but the two methodologies came up with two different values. Pearsons said he proposed using the nadir method because it was used in the past and it was used for other species. The monitoring and evaluation method was shown just to demonstrate that the values were similar. Truscott said one of those methods showed fewer NOR spring Chinook salmon at Priest Rapids Dam than at Rock Island. Pearsons said that's why they presented two different methods. Truscott said it doesn't look correct if we agree to a method that shows fewer returns to Priest Rapids Dam than at Rock Island Dam. Murdoch said in the past they may have resolved this by using the Rock Island counts for both in years where that was the case.

Preparing to Approve in September

Tracy Hillman said the HCP Policy Committee direction was for the Hatchery Committee to focus on technical decision making, and to elevate policy-level decision making to the Policy Committee, if necessary. Hillman asked for thoughts on how to move this forward, given differences in perspectives and the milestone for approving data sources in September. He also asked whether the Parties are so far apart that this should be elevated to the Policy Committee in the near-term.

Brett Farman said this is a two-part question: 1) can mitigation be calculated with the data available and 2) what latitude does each party have to modify their current proposals? If the guidance from their group is going to limit our ability to make a decision, we need to elevate this to the Policy Committee soon. Tom Kahler said there is differentiation between elevating an issue to the Policy Committee because it is a non-technical policy issue, versus whether this is a dispute that should go through the Coordinating Committee first. Keely Murdoch said her understanding is that both situations are a dispute, but that the Coordinating Committee can be bypassed to save time and effort.

Kirk Truscott said there is not necessarily any philosophical differences among Parties, but rather differences in the interpretation of the HCP. There is a need to review the Statement of Agreement that was passed earlier this year, which states that methods would be used that are consistent with those used during the last recalculation effort; the Statement of Agreement says, *"As a final step, adult equivalents will be converted to hatchery smolt production numbers required to meet NNI by dividing the number of adult equivalents by the average hatchery-specific smolt-to-adult returns (SARs)."*

Hillman said he would like all Parties to review all the information provided today and would reach out to the Parties by September 13, 2021, to determine whether a decision can be negotiated in the September meeting. In the meantime, the Committees need to move forward with other elements of the recalculation effort (e.g., sensitivity analysis). Hillman strongly encouraged communication and coordination among members for clarification on materials that have been provided on use of SARs in the BAMP calculation prior to the next meeting.

III. Administrative Items

A. Next Meetings

The next regular HCP-HCs and PRCC HSC meetings will be Wednesday, September 15, 2021; Wednesday, October 20, 2021; and Wednesday, November 17, 2021, held by conference call and web-share until further notice.

There will be no U.S. Fish and Wildlife Service representation at the September 15, 2021, meeting.

IV. List of Attachments

Attachment A List of Attendees
Attachment B Hatchery Mitigation for No Net Impact Flow Chart
Attachment C Hatchery Recalculation Smolt-to-Adult Returns Summary

Attachment A
List of Attendees

Name	Organization
Larissa Rohrbach	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins*	Chelan PUD
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Rod O’Connor	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Katy Shelby	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation
Tom Scribner*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

Attachment B
Hatchery Mitigation for No Net Impact Flow Chart

BAMP Method for calculating mitigation

Example: Natural Origin Spring Chinook at Rock Island Dam & Chiwawa Acclimation Site

NOR spring Chinook @ RIS = 1613	÷	Juvenile survival rate = 0.9375	=	Number of NOR adults if no project mortality = 1720.5
Number of NOR adults if no project mortality = 1720.5	-	NOR spring Chinook @ RIS = 1613	=	Number of NOR adults to replace with hatchery mitigation = 107.5

BAMP Method for determining hatchery release size

# NOR adults to replace with hatchery mitigation	108	# NOR adults to replace with hatchery mitigation	108
	÷		÷
In-basin CWT SAR	0.49%	At dam PIT SAR	0.69%
	=		=
Smolt Release Size	21939	Smolt Release Size	15580

For ESA listed populations - the BAMP directs us to in-place/in-kind mitigation to support recovery. We release ESA listed spring Chinook in key tributaries to replace the adults that would have returned in the absence of project related juvenile mortality.

Smolt Release Size based on in-basin SAR	21939	Smolt release size based on at Dam PIT SAR	15580
	=		=
Number of adults back to basin	108	Number of adults back to basin	76
NNI (as if the dams were not there)	**Achieved**	**NNI (as if the dams were not there)**	**Not Achieved**

Data Sources:

Metric	Source
NOR spring Chinook Count @ RIS	2024-2033 recalculation data summary. Prepared by: Chelan PUD, Douglas PUD, Grant PUD. August 2021 (M&E method; years 2011-2020)
RIS juvenile Project Survival	2024-2033 recalculation data summary. Prepared by: Chelan PUD, Douglas PUD, Grant PUD. August 2021
In-basin CWT SAR	Table 5.46 (years 2007-2013) in: Hillman, T., M. Miller, M. Hughes, C. Moran, J. Williams, M. Tonseth, C. Willard, S. Hopkins, J. Caisman, T. Pearsons, and P. Graf. 2020. Monitoring and evaluation of the Chelan and Grant County PUDs hatchery programs: 2019 annual report. Report to the HCP and PRCC Hatchery Committees, Wenatchee and Ephrata, WA.
At dam PIT SAR	Table 9 (years 2007-2013) in: 2024-2033 recalculation data summary. Prepared by: Chelan PUD, Douglas PUD, Grant PUD. August 2021

Attachment C
Hatchery Recalculation Smolt-to-Adult Returns Summary

Calculating Hatchery Compensation

Figure 1 illustrates the basic algebra used to calculate smolt production requirements based on the BAMP methodology and highlights how location-specific adult counts and SARs may be incorporated. Figures 2 and 3 illustrate how the calculation of hatchery smolt production is influenced by the alignment of the location of the SAR estimate and location of adult counts. See Attachment 1 for additional information.

$$\frac{Adults}{SAR}$$

Written another way

$$\frac{Adults\_PR}{1} * \frac{Smolts}{Adults\_PR} = Smolts$$

Do the algebra . . . .cancel out the like terms and solve for smolts

$$\frac{\color{red}{Adults\_PR}}{1} * \frac{Smolts}{\color{red}{Adults\_PR}} = Smolts$$

Figure 1. Algebraic representation of BAMP smolt calculation based on SAR and adult returns

Any location where both an estimate of NOR adults and SARs can be completed can work

$$\frac{Adults\_MET}{1} * \frac{Smolts}{Adults\_MET} = Smolts$$

$$\frac{Adults\_BON}{1} * \frac{Smolts}{Adults\_BON} = Smolts$$

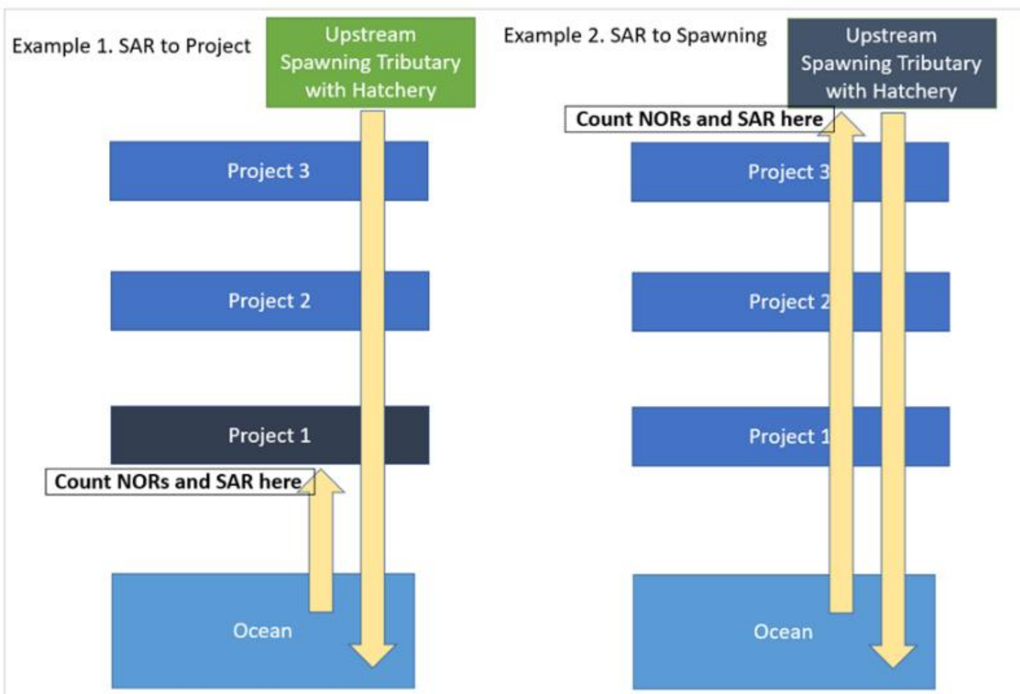

Figure 2. Illustration of proper alignment between SAR and adult return calculation locations

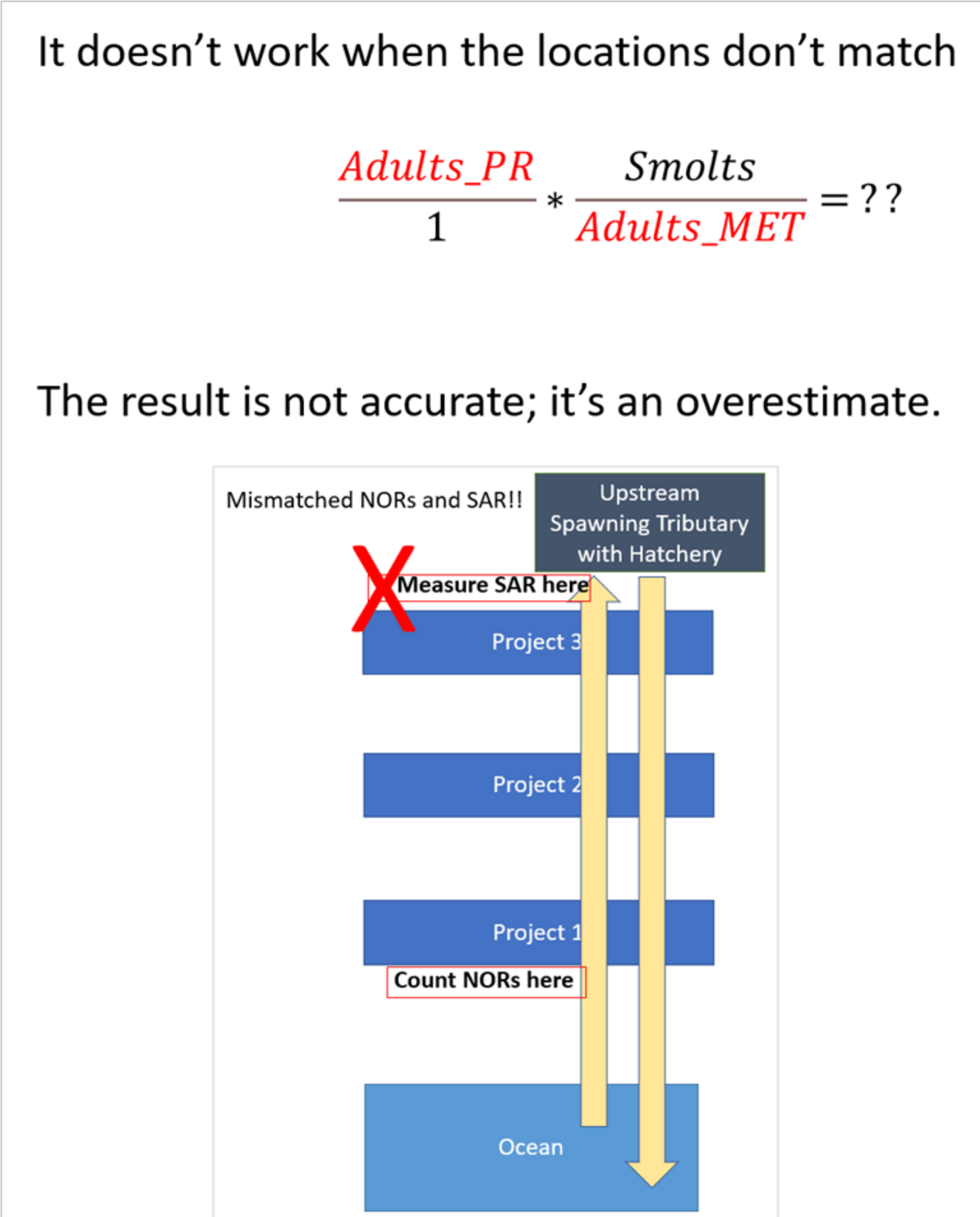

Figure 3. Illustration of decoupled SAR and adult return calculation locations

Comparison of CWT and PIT SARs

CWT SAR

The CWT SAR estimates in the M&E plan reflect the total adult return divided by the number of marked fish released, from a given brood year. The CWT estimates calculated in the M&E reports are based on CWT SAR tag recoveries from three major sources:

1. Harvest (ocean, mainstem Columbia R, others)
2. Spawning grounds (carcass surveys)
3. Broodstock collection

CWT tag data must be actively collected and read. If tags are not collected or read, the SAR is underestimated. Tag recoveries and processing depend on the contributions and collaboration of multiple state, federal, tribal, and other entities and it is impossible to determine whether all of the samples for a given brood year have been processed. The lag between tag collection and data upload varies, but is assumed to be at least 5-years.

Excerpt from p. 16 of Hillman et al. (2021)[1]:

> *Derived data that rely on CWTs (e.g., HRR, SAR, stray rates, etc.) are five or more years behind release information because of the lag time for returning adult fish to enter the fishery and spawning grounds, and the processing of tags.*

The fact that CWT SARs continue to evolve for years after they are reported is one of the reasons why PIT SARs were used during the previous recalculation effort (where PIT data were available). Table 1 was presented in 2011[2] to illustrate how much historic CWT SARs actually changed between the 2007 and 2010 M&E plans as a result of lag times between sample collection, processing, and data uploading. Note that brood years as far back as 1995 were still changing significantly between 2007-2010.

[1] Hillman, T., M. Miller, K. Shelby, M. Hughes, C. Moran, J. Williams, M. Tonseth, C. Willard, S. Hopkins, J. Caisman, T. Pearsons, and P. Graf. 2021. Monitoring and evaluation of the Chelan and Grant County PUDs hatchery programs: 2020 annual report. Report to the HCP and PRCC Hatchery Committees, Wenatchee and Ephrata, WA.

[2] Final Minutes of April 20, 2011 HCP Hatchery Committee Notes

Table 1. Changes in CWT-based SARs as reported in the 2007 and 2010 Chelan PUD M&E Reports.

	Percent Difference					
Broodyear	WEN SUM	MET SUM	OK SUM	TR SUM	WEN SOCK	CHIW SPR
1995	3%	8%	1%	5%	22%	NA
1996	3%	4%	0%	7%	2%	0%
1997	2%	2%	2%	3%	10%	-1%
1998	2%	0%	1%	5%	-33%	2%
1999	1%	0%	2%	4%	29%	NA
2000	15%	18%	12%	70%	38%	1%
2001	45%	50%	54%	64%	NA	11%
2010 vs 2007 change for combined AVG 2000-2001 BY	21%	36%	32%	66%	38%	4%

PIT SAR

A PIT-tag-based SAR provides an estimate of the number of adult returns at a given interrogation location divided by the number of marked fish released, for a given brood year. Because the PIT estimate does not include harvest, it is an underestimate of the total adult return SAR (e.g., Welch et al. 2021[3]).

PIT-tag data are collected passively at detection arrays within fishways at each Project and detection efficiencies are high. PIT-tag detections are also reported on a real time basis. Collectively, this means there is high confidence that the observed SARs at a given Project reflect an accurate census of the tags passing the dam. Compared to CWT data, PIT-tag reporting has no lag time and the completeness of results for a given brood year is not dependent on multiple entities contributing information.

PIT data is well suited for hatchery recalculation because it allows for SAR estimates to be calculated to individual projects and allows for compensation calculations to be aligned with unavoidable project mortality at the same project. PIT-SARs were used previously in hatchery recalculation efforts although data were limited by the number of programs/stocks that had PIT tagging programs. The PUDs have subsequently increased the number of PIT tags deployed to support hatchery M&E efforts.

Summary

- CWT SARs in M&E reports include reported harvest and recovered strays and approximate total returns (not tributary returns)
- CWT SARs take years to “mature” and there is no way to tell if all of the samples from a brood year have been included in an SAR estimate
- PIT-tag SARs reflect near-census level accounting of tags and detections are reported immediately

[3] Welch, D.W., Porter, A.D. and Rechisky, E.L., 2021. A synthesis of the coast-wide decline in survival of West Coast Chinook Salmon (Oncorhynchus tshawytscha, Salmonidae). Fish and Fisheries, 22(1), pp.194-211.

- PIT SARs do not include harvest, but are congruent with project-specific compensation calculations because of PIT-tag detection at each project
- PIT SARs were used previously for hatchery recalculation

PIT and CWT SAR Bias

Both types of tags are routinely used in M&E analyses related to PUD hatchery programs. However, it has been suggested within the HC that PIT tagged fish are not representative of the hatchery populations from which they are tagged because of biases associated with the size of fish selected for tagging and the comparatively small number of fish that are PIT tagged (relative to the number that are CWT tagged). With respect to size bias, PIT tagging does not occur until fish are grown to a size suitable for tagging to ensure that a representative sample can be taken. To date, no data have been presented to demonstrate that the size of fish PIT-tagged is not representative of the PUD hatchery populations. With respect to tag numbers, all mark-recapture studies are based on the concept that a representative sample can be used to make inferences about a population. The fact that most dams have very high detection probabilities means that a smaller sample size of PIT tags can provide reasonable population information for returning adults. In short, the mark-recapture framework for PIT tag SARs is based on a relatively small number of tags deployed but extremely high recapture probability. This contrasts with CWTs that have an extremely low probability of detection/recovery and therefore require extremely large numbers of marked fish to develop population information for returning adults. For CWTs, even 100% marking does not mean that population information collected from tags is unbiased. The Expert Panel on the Future of the Coded Wire Tag Recovery Program for Pacific Salmon (Hankin et al., 2005[4]) provided a comprehensive analysis of how CWT data results can be biased:

> *Especially serious issues that generate unknown bias include incomplete, inconsistent or nonexistent sampling programs for estimation of freshwater escapement (especially non-hatchery, stray escapement) and freshwater sport fishery catches of CWT fish. Finally, in some areas the numbers of unreported commercial catches are increasing but these catches may not be sampled at all, thus creating many nonresponse strata and generating negative bias in estimates of catches from CWT release groups. Analysts of CWT data have become progressively more aware and more concerned about these problems, but these issues did not reach crisis levels until the mid-late 1990s.*
>
> *Unbiased estimation of tagged fish harvested or in escapement and estimation of exploitation rates requires that several basic assumptions be met, including:*
>
> > *1. Sampling in each stratum is random or representative.*
> > *2. The total harvest or escapement is known or estimated with no bias.*
> > *3. All fishery strata and all locations of escapement (hatcheries, spawning grounds) are sampled.*
> > *4. All tagged fish in the sample are correctly identified.*
>
> *The basic design for the CWT sampling program is a stratified sampling design. Fisheries are stratified by type and, within each fishery type, individual strata are sampled by week, month or*

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[4] Hankin, D. G., Clark, J. H., Deriso, R. B., Garza, J. C., Morishima, G. S., Riddell, B. E., & Scott, J. B. (2005). Report of the expert panel on the future of the coded wire tag recovery program for Pacific salmon. Pacific Salmon Commission. Retrieved from https://www.psc.org/publications/workshop-reports/coded-wire-tag-program-review/

year. The definition of the spatial-time strata for sampling is determined by the conduct of the fisheries. The intent is that any fishery that exploits tagged salmon will be sampled at a known rate for CWTs. In addition, the sampling design calls for selection of samples from all escapement locations, including hatcheries and natural spawning grounds.

<u>In practice, many of the basic assumptions (see Alexandersdottir et al. 2004) underlying use of CWT recovery data may often not be met</u>

CWT tags are the only source of harvest data for hatchery programs, and they help identify the contribution of hatchery fish to spawning escapements and broodstock collections. However, the premise that CWT data is bias-free or less biased than PIT data is incorrect.

Given that PIT tags have been used in the PUD hatchery programs for over two decades with oversight by the HC; PIT tags were used previously in hatchery recalculation efforts; and PIT tags are used by virtually every State, Federal and Tribal entity for calculating SARs and other M&E analyses, it is unclear why they would not be reasonably considered for the SAR calculations in the current hatchery recalculation effort. In short, the assertion that PIT tagged hatchery fish are somehow not representative of hatchery populations and therefore result in inflated SARs compared to CWT data is not supported by available science or the myriad of fisheries managers that routinely use PIT-tag data. It is more likely that PIT-tag data underestimate SARs when PIT- and CWT-based SARs are calculated at the same return location (AA/NOAA Biop RM&E Workgroup, 2013)[5]:

Some recent studies suggest that absolute values of SAR derived from PIT-tagged fish may be biased low, compared to the general untagged population (Knudsen et al. 2009; Copeland and Johnson 2007; Williams et al. 2005). Knudsen et al. (2009) implanted juvenile hatchery spring Chinook salmon in the upper Yakima River with PIT- and coded wire (in snout) tags in a double tag study. The purpose was to test the assumptions that PIT tags do not fail, are not expelled, or negatively affect survival, behavior, or growth after release through the returning adult stage. They found that on average tag loss was 2.0% in juveniles prior to release, and 18.4% for fish returning 6 months to 4 years after release. Their analyses indicate that the majority of PIT tag loss had occurred within the first 6 months post-release. Smolt-to-adult survival (SAR) of PIT tagged fish was significantly lower than that of non-PIT-tagged (NPT) fish. On average, the SARs estimate based on PIT-tagged fish underestimated the corresponding SARs estimated using CWT fish by 25.0%. After correcting for tag loss, they estimated that over all study years PIT tag-induced effects averaged 10.3%, with a maximum of 33.3% estimated. Results from this study are generally consistent with two other investigations that reported anadromous salmonids PIT-tagged as juveniles return at lower rates than non-tagged counterparts (Williams et al. 2005; Copeland and Johnson 2007).

Proposed PIT + CWT Project SAR

Recognizing that 1) CWT-based SARs are lagged, potentially incomplete, and can't be calculated to an individual project, and 2) PIT-tag-based SARs do not account for harvest, neither method is perfect for estimating project specific or total return SARs. Using both data sources provides a more complete estimate of actual returns and SARs that are relevant for recalculation. More specifically, determining

[5] AA/NOAA BiOp RM&E Workgroup. 2013. The Status & Needs of the Columbia Basin PIT Tag Information System as Related to FCRPS BiOp RME Requirements. April 4, 2013

the actual returns and SARs from a given hatchery brood year can be conservatively estimated by adding harvest components from CWT data (only harvest downstream of a Project) to Project-specific PIT-detection data.

The use of PIT-tag data in the calculation of hatchery SARs is aligned with the BAMP recalculation methodology because adult return data for which the production obligation is calculated uses the same control point as the calculated hatchery SAR. For this reason, PIT tag SARs were used in the previous recalculation effort. Similarly, harvest is an important component of hatchery returns and at least a portion of the harvest data can be obtained from CWT data sources. CWT harvest data were also included in the previous hatchery recalculation effort for those programs that used CWT SARs. In short, both CWT and PIT-tag data were used in the previous recalculation efforts and the availability of new PIT data from additional programs allows for more complete SAR estimates.

The combination of data from both sources to estimate an SAR is conservative because 1) CWT data including harvest data may not be complete for a given brood year, and 2) PIT SARs are likely biased low. If the CWT harvest data are only taken from fisheries downstream of the Projects, there is no clear bias that would inflate SARs. Figures A4 and A5 (Attachment 1) illustrate the proposed calculation approach and document compliance with the HCPs' NNI requirements.

It should be noted that the use of combined PIT and CWT data are only possible where both data sets exist. For steelhead, SAR estimates are not supported by CWT data.

HCP Compensation Based on Project Effects

The HCPs are intended to recover listed species and compensate for Unavoidable Project Mortality. The HCPs are an ESA Section 10 Permit, so hatchery production, particularly in the context of ESA listed species such as spring Chinook Salmon and steelhead, is required to benefit Plan species and secondarily support other objectives:

> *8.1.2 The District shall implement the specific elements of the hatchery program consistent with overall objectives of rebuilding natural populations and achieving NNI. Species specific hatchery programs objectives developed by the JFP may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.*(Excerpt from RI HCP)

The HCP definition of NNI is:

> *NNI consists of two components: (1) 91% Combined Adult and Juvenile Project Survival achieved by project improvement Measures implemented within the geographic area of the Project, (2) 9% compensation for Unavoidable Project Mortality provided through hatchery and tributary programs, with 7% compensation provided through hatchery programs and 2% compensation provided through tributary programs.* (Excerpt from RI HCP)

Other interpretations of NNI (e.g., "as if the dams were not there"; Figure A1 in Attachment 1) do not represent any survival or compensation commitments outside of the actual HCP NNI definition.

To achieve NNI, the specific Plan Species survival requirements focus on Combined Adult and Juvenile Project Survival. Combined Adult and Juvenile Project Survival is defined as follows:

"Combined Adult and Juvenile Project Survival" means that 91% of each Plan Species (juvenile and adult combined) survive ***Project effects when migrating through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect, and delayed mortality wherever it may occur and can be measured (as it relates to the Project)*** *given the available mark-recapture technology.* (Excerpt from RI HCP)

This definition identifies the Project boundaries where effects occur (i.e., Project's reservoir, Forebay, Dam and Tailrace) and notes that effects outside of the Project may only be considered if measured and related to the Project. There is no requirement within the HCPs to meet survival standards for non-Project effects or to meet an undefined "back to basin" survival target (Figure A1 in Attachment 1) that incorporates non-Project effects. To date, Project effects related to adult and juvenile survival have been measured through juvenile Project survival studies and adult passage studies and the PUDs have provided compensation for these effects to meet NNI. Project effects outside of those addressed by adult passage and juvenile passage studies have not been identified or measured.

The HCP hatchery compensation obligations are based on addressing Unavoidable Project Mortality. Unavoidable Project Mortality is defined as follows:

"Unavoidable Project Mortality" refers to the assumed 9% mortality caused by the ***Project*** *to Plan Species that is compensated through the tributary and hatchery programs.* (Excerpt from RI HCP)

The compensation requirements for Unavoidable Project Mortality are limited to mortality caused by the Project. There is no provision in the HCPs for compensating for non-Project impacts (e.g., undocumented harvest, catch-and-release mortality, predation, poor tributary habitat conditions, etc.).

This distinction is important because moving the adult return SAR calculation location outside of the project boundary to include non-Project effects on adults would require the PUDs to compensate for non-Project mortality not contemplated or covered by the HCPs (Figure A1, Attachment 1). Existing adult passage data indicate that adult Project survival is above the 98% target identified in the HCPs and would be higher if not confounded by harvest impacts. As examples, adult passage data can be easily acquired through PTAGIS or DART and conversion rates are above 99% per project for spring Chinook and steelhead (without adjusting for harvest) between Priest Rapids and Wells hydroelectric projects (Table 2; note that Sockeye and Summer Chinook are not included because they are routinely harvested and reach-specific harvest data is not available to correct conversion estimates). Assigning adult tributary mortality to Project effects would minimally require a plausible linkage between the two and data to support the presence of an effect. Given the extremely high conversion rates between projects, no such linkage has been demonstrated or even proposed.

Table 2. PIT-tag based conversion rates for hatchery and wild spring Chinook and Steelhead between Priest Rapids and Wells hydroelectric projects.

Year	Priest Rapids to Wells Conversion Rate Spring Chinook (Hatchery and Wild)	N PRD	N Wells		Priest Rapids to Wells Conversion Rate Steelhead (Hatchery and Wild)	N PRD	N Wells
2011[1]	99.2%	239	237		97.9%	387	379
2012[1]	95.9%	98	94		98.7%	379	374
2013[1]	96.0%	126	121		97.1%	312	303
2014[1,2]	97.2%	285	277		97.0%	363	352
2015[1]	100.0%	219	219		97.2%	362	352
2016[1]	99.1%	108	107		92.5%	147	136
2017	98.1%	106	104		96.5%	173	167
2018	98.4%	128	126		97.5%	81	79
2019	97.3%	147	143		95.6%	68	65
2020	97.8%	91	89		99.3%	141	140
Average (combined projects)	97.9%				96.9%		
Average (per project)[3]	99.5%				99.2%		

Notes:

1. Steelhead harvest occurred however conversion rate has not been corrected for harvest removals
2. Wanapum Dam repairs occurred
3. Average Combined Projects^(1/4)

Because adult passage studies based on PIT-tag data have been used and approved to demonstrate compliance with the HCP 98% adult survival requirement and currently available passage data indicate 99% or better adult Project survival, requiring the PUDs to provide compensation for adult tributary mortality is not only inconsistent with the HCPs, but not supported by available data. Even if there was a plausible hypothesis to refute the observed survival data, compensation for adult survival would be covered by the PUD's funding commitment to the Tributary Fund (i.e., not hatchery compensation) until the hypothesis was tested empirically:

> *Prior to the completion of adult survival studies, compensation for adult mortality shall be assumed completely fulfilled by the District's contribution to the Tributary Fund.* (Excerpt from Rock Island HCP)

It should also be noted that non-Project tributary mortality may be substantial and reduce the SAR estimate. Calculating hatchery compensation using a lowered tributary SAR coupled with adult returns from a non-tributary location (i.e., Project estimate) would inflate the estimate by including 1) non-project mortality and 2) misaligning the SAR calculation and adult return locations. Figures A1-A3 (Attachment 1) illustrate these impacts and explain why this approach is neither consistent with the HCPs nor appropriate for calculating hatchery compensation for Project effects.

Attachment 1-Review of Hatchery Compensation Calculations

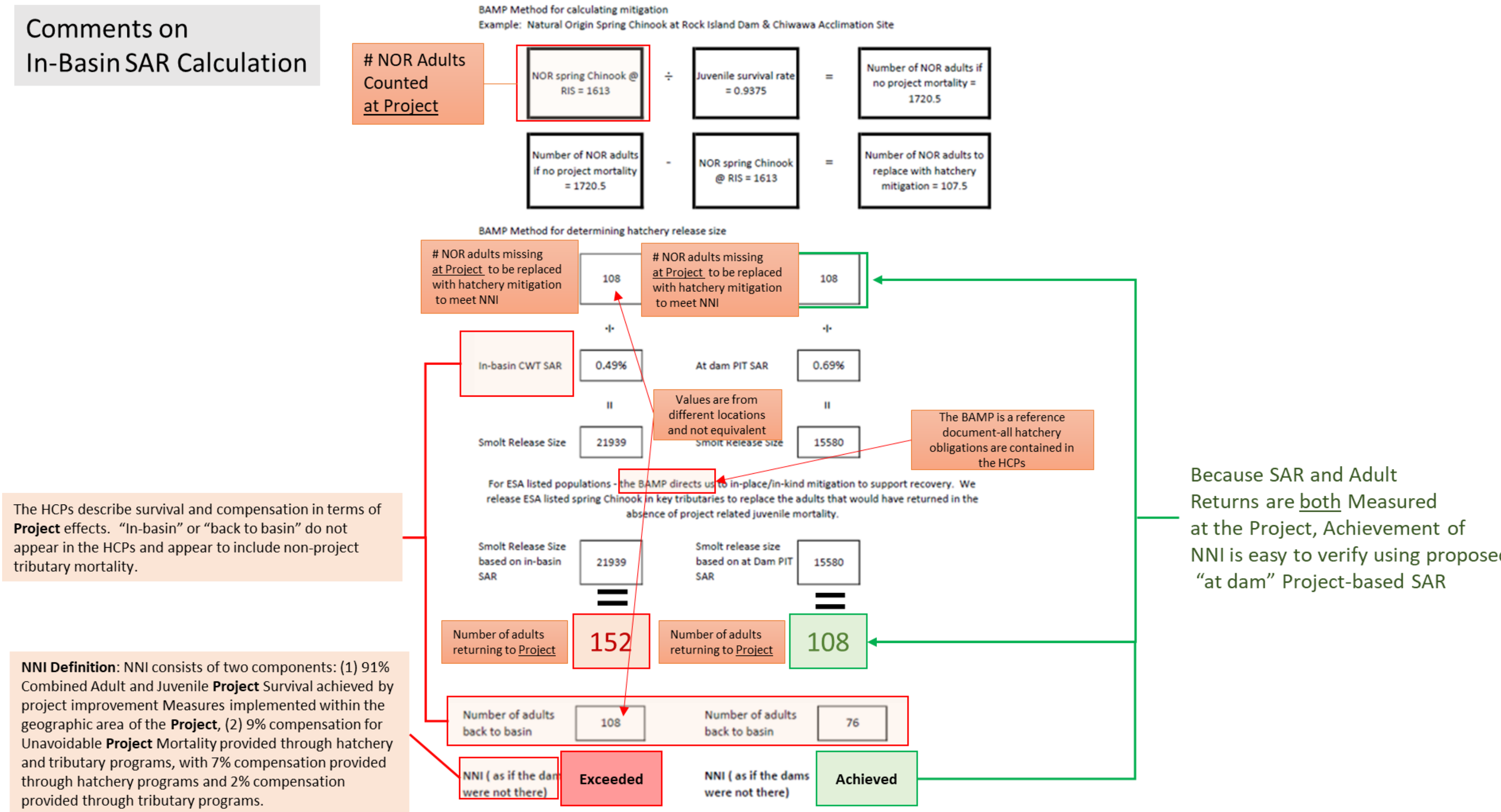

Figure A1. Comments on "In-Basin CWT SAR" proposal

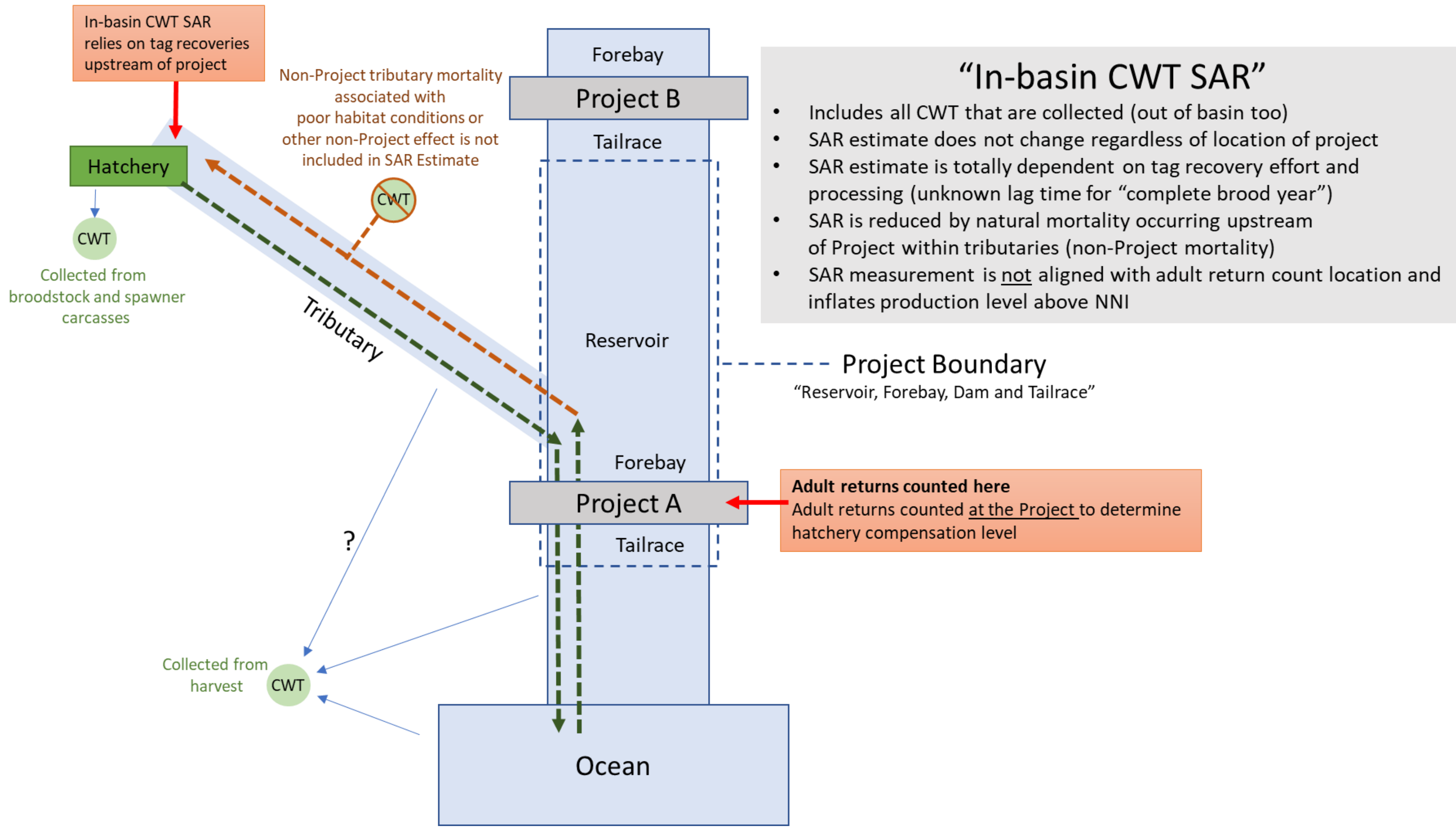

Figure A2. Conceptual illustration of "In-basin CWT SAR" attributes highlighting the inclusion of non-Project mortality in SAR and misalignment of SAR calculation location and adult return count location.

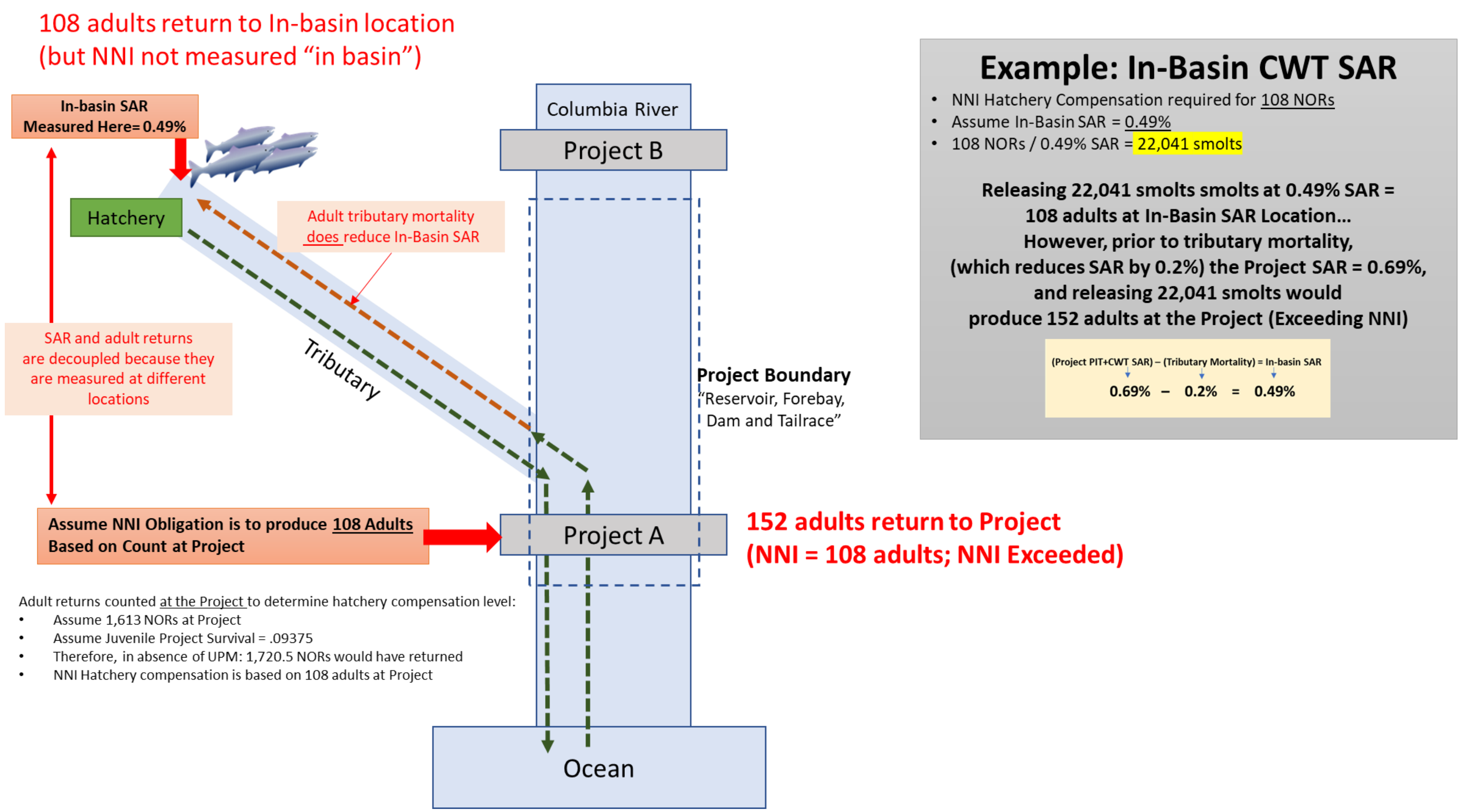

Figure A3. Example calculation of hatchery compensation using "In-basin CWT SAR" illustrating how 1) decoupling the SAR calculation location and adult return count location compounds the effect of SAR reduction from non-Project mortality, and 2) results in hatchery production in excess of NNI obligation.

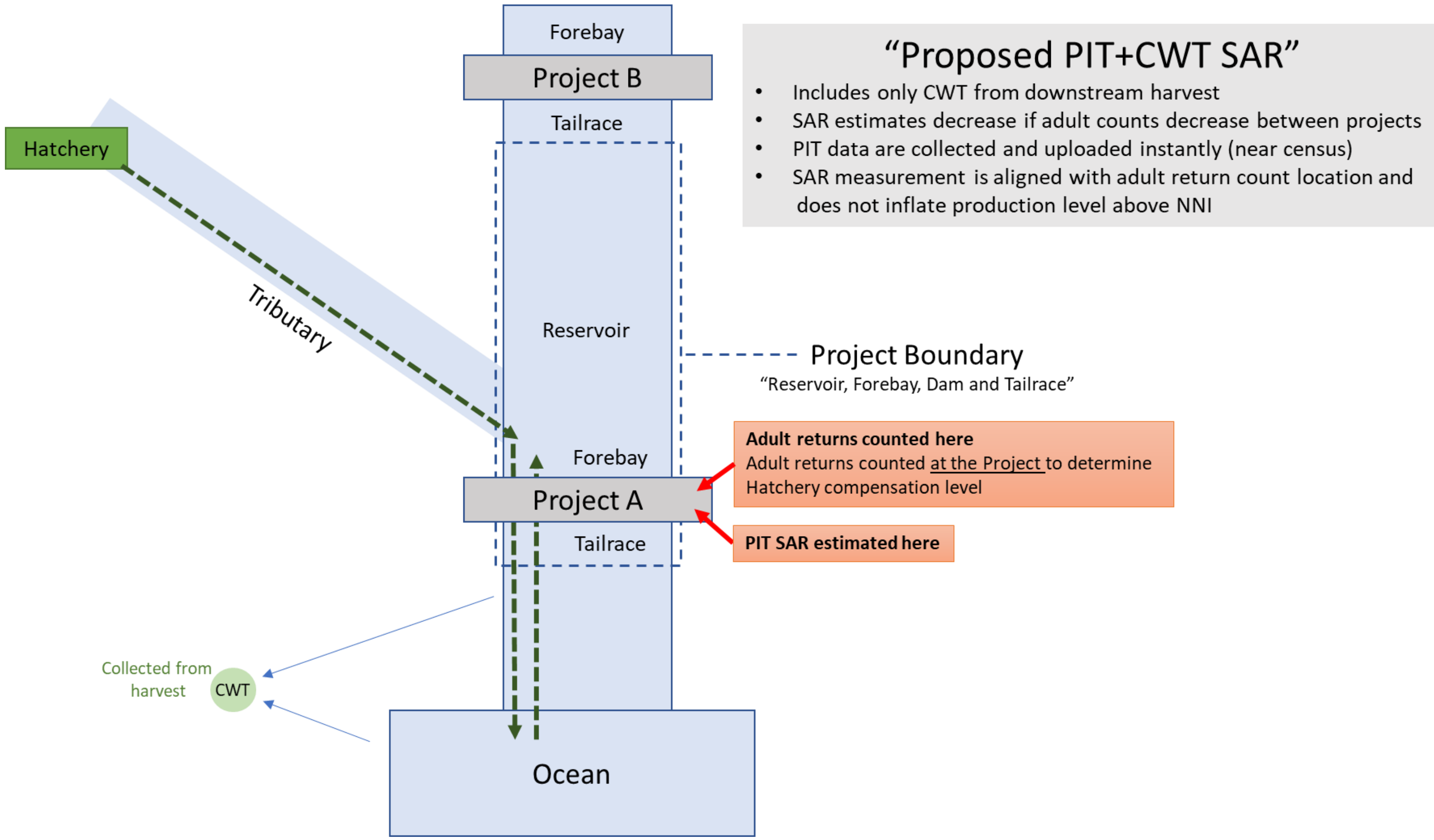

Figure A4. Conceptual illustration of proposed PIT+CWT SAR attributes highlighting the alignment of SAR calculation location and adult return count location.

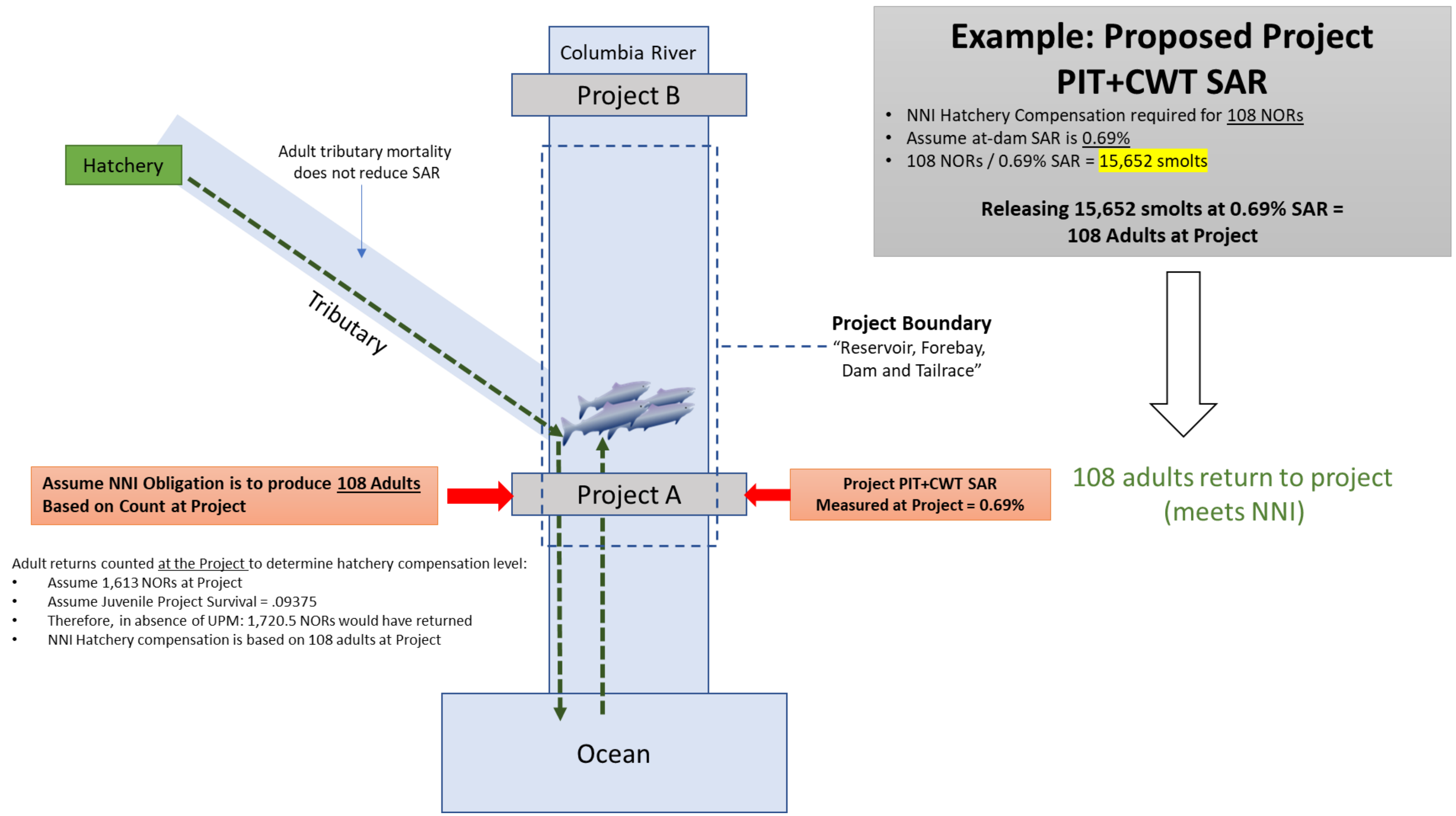

Figure A5. Example calculation of hatchery compensation using proposed PIT+CWT SAR illustrating 1) alignment of SAR calculation location and adult return count location, and 2) compliance with NNI production obligations.