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for the Northwest Power and Conservation Council
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2019 Step Review of the Hood River Production Program

Review of the *Addendum to the 2008 Revised Master Plan for the Hood River Production Program* (HRPP) produced by the Confederated Tribes of Warm Springs (CTWS) and Oregon Department of Fisheries and Wildlife (ODFW)

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Background

In response to the Northwest Power and Conservation Council's June 20, 2019 request, the Independent Scientific Review Panel (ISRP) reviewed the *Addendum to the 2008 Revised Master Plan for the Hood River Production Program* (HRPP) produced by the Confederated Tribes of Warm Springs (CTWS) and Oregon Department of Fisheries and Wildlife (ODFW). The HRPP consists of improvements to supplementation, research, monitoring, evaluation, and habitat. The following six projects are associated with HRPP implementation:

- Project #1988-053-03, Hood River Production Monitoring and Evaluation (M&E)-Warm Springs (CTWS)
- Project #1988-053-04, Hood River Production Monitor and Evaluation (M&E)-Oregon Department of Fish and Wildlife (ODFW)
- Project #1988-053-07, Hood River Production Operations and Maintenance (O&M)-Warm Springs (CTWS)
- Project #1988-053-08, Hood River Production Operations and Maintenance (O&M) and Powerdale (ODFW)
- Project #1988-053-15, Hood River Artificial Production-Parkdale (CTWS)
- Project #1998-021-00, Hood River Fish Habitat (CTWS)

The addendum and supporting material were submitted to meet the Council's request to provide additional information based on the ISRP's Step Review of the 2008 Revised Master Plan (ISRP 2008-10). The ISRP found the 2008 Revised Master Plan *Meets Scientific Review Criteria - In Part (Qualified)* and recommended that the co-managers revise and update the Master Plan based on the qualifications and comments in the review. On October 15, 2008, the Council approved the Revised Master Plan, recommended that the Phase 1 activities associated with the comparative release evaluation and fish trapping facilities proceed, and called on the proponents to develop additional information to address the issues raised by the ISRP, including updating the Master Plan for final review in 2013 (Council decision letter and decision memo).

For the past 11 years, the HRPP has proceeded with Phase 1 activities. The Addendum focuses on key program changes since the approval of the Revised 2008 Master Plan, and on how the Council's and ISRP's issues from 2008 have been addressed. For this review, the CTWS and ODFW are requesting to increase spring Chinook production from 150,000 to 250,000 yearling smolts, but no changes are being proposed to the winter steelhead hatchery program. In addition, the document provides updates to the program goals and objectives (Section 2), facilities (Section 3), and monitoring and evaluation plan (Section 4), and summarizes program costs (Section 5). Responses to the ISRP's 2008 comments are provided in Appendix A of the

Addendum and are excerpted and addressed point-by-point in the ISRP's review below. There are just over 20 issues.

The ISRP's 2008 review stated that the revised master plan was "*an impressive step forward in concept, decision-logic, organization, and scientific justification.*" However, the ISRP recommended "*Qualified*" because of concerns about "*1) using acclimation ponds to volitionally release steelhead in the mid/upper watershed where released fish can residualize; 2) using hatchery-origin adults for broodstock when natural fish are low in abundance, and; 3) insufficient justification for assessment methods for the monitoring component.*"

The ISRP recommended "*In Part*" because, although the facility improvements for the proposed spring Chinook rearing experiment were justified, the construction of six production ponds at Moving Falls could not be scientifically justified until the experiment was complete; the six ponds were not needed for the experiment but were proposed for program implementation. In addition, the ISRP (2008-10) recommended that the proponents update the Step One Revised Master Plan for the Hood River Production Program before proceeding to Step Two, and specifically recommended:

1. *Adding a section in Chapter 3: Proposed Production Alternatives on winter steelhead production alternatives that evaluates the effect broodstock collections have on winter steelhead population dynamics and also evaluates the acclimation versus direct release of winter steelhead smolts relative to residualization, subsequent harvest opportunities, and excess spawning abundance of hatchery-origin winter steelhead.*
2. *Further development of Chapter 4: Proposed Trapping and Collection Alternatives to document the level of trapping and enumeration of both adults and smolts required to provide statistical power to adequately assess the program, and consider additional electronic counting that may be valuable in this subbasin.*
3. *In Chapter 5: Hood River Habitat Improvements consider in more detail passive habitat improvement actions and strategies beyond adding large woody debris to the system.*
4. *Develop in Chapter 6: Hood River Production Program Monitoring and Evaluation an assessment and evaluation for the habitat enhancements proposed in Chapter 5.*

Review Documents

The ISRP considered the following documents in this review:

- *Cover email* dated June 4, 2019:
- *Transmittal Letter* dated May 16, 2019
- *Addendum to the 2008 revised Master Plan for the Hood River Production Program, Volume I*
- *Appendices A – E to the 2008 revised Master Plan for the Hood River Production Program, Volume II*:

- *Appendix A, Responses to ISRP Comments* – responses of key text related to specific items from ISRP document 2008-10
- *Appendix B, Hood River Production Program Revised 2008 Master Plan*
- *Appendix C, Hood River Winter Steelhead HGMP (2017)*
- *Appendix D, Hood River Spring Chinook HGMP (2017)*
- *Appendix E, Hood River Watershed Action Plan (2014)*

Definition of Terms from Hatchery Scientific Review Group (HSRG)[1]

- **HOR** refers to a fish of hatchery origin. When used as a variable, it is the total number of hatchery origin recruits from a hatchery program (i.e., the sum of hatchery origin spawners [HOS], hatchery origin broodstock [HOB], and hatchery origin fish intercepted in fisheries).
- **NOR** refers to a fish of natural origin (i.e., a product of natural spawning). When used as a variable, it is the total number of natural origin recruits from a population (i.e., the sum of natural origin spawners [NOS], natural origin broodstock [NOB], and natural origin fish intercepted in fisheries).
- **pHOS** refers to the mean proportion of natural spawners in a watershed or stream composed of hatchery origin adults each year.
- **pNOB** refers to the mean proportion of a hatchery broodstock composed of natural origin adults each year.
- **PNI** is the Proportionate Natural Influence on a composite population (i.e., comprising both HOR and NOR). PNI is calculated as pNOB/(pNOB + pHOS) and represents approximately the average proportion of time that genes in the composite population spend in the natural environment.

[1] ISRP members Steve Schroder and Greg Ruggerone were recently appointed as unaffiliated members of the HSRG, for which their role is to provide impartial, independent advice. They have not yet completed any reviews for the HSRG and were not involved in creating the HSRG guidelines or applying the guidelines to the HRPP.

ISRP Recommendation

Meets Scientific Review Criteria (Qualified)

The Addendum to the Hood River Production Master Plan is well written and adequately addresses many of the qualifications from the 2008 ISRP review. It includes revised objectives for both the winter steelhead and spring Chinook integrated hatchery programs, All-H Analyzer (AHA) model simulations to justify proposed levels of release and harvest, and a broodstock management plan for winter steelhead. The proponents are making good progress in developing alternative approaches to enumerate smolts and adults following the removal of the Powerdale Dam and its associated infrastructure. They are addressing genetic and ecological risks associated with precocious maturation and residualization of hatchery fish. We commend them for their prudent application of the HSRG guidelines and their thorough responses to our questions.

The following qualifications should be addressed in the next iteration of the Step Review. We also provide some specific comments, queries, and editorial suggestions to be considered as the program proceeds.

Qualifications:

Winter steelhead program

1. Justify the goals and quantitative metrics for the winter steelhead program. The long-term viability of this primary population of the ESA-listed Lower Columbia River Steelhead could be undermined by indefinitely continuing hatchery supplementation to achieve an unrealistic target. Hatchery supplementation to provide opportunities for selective in-basin harvest can also promote the recovery of the natural population only so long as the natural population is being boosted to levels that are self-sustaining without supplementation. The ISRP is concerned that the escapement target of 1,100 natural origin winter steelhead is too high given existing habitat capacity in the Hood River. The recent 5-year average escapement of 1,041 natural spawners included 43.7% hatchery origin fish that had escaped the fishery and traps. Continuing hatchery supplementation above the existing self-sustaining level is likely to reduce long-term fitness in the natural environment, unless habitat restoration efforts succeed in creating conditions that will support a larger self-sustaining population in the future. Accordingly, the proponents need to:

   a) Revise (or justify) the escapement target of 1,100 natural origin winter steelhead by providing statistical analyses or statistical models based on all available data related to current productivity and carrying capacity (i.e., density dependence). The AHA analysis presented in Table 13 suggests that the self-sustaining population under current conditions is < 400 natural origin spawners.

   b) Monitor the abundance of natural origin smolts and total smolts to estimate freshwater productivity (i.e., smolts-per-natural spawner). Is it feasible to restart the smolt enumeration program that was terminated after 2014? If the program was terminated because of uncertainty distinguishing summer and winter steelhead smolts, consider contacting the CRITFC Hagerman Lab about the feasibility of using genetic analysis (see qualification 6).

c) Estimate the maximum self-sustaining population under planned future conditions based on evidence of successful habitat restoration efforts in the Hood River subbasin.

d) Describe how habitat restoration efforts in the Hood River subbasin are being evaluated and indicate if reference streams are being used. Evaluation of fish responses to habitat restoration actions typically requires reference streams for use in Multiple Before After Control Impact (MBACI) designs (when habitat improvements are large and sudden) or Stair Case Designs (when habitat improvements are added incrementally over time).

e) Revise the AHA modeling tables as appropriate if values change as a result of new analyses of capacity and productivity, including the winter steelhead escapement target.

2. Provide quantitative decision rules that specify the conditions and time frames that would trigger changes to hatchery supplementation of winter steelhead (including reduction or termination). Examples might be a continuing decline in natural origin returns that reduces pNOB to below a specified threshold or a continuing increase in natural spawners (both HOS and NOS) to densities that cannot be sustained by existing habitat.

3. Improve monitoring and evaluation methods to meet NOAA criteria for the precision of escapement estimates (i.e., CV < 15%) for natural and hatchery origin winter steelhead.

4. Provide estimates of all hatchery steelhead removed each year including those harvested by anglers and those removed in all traps, ladders, and weirs in the subbasin. This information is critical to documenting program success and evaluating the overall harvest goals. Describe how the harvest of winter steelhead will be monitored in the future given the lack of funding to support the harvest survey in 2019. Will the East Fork Irrigation District ladder and adult trap be operated every year as a means to remove hatchery fish (in addition to obtaining hatchery broodstock)?

5. Reconsider the decision not to release some hatchery steelhead smolts in the lower river. Releasing a portion of the smolts in the lower river would make it easier to achieve the harvest goal (i.e., average annual harvest of 876 adults), which requires selectively catching 67% of hatchery origin fish in the terminal fishery. Describe what steps will be taken to increase the terminal harvest rate by improving angler access and how these actions will be evaluated.

6. Examine the feasibility of conducting genetic analyses of tissue samples from smolts collected in the rotary screw traps (RST) to:

   a) distinguish summer and winter steelhead smolts to determine their relative abundance (see qualification 1b); and

b) monitor the extent of hybridization between residual steelhead and cutthroat trout (see Christie et al. 2011).

Spring Chinook program:

7. Develop a quantitative objective for harvests associated with the proposed increase in hatchery production of spring Chinook salmon, and provide background information and decision criteria to justify the increase.
8. Evaluate options and propose a plan to estimate the annual smolt production and parental spawning abundance of natural origin spring Chinook in the Hood River subbasin. To date, natural origin spawning abundance has been estimated in only one year (2016). A primary objective should be to analyze density effects on productivity (e.g., the decline in smolts-per-spawner with increasing spawning abundance) to develop more explicit goals for terminal harvests and escapements. We urge the proponents to determine the relationship between river conditions (e.g., discharge and water height) and trapping efficiency for each RST, and to use that relationship to refine estimates of smolt production from trap catch data.
9. Develop a plan to monitor hatchery origin Chinook returns and to reduce pHOS when total spawner abundance approaches the capacity of the watershed to support both natural origin and hatchery origin Chinook.
10. Compare straying rates of adult spring Chinook with different rearing histories. Some fish are incubated, reared, and released entirely within the Hood River subbasin, whereas others are incubated and reared in the Deschutes River subbasin prior to being acclimated and released back into the Hood River subbasin. The ISRP is concerned that in years of low harvest rate, straying of Hood River hatchery origin Chinook may adversely affect other natural populations in neighboring watersheds.
11. Review existing studies and/or conduct new research to evaluate the risk that the productivity of natural origin winter steelhead or other non-target native fishes might be adversely affected by increasing hatchery releases of spring Chinook smolts from 150,000 to 250,000 annually. Previous work in the Yakima River by McMichael and Pearsons (1998), Temple and Pearsons (2012), and Fast et al. (2015) suggests that hatchery supplementation of spring Chinook generally had no detectable effects on resident rainbow trout and other native fish species. However, Pearsons and Temple (2010) did find reductions in rainbow trout abundance and biomass in one Yakima River tributary that might have been linked to the continuing annual release of hatchery spring Chinook juveniles. Consequently, we suggest that the proponents consider assessing possible impacts of continuing annual releases of hatchery origin spring Chinook on the abundance and growth of Hood River steelhead.

Specific comments and suggestions

- Correct (or explain) apparent errors in the PNI calculations in Tables 11, 13 and 15.
- Provide more detail (or a reference) to justify the decision rule that allows no more than 25% of the natural population to be removed for hatchery broodstock. The ISRP remains unconvinced that the 25% threshold is optimal for protecting the natural population if it decreases PNI by triggering the use of hatchery origin or out-of-basin broodstock. It is unclear if this decision rule is specified in ODFW and/or NOAA policy or was developed by the proponents and approved by these agencies. In any case, the decision rule highlights a conflict between the conservation and harvest goals for the program. An alternative approach would be to focus on maintaining a high PNI value by reducing the total number of broodstock used and smolts produced as circumstances dictate.
- How long are juvenile winter steelhead held prior to volitional release under the new acclimation protocol? Have straying rates increased or decreased following changes to the protocol? Would it be advantageous to create more natural settings for smolt rearing and acclimation? The Yakama Nation and Nez Perce Tribe are currently rearing Chinook in quasi-natural hatchery environments featuring underwater feeders, floating covers, painted walls, and in some cases natural substrates and in-water structures. The proponents may wish to consider two relevant publications (Maynard et al. 2001, Fast et al. 2008) and consult Charlie Strom (Yakama Nation, Cle Elum hatchery manager) and Billy Arnsberg (Nez Perce Tribe) for more details regarding this possibility.
- Are the proponents removing fish that remain in the acclimation pond after most fish have emigrated? Is it feasible to recapture and remove steelhead that residualize in the river following volitional release in order to reduce their potential interactions with native salmonids?
- Population estimates from mark-recapture analysis involving the CJS model benefit from sequential detections of the same marked fish through the migration corridor. We recommend that the proponents contact researchers involved with BPA projects 1982-013-01 (New Marking and Monitoring Technologies) and 1993-029-00 (Survival estimate for passage through Snake and Columbia River Dams and reservoirs) who are developing, implementing, and evaluating new methods to detect PIT-tagged fish in large rivers. The experience and equipment they have developed may be useful for improving detections at the mouth of the Hood River and elsewhere in the subbasin.
- The proponents have made reasonable assumptions about the abundance, harvest rates, and apparent survival of the program's winter steelhead in the ocean, the estuary, and Zone 6. However, they should consider possible opportunities to validate or refine these initial assumptions using additional data from three continuing BPA projects. CRITFC staff use genetic analyses of tissue samples to estimate the abundance of salmonid stocks passing Bonneville Dam and stock-specific harvest rates in Zone 6 and elsewhere (Project 2008-907-00 Genetic Assessment of Columbia River Stocks). They also estimate stray rates and provide mortality estimates on adult salmonids as they move upstream in the mainstem (Project 2008-518-00 Upstream Migration Timing). Finally, project 2008-502-00 (Expanded

Tribal Catch Sampling) documents tribal harvest by species using PIT-tag recoveries of fish caught in Zone 6.

- The adaptive management process should include quantitative objectives with timelines, robust monitoring of performance metrics, and regular evaluation to assess progress toward achieving the objectives. The proponents should explain how the adaptive management process will enable review and refinement of specific monitoring methods, for example, how smolt and adult abundances are estimated, or how in-hatchery performance is measured. Will the adaptive management process address the challenge of meeting NMFS monitoring criteria for the precision of spawner abundance estimates?
- Why were SAR estimates for wild winter steelhead consistently and substantially lower for the method based on tag detections at Bonneville Dam than for the method based on total smolt and adult return enumerations for the three years when both methods were used (smolt migration years 2005-2007, Table 2.2.2 in Appendix D)?
- The proponents provide a good summary of habitat restoration activities, but more analysis is needed to support the conclusion that "*the distinct increase in wild winter steelhead smolt production in recent years (Table 4) clearly corresponds to the removal of Powerdale Dam in 2010"* and to support the interesting discussion that *"However, the mechanisms are somewhat in question as Powerdale dam was not generating or diverting water for several years before its actual removal, and thus was not expected to have a large impact on downstream juvenile survival (it was a low head dam with negligible reservoir). Eliminating adult migration delay, and handling and sorting at the Powerdale trap, may have provided the largest benefit for steelhead production.*" Evaluation of the extent to which the productivity of natural steelhead has been or can be improved by habitat restoration is critical to justifying targets for the supplementation program.
- Describe how decommissioning Powerdale Dam has affected the Hood River ecosystem beyond the direct effects on steelhead and Chinook populations.

Editorial suggestions

- To improve the clarity and readability of the Executive Summary, describe the programs for each species separately as in the main text (i.e., first the winter steelhead program and then the spring Chinook program).
- Clarify how average values are calculated and explain the different choices of geometric and arithmetic means. Show the variance of mean values (i.e., standard error) and explain the choice of time period for calculating recent running averages (e.g., the 5-year averages shown in several tables). Including a running average based on generation time (or other time period based on population biology) in tables reporting smolt or adult abundances could help to highlight demographic trends.
- A brood table, including natural smolts produced per spawner, should be created for natural steelhead production in the Hood River so that productivity can be tracked over

time to evaluate effects of habitat restoration and hatchery supplementation activities on the natural population.

ISRP Comments on CTWS/ODFW responses to previous ISRP concerns

Program Objectives

ISRP 2008 Comments:

The ISRP requested that the co-managers clarify the winter steelhead and spring Chinook program goals.

ISRP 2019 Comments on the 2019 Response:

Overarching goals of the Hood River production programs for winter steelhead and spring Chinook are sufficiently articulated in the Addendum.

The primary goal for winter steelhead is to provide an opportunity to selectively harvest 876 hatchery origin adult steelhead annually. A secondary goal is to achieve and maintain an annual spawning escapement of 1,100 natural origin steelhead. The steelhead program is characterized as an integrated hatchery program, which implies that constraints on hatchery production are needed to maintain PNI objectives for a self-sustaining natural steelhead population. As discussed below, more monitoring and evaluation are needed to document whether or not the winter steelhead population is self-sustaining as required in a successful integrated program. The ISRP is concerned that the escapement goal of 1,100 natural origin winter steelhead exceeds existing habitat capacity in the Hood River, given that many hatchery origin spawners will escape the fishery and traps and will attempt to spawn naturally. The recent 5-year average escapement of 1,041 spawners comprised 43.7% hatchery origin fish. It appears that substantial habitat restoration is needed to meet this program goal.

The spring Chinook program has two goals: (1) re-establish and maintain a naturally self-sustaining spring Chinook salmon population in the Hood River subbasin, and (2) provide sustainable and consistent in-basin tribal and sport harvest opportunities. No specific quantitative goals for natural spawning escapement or terminal harvest of spring Chinook have been proposed due to the lack of knowledge about natural escapements. The ISRP emphasizes that a quantitative objective for harvest level, supported by a reasoned argument, is needed to justify revising the hatchery program to increase releases from 150,000 to 250,000 smolts per year. Perhaps a phased increase would better achieve the program’s goals.

Quantitative objectives and timelines for both natural and hatchery fish production were listed in the 2008 Master Plan (e.g., Table 8). The Addendum could be improved by including a more explicit evaluation of progress towards achieving those objectives. Summary data presented in the Addendum suggest that many, but not all, of the 2008 objectives have been met, but it is difficult to judge without more thorough analysis. Such evaluation is important because success (or not) in meeting escapement targets for natural-origin steelhead and spring Chinook will increase (or reduce) confidence in the assumptions on which the programs are based.

For winter steelhead, recent 5-year average values suggest that the proposed objectives for 2018 (shown in Table 8 of 2008 Master Plan) have been achieved for returns to the river mouth (shown in Table 30 of the Addendum), for both NOR (700 average > 656 target) and HOR (1,143 average > 1,000 target). In-river harvest averaged about half that proposed (423 < 876), yet, effective pHOS has been less than the project's objective for this metric (39.7% < 50%; Table 10). SARs were higher than proposed for hatchery-origin smolts (2.8% > 2%) but lower than proposed for natural origin smolts (5.6% < 7%). Other comparisons should be possible, but the appropriate summary statistics are not presented.

For spring Chinook, recent 5-year average values suggest that the proposed objectives for 2018 (from Table 8 of 2008 Master Plan) have been met or exceeded for HOR with respect to returns to the river mouth (1,640 average > 600 target), in-river harvest (1,020 > 318), and SARs (0.65% > 0.4%), and nearly met for NOR at the river mouth in 2016, the only year of enumeration (285 < 300). Other comparisons might be possible, but the appropriate summary statistics are not presented.

The Hood River winter steelhead population is designated a primary population of the ESA-listed Lower Columbia River Steelhead. Accordingly, a key assumption of this program is that the productivity of natural origin fish will not be appreciably reduced by incidental mortality from selective terminal fisheries or competitive interactions with hatchery fish. Despite including many tables of data spanning up to 22 years, the Addendum provides very few statistical analyses to address these conservation concerns.

The 2019 Addendum indicates that the spawning escapement objective for natural origin winter steelhead is 1,100. This number appears to originate in the Hood River Subbasin Plan (Coccoli 2004) but was not explicitly adopted in the 2008 Master Plan. The 1,100 target seems inconsistent with the AHA parameters presented in the Addendum and with AHA simulation results provided for scenarios with no hatchery supplementation. Without supplementation, the equilibrium spawning population (all of natural origin) is estimated at 371 adults (Table 13). Thus, the AHA analysis suggests that the current natural population is being maintained above current habitat capacity by hatchery supplementation. Moreover, the ISRP found that plots of smolts-per-natural spawner versus natural spawner abundance (data in Appendix C [HGMP] Table 6) and SARs for natural origin smolts versus natural origin smolt abundance (data in Addendum Table 4) both reveal appreciable density dependence. Of particular note, the smolts-per-spawner index of freshwater productivity appears to drop dramatically when natural spawning abundance exceeds 400 fish. These plots and the AHA simulation cast doubt on the hypothesis that "*subbasin spawner escapements are currently below the level needed to fully seed the subbasin*" (Addendum Section 4.1.2. The derivation of the Beverton-Holt parameters used in the AHA modeling is not presented (nor is a link to another source provided).

If current habitat is insufficient to sustain a natural population of winter steelhead at levels above 400 spawners without hatchery supplementation, then the current objective of using integrated hatchery supplementation to augment harvest of hatchery returns appears to conflict with the objective of maximizing long-term fitness of a self-sustaining natural population. The extent of the conflict will depend on the degree to which the productivity of the natural population is eroded by indirect mortality from selective fisheries and ecological or genetic interactions between the hatchery origin and natural origin winter steelhead (or ecological interactions with hatchery releases of spring Chinook smolts). Again, this potential conflict should not be taken lightly given that Hood River winter steelhead are designated a primary population of the ESA-listed Lower Columbia River Steelhead.

Our concern about the spawning escapement target for natural origin winter steelhead might be alleviated if there is convincing evidence that the parallel efforts to restore habitat (listed in Appendix E) can be expected to augment the natural habitat capacity of winter steelhead in the future. Have the proponents evaluated the amount of habitat that is suitable (e.g., in terms of food, temperature and cover) for juvenile rearing and migration? A related concern is the widespread use of pesticides in the Hood River basin, especially by fruit growers. Riparian zones serve as filters for pesticides being sprayed, but a large percentage of the food consumed by juvenile fish originates directly from riparian zones. Is pesticide use being addressed as a potential limiting factor? The ISAB's reports on food webs (ISAB 2011-1) and density dependence (ISAB 2015-1) strongly suggest that juvenile fish densities exceed existing habitat capacity in many parts of the Columbia River Basin. A more careful evaluation of density dependence in the Hood River is warranted and should be presented in the next iteration of the Step Review.

Program Size and Terminal Harvest Rate – Winter Steelhead

ISRP 2008 Comments:

- **Use AHA modeling** to evaluate assumptions about harvest rates for hatchery and wild fish and effects on the winter steelhead population. Will program goals for harvest be met with the proposed production levels?
- **Evaluate** harvest rates (using AHA) based on different **assumptions about the harvest location**: 1) lower in the watershed, using observed harvest rates on NOR and HOR, 2) in the upper watershed. The ISRP recommends examination of where in the watershed the harvest of hatchery fish is likely to be maximized with low impact on wild fish. Absent other information, it appears that harvest will be maximized lower in the watershed (i.e., in the first few kms). If so, this would negate the need for acclimation sites significantly further up in the watershed, thereby concentrating a terminal fishery within the lower watershed.
- Because the goal of the winter-run steelhead program is to meet a recreational and tribal **harvest demand, the scale of hatchery fish releases** should numerically reflect that need. Only 25% of hatchery steelhead has historically been harvested annually, on average. Some explanation is necessary as to why more hatchery fish are not harvested or why production should not be reduced to lower the surplus production.
- In contrast, there is also need for an explanation or justification of the quantity of **wild harvest** based on the population dynamics. Is there a harvestable surplus? **Recruitment** information on wild steelhead was not presented to address this, and should be (the data exist).

ISRP 2019 Comments on the 2019 Response:

AHA modeling: As requested, the proponents used an AHA model to evaluate harvest rate options for the selective terminal fishery on hatchery origin winter steelhead. The AHA model is a tool to explore the implications of explicit assumptions about freshwater productivity and capacity, ocean survival, harvest rates, hydrosystem impacts, hatchery performance metrics (e.g., annual smolt releases and SARs), as well as hatchery effects on fitness in the wild associated with broodstock and pHOS management. These assumptions were based mainly on project data that had been collected over multiple years or on results of scientific studies conducted elsewhere.

The AHA model indicates that it is reasonable, based on the assumptions, to expect the existing program to support an annual potential harvest of 876 HOR by releasing ~50,000 hatchery origin smolts annually. However, harvest data indicate a geometric mean harvest rate of only 33.6% (i.e., 423 HOR harvested per year; Table 6), leaving many hatchery steelhead to potentially spawn in the river.

The existing program includes a number of management options to reduce impacts on the natural winter steelhead population, which is protected by the ESA. All HOR are marked before release, so they can be harvested selectively in a terminal fishery; unmarked fish must be released, and < 5% of those caught are expected to die. The proportion of NOR in the hatchery broodstock (pNOB) has averaged 60% in recent years, but the long-term target is 100%; this is a key part of the strategy to maximize proportionate natural influence (PNI). The proportion of hatchery origin adults spawning naturally (pHOS) is reduced by removals in the terminal fishery and at traps and weirs within the subbasin. The proponents report that PNI is 0.73 and effective pHOS is 42% based on the AHA model for the current program (Table 11). These pNOB, pHOS, and PNI values generally exceed minimum short-term targets for these parameters recommended by the Hatchery Science Review Group (HSRG). However, the calculations of PNI in Tables 11, 13 and 15 (and perhaps elsewhere in the Addendum) seem to be in error. For example, in the first scenario in Tables 13 and 15, pNOB is 100% and pHOS is 30%, so PNI should be 1.0/(1.0 + 0.3) = 0.77 rather than 0.89. Similarly, it seems that PNI in the second scenario in Table 13 should be 0.84 rather than 0.93; in the second and third scenarios in Table 15, PNI should be 0.74 not 0.84, and 0.60 not 0.73, respectively. In Table 11, it seems that PNI should be 0.59 not 0.73 using the effective pHOS and pNOB values. PNI should be even lower if the census (rather than estimated effective) pHOS value were used.

Currently, the program is attaining only about half the in-basin harvest goal of 876 HOR per year (5-year average is 423) because the selective terminal fishery harvests only about a third of the hatchery steelhead returns. The proponents note that the goal might be achieved if additional HOR steelhead were harvested at the weir and ladder. Reducing pHOS in this way could improve the PNI of the integrated population and the productivity of natural spawners but would likely reduce total returns of natural origin steelhead in the short term because fewer fish would spawn naturally overall (i.e., NOS + HOS). The proponents should clarify if they will remove more of the HOR at the weir as a means to increase PNI and reduce density dependence associated with high total spawning density. What is the total harvest if HOR collected at the weir and ladder are counted as fishery harvest? Even if the harvest rate were doubled, effective pHOS would still be relatively high (30%).

In Table 11, the proponents should clarify whether or not the decline in NOS under the double harvest rate scenario is due to increased collection of natural origin fish to increase pNOB from the current value (i.e., 60%) to the target (i.e., 100%) or to additional incidental mortality. We recognize that the sliding scale allows for up to 45 NOR steelhead to be used as broodstock. Changing both pNOB and the harvest rate complicates the interpretation of results from this analysis. Footnote 17 in the Addendum says that winter steelhead harvests will not be monitored in 2019 due to lack of funding. This monitoring is essential for evaluating the program's success. In the next iteration of the Step Review, the proponents should discuss how they will address this problem.

Overall, the AHA modeling is a very useful component of the Master Plan, but the model assumptions and results may need revision. More complete documentation (perhaps an additional Appendix) is needed to explain how parameters were estimated, especially the Beverton-Holt parameters given the policy implications of correctly assessing current natural capacity for winter steelhead (see previous comments under Program Objectives regarding the escapement target).

Harvest location: In our 2008 review, we suggested that hatchery steelhead should be acclimated and released in the lower river to concentrate HOR in areas of the river accessible to the terminal fishery. The proponents have rejected this idea for several reasons. First, they want some HOR to spawn upstream because a secondary goal of the steelhead program is to supplement NOR abundance. Upstream acclimation sites are used to imprint HOR to upstream spawning and rearing areas. Second, the proponents plan to control pHOS by trapping, especially when the terminal harvest rate is below target. They suggest that releasing hatchery origin smolts below the broodstock collection traps might increase pHOS if fewer HOR could be intercepted and removed at the trapping sites. And third, an acclimation site in the lower river may be logistically impractical.

The proponents note that some HOR steelhead are removed at the East Fork weir and the East Fork Irrigation District ladder and trap (where fish are released). Data on removals are documented for the ladder and trap (in Table 29) but not for the East Fork weir. These removals should be presented to support the argument that an acclimation site is needed in the upper river to allow hatchery fish to be removed as they attempt to migrate up the ladder. Documentation of removals at all traps is also needed to determine total removals (i.e., in-river harvest by fishermen and traps combined).

Research in the Wenatchee River supports the proponents' contention that upstream acclimation sites improve natural spawning success. Hatchery origin spring Chinook that spawned adjacent to their acclimation sites had lower reproductive success than those spawning farther upstream in areas used by natural origin Chinook (Williamson et al. 2010; Hughes and Murdoch 2017). The argument that releasing fish below the East Fork adult trap could increase pHOS and reduce PNI is more problematic. The PNI concept implicitly assumes that HOR and NOR mate randomly with one another. HOR released in the lower river may not migrate to spawning areas used by NOS, and many of those that do attempt to migrate that far upstream could be intercepted at the East Fork adult trap. If fewer HOS spawn with NOS, effective pHOS might even decrease.

In summary, we urge the proponents to revisit their decision not to release a portion of their hatchery steelhead in the lower river and to discuss this issue in the next iteration of the Step Review. Here is an opportunity to include a controlled experiment to test these competing perspectives. Of course, the absence of suitable acclimation sites might make this a non-viable management option.

Harvest demand and the scale of hatchery releases: The harvest rate on HOR steelhead in the selective terminal fishery has averaged only 33.6% (5-year geomean), and 89% of this harvest has occurred in the lower river (i.e., RM 0 to RM 2.5). The proponents suggest that fishing effort for winter steelhead elsewhere in the subbasin is limited by a lack of access to fishing sites. They suggest that improving access could increase harvest rate and reduce pHOS. However, more detail is needed. Where and how much access would have to be improved for the program to meet its harvest target?

An alternative option is to reduce the hatchery release target to match the existing fishery demand for steelhead. The proponents suggest that a decline in hatchery steelhead production might further reduce harvest rate if anglers become disillusioned with a reduced adult abundance (and presumably reduced catch-per-unit effort). A monitoring program is necessary to evaluate this scenario. The AHA analysis (Table 13) indicates that reducing hatchery production would also reduce the abundance of NOR that are produced in the next generation by HOS. However, it is not clear if this analysis considers the extent to which the reduced production from HOS might be compensated for by a higher productivity of NOS when spawning at lower overall density and long-term fitness benefits to NOS associated with lower pHOS.

Increasing the number of NOS through integrated supplementation can reduce extinction risk as long as their natural productivity is not compromised through density dependence or loss of fitness (i.e., genetic adaptations). However, productivity typically declines both as spawning density increases (ISAB 2015-1) and as PNI is reduced (due to domestication effects, as shown in Table 13 and noted in the proponents' response). Thus, supplementation is expected to decrease demographic risk in the short-term at the cost of reducing fitness in the longer term. Even so, supplementation for conservation is often justified as a temporary measure to maintain abundance while the factors that have led to population decline are being mitigated (e.g., Waples and Do 1994). This justification requires that habitat quality or capacity will be sufficient to maintain a larger self-sustaining natural population once supplementation is discontinued. The optimal tradeoff between increasing spawning abundance versus increasing PNI (by not restricting pHOS) is uncertain even in cases where supplementation is viewed as a temporary measure.

If current habitat in the Hood River is insufficient to sustain the natural population of winter steelhead at the current target (i.e., 1,100 natural origin spawners) without hatchery supplementation, then using integrated hatchery supplementation indefinitely to augment selective harvest opportunities appears to conflict with the objective of maximizing long-term viability of a self-sustaining natural population. Given the uncertainty about current habitat capacity, it seems difficult to justify a level of hatchery supplementation that produces more surplus hatchery fish than can be harvested selectively at current terminal fishing rates, unless pNOB and pHOS are managed very carefully. This issue should be discussed in the next iteration of the Step Review.

Harvest and recruitment of naturally spawning steelhead: No retention of NOR is allowed in the terminal steelhead fishery. It is assumed that 5% of the NOR caught will die due to handling stress or injuries incurred at capture. It is also assumed that NOR and HOR are equally vulnerable to terminal fisheries. Thus, in the terminal fishery, the incidental harvest rate on NOR is assumed to be 5% of the observed harvest rate on HOR. The hooking mortality assumption is based on values reported in the scientific literature. This value seems plausible provided anglers are vigilant and use proper techniques and gear. The proponents suggest that 5% is conservative (i.e., biased high) in this case because steelhead are caught while water temperatures are relatively cold. With some additional effort the proponents could conduct creel surveys to document catch rates for HOR and NOR adults to test the hypothesis that HOR and NOR steelhead are equally vulnerable to harvest.

The proponents acknowledge that Hood River winter steelhead are likely harvested in the ocean, the lower river (i.e., below Bonneville Dam), and Zone 6 (i.e., from Bonneville Dam to McNary Dam). They have made reasonable assumptions about the abundance, harvest rates, and the apparent survival of the program's winter steelhead in the ocean, the estuary, and Zone 6. We recommend that the proponents consider if data from three ongoing BPA projects (2008-907-00 Genetic Assessment of Columbia River Stocks; 2008-518-00 Upstream Migration Timing; and 2008-502-00 Expanded Tribal Catch Sampling) might help to validate or refine their initial assumptions.

Parameters for Beverton-Holt recruitment relationships fitted to data from naturally reproducing Hood River winter steelhead are presented in Table 5. However, the data and methods for estimating these parameters are not documented well enough to ensure that appropriate analyses has been done. Nor is any explanation given for why the smolt recruitment parameters have changed (i.e., why freshwater productivity and capacity have increased) since the 2009 EDT analysis (page 21 of the Addendum). If the ISRP has understood the terms correctly, the 2019 Beverton-Holt parameter values imply an equilibrium unfished (natural) population of 630 adults and a maximum "harvestable surplus" of 180 adults.[2] More empirical information is needed to evaluate these estimates of current status and capacity. Is natural origin production self-sustaining at current levels of natural spawning escapement (NOS and HOS)? Data shown in Table 10 suggest that, on average, returns-per-natural-spawner have been much less than 1.0, implying that the population is not self-sustaining at recent spawning densities. On average during the last five years, only 638 NOR steelhead were counted at the trap, of which 599 NOS spawned naturally among a total of 1,041 adults (i.e., NOS + HOS) spawning in the river. The data in Table 10 show that NOS has exceeded 1,000 only once in 23 years (in 2014).

A brood table, including natural smolts produced per spawner, should be created for natural steelhead production in the Hood River so that productivity can be tracked over time to evaluate effects of habitat restoration and hatchery supplementation activities on the natural population.

[2] Adult "productivity" is taken to mean adult returns-per-spawner as spawner density approaches zero (1.07 in 2009 and 1.4 in 2019); "capacity" is taken to mean maximum adult recruitment (2,096 in 2009 and 2,213 in 2019).

It is difficult to judge from Table 13 whether or not the natural population will be self-sustaining under the 50,000 smolt release scenario, but the predicted average returns of 499 NOS (including broodstock) and 769 natural spawners in total (i.e., NOS + HOS) suggest that continued supplementation will, on average, exceed the watershed's capacity to support natural production. Table 13 suggests that if hatchery releases were terminated, the natural population would be self-sustaining but relatively small with an average of 317 spawners (all natural origin) producing an average return to the river of 371 adults.

This type of analysis justifies restoration activities in the basin to increase the capacity and productivity of the natural winter steelhead population (as the proponents recognize). It also highlights the need to re-evaluate the modeling assumptions about productivity and capacity shown in Table 5. It is unclear if values in Table 13 reflect increased productivity due to higher long-term fitness when pHOS = 0.

In summary, we recommend that the proponents re-assess the productivity and capacity parameters for winter steelhead, update the AHA analysis, and describe spawning levels that support a self-sustaining population under current conditions. This information should be included in the next iteration of this Step Review.

Broodstock Management – Winter Steelhead

ISRP 2008 Comments:

- Provide scientific **justification for the steelhead broodstock collection protocol** and **use All H Analyzer (AHA) modeling to explore long-term effects** on the population. Add a section on winter steelhead production alternatives that evaluates the effect broodstock collection has on winter steelhead population dynamics. Use AHA modeling to show long-term outcomes for the program. Our review of the winter steelhead production program is qualified because of a general ambiguity in the broodstock collection protocol (page 28). [B]ased on the project objectives in table 9 on page 37, there will be fewer fish spawning naturally with the program than without it. The program anticipates that 64 wild fish will be collected for hatchery broodstock but that only 24 hatchery fish will be permitted to escape for natural production. The justification that the population is sufficiently productive with these fish removed should be presented in more detail. We recommend an All H Analyzer (AHA) modeling approach to explore this justification.

- Based on the investigations of relative reproductive success for winter steelhead in the Hood River (Araki et al. 2007), the sponsor's preferred protocol is to use only naturally produced parents as broodstock for hatchery production. However, for winter steelhead, the sponsors indicate (page 28) that should the 25% limit on collecting natural-origin winter steelhead provide insufficient numbers for hatchery production, they will "re-evaluate broodstock collection and consult with NOAA-Fisheries." The ISRP identified several issues with this approach. First, while a 25% limit on collecting natural-origin fish for broodstock may ultimately prove to be a very reasonable and appropriate level to avoid "brood mining" and affecting natural productivity, there does not appear to be a description of the scientific basis for this threshold. Sponsors do not provide a basis or support for this exact threshold. Why not a higher or lower percentage? 25% of a large wild population may be insignificant, while 25% of a small population could be problematic. In other words, the management decision should be contingent upon the strength of the wild run. Describe the program's decision rules and justification for 25% NOR mining constraint; **discuss program scenarios for low NOR abundance**.

- Second, the sponsors propose to use serial hatchery fish (offspring of hatchery-bred fish rather than wild fish) when the 25% limit of wild adults falls below that needed to maintain production objectives. This scenario is expected to emerge especially in years with low wild adult returns. The ISRP recommends that rather than using hatchery-origin adults to maintain the artificial production program at pre-set levels, the **program should be scaled to the natural adult return abundance**.

- Third, the sponsor need not wait for the case where the 25% threshold is approached for consultation with NOAA Fisheries. There are a limited number of likely scenarios that can be predicted and addressed in advance. While not every contingency for population viability or relative reproductive success need be modeled, a limited number of likely outcomes should be modeled with a tool such as the All H Analyzer and developed *a priori* into a **structured decision management pathway**. Finally, the sponsors indicate they will evaluate in 2010 the need to alter production. Within an adaptive management context, evaluation is best viewed as a process undertaken periodically rather than a single event. Ultimately, the plan would benefit greatly from an expanded presentation of the manner, criteria, objectives, and periodic timeframes by which the co-managers will evaluate this need to alter production.

ISRP 2019 Comments on the 2019 Response:

Justification for steelhead broodstock collection protocol: The proponents used the AHA model to examine three different pNOB scenarios (i.e., 100%, 75%, and 50%). Values for pHOS varied between 30% and 34%. Output from these model runs showed terminal harvest of HOR, total run size, and PNI values were highest when pNOB was set at 100% (Table 15). These outcomes incorporate assumptions about PNI effects on productivity that are consistent with the proponents' goal to use NOR exclusively as broodstock whenever possible.

Because of assumptions about the effect of PNI on fitness, the AHA model predicts that long-term abundance of NOS will decline as pNOB is reduced from 100% to 50% even though hatchery smolt releases are held constant at 50,000 and fewer NOR must be collected as broodstock, which increases NOS in the short term. In other words, the AHA modeling suggests that the fitness benefit of high pNOB more than offsets any short-term increase in NOS due to reduced broodstock mining. Consistent with this assumption, a recent study suggests significant fitness loss in steelhead after just one spawning event in the hatchery (Christie et al. 2016). Still, robust monitoring and more evaluation are needed to evaluate the fitness assumptions underlying the AHA model.

Program scenarios for low natural adult returns: The proponents state that the 25% maximum "mining" rate for NOR broodstock is ODFW and NOAA policy, but no reference is provided. The scientific rationale for the policy is not explained, except to say that it is comparable to or more stringent than broodstock mining rules for other hatchery programs. The ISRP accepts that such agency policies are needed in the face of uncertainty about the optimal tradeoffs between achieving the pNOB target to maintain high PNI versus maintaining the abundance of NOS. Yet we still do not understand the scientific justification for this particular policy, and in particular, why the policy does not take into account both the abundance and proportion of NOS. It seems that a decision rule based on the absolute number of NOS removed is needed at very low abundance to protect against adverse random events (i.e., genetic drift and demographic risk), and another decision rule based on proportion removed is needed to protect against the risk of domestication effects on fitness even when demographic risk is low. This uncertainty highlights the need for robust monitoring and an unbiased evaluation of PNI and population demographics.

Scaling program to natural adult returns: Although the proponents conclude that natural production will be improved by achieving higher fitness through careful management of pNOB and PNI, they seem reluctant to accept a decision rule that would trigger a reduction in hatchery releases in order to maintain high pNOB in the face of low natural returns. We note that high PNI can be maintained more reliably by careful broodstock selection to ensure that pNOB is close to 100% rather than by reducing pHOS by preventing HOR adults from reaching the spawning grounds. Currently, about 40% of the broodstock consists of HOR, which is far from ideal and far from the goal of 100% pNOB.

The AHA model predicts that reducing smolt production by half (i.e., to 25,000) to maintain pNOB at 100% would maintain NOS at 451 fish but would reduce terminal harvest to 418 fish and total run size to 1,210 fish (Table 13). In contrast, maintaining smolt production at 50,000 by reducing pNOB to 50% would reduce NOS to 420 fish but maintain terminal harvest at 829 fish and total run size at 1,840 fish. These outcomes provide some justification for the proponents' preference to continue with existing smolt releases by incorporating HOR in the broodstock when it becomes necessary. The justification would be more compelling if the need to seek additional broodstock can be minimized by additional efforts to randomly intercept NOR over the duration of the run to reach the 100% pNOB target. We note that returns of NOR winter steelhead to the Hood River subbasin over the past decade (Table 10) have been sufficient to preclude the use of HOR adults in the hatchery program. We also understand that if trap efficiency is low, capturing broodstock can be difficult even when NOR abundance is adequate. However, it might be feasible to collect additional broodstock by angling if hooking mortality is < 5%, as assumed.

The proponents also point out that reducing hatchery production could have negative impacts on effective population size in the integrated population. We find this argument difficult to understand (and unconvincing) as it runs counter to the expected Ryman-Laikre effect in supportive breeding programs. We encourage the proponents to consult with experts at the NOAA, Northwest Fisheries Science Center (NWFSC) Conservation Biology Program for a more thorough analysis. Again, robust monitoring and evaluation will be needed to evaluate these tradeoffs given the difficulty in predicting and enumerating natural origin returns.

Structured decision management pathway: The response, and inclusion of Table 16 helps to resolve this ISRP concern. The proponents have developed a sliding scale decision rule to guide for broodstock collection in years when insufficient NOR steelhead are captured due to trap inefficiencies, low abundance, or both.

The Annual Operation Procedure meeting sounds like a good opportunity for review and adaptive management to identify successes, expose potential problems, and recognize the need for alternative approaches.

Potential Hatchery Impacts

ISRP 2008 Comments on Rearing and Release Strategies – Winter Steelhead

- The effect of **residualized steelhead** (smolts that fail to migrate) on program success and natural parr was insufficiently addressed in the Revised Master Plan. Concerns about high levels of residualism by hatchery steelhead were highlighted in recommendations of the ten-year HRPP (Underwood et al. 2003) and the ISRP FY 2007-09 reviews of the associated project proposals. Those reviews recommended that the project sponsors develop monitoring and evaluation protocols to "assess the extent to which the residualism of hatchery steelhead is resulting in the displacement of wild fish from Hood River habitat" (Underwood et al. 2003).

- The implicit and prevailing assumption about residual fish is that any deleterious effect will be addressed by trucking those fish that did not volitionally leave acclimation sites to a **release location below Powerdale Dam**. The ISRP concludes that this assumption is not supported by evidence presented. In fact, parr which are not yet ready to migrate as smolts are believed to be leaving acclimation sites with smolts, but remain in the river. These yearling "residuals" may compete with and displace wild underyearling parr, but die over summer (likely due to physiological reasons). They may contribute little or nothing to subsequent smolt yields, while a few likely mature precociously and spawn with wild fish, thus decreasing fitness of wild spawners, and further confounding relative fitness comparisons.

- In addition, the presence of residualized steelhead could potentially be a key factor contributing toward **creation of "hybrid swarms" with cutthroat trout**. Issues of relative fitness of cutthroat and hybrid impacts were mentioned but not adequately addressed through experimental design and effective evaluation. See also the recent discussion on residualism of steelhead in Kostow (2008; Factors that contribute to the ecological risks of salmon and steelhead hatchery programs and some mitigating strategies, Reviews in Fish Biology and Fisheries, DOI [Digital Object Identifier] 10.1007/s11160-008-9087-9). The ISRP did not find anything specific in the Revised Master Plan for future monitoring of residual hatchery steelhead or evaluation of the potential consequences to wild parr. Given the displacement risk to wild fish, this monitoring is critical.

ISRP 2019 Comments on the 2019 Response:

Residualism following release: The proponents describe two independent assessments of the prevalence of residualism in project steelhead. In the first, they analyzed PIT tag detections to estimate the proportion of smolts that emigrated out of the Hood River subbasin one year after being released (i.e., they considered smolting at age 2+ to be an index of residualism). Less than 2% of the fish released emigrated as age 2+ smolts. The proponents acknowledge that this index underestimates the overall rate of residualism because some residuals may perish before smolting or not smolt at all.

In the second evaluation, NOAA scientists used morphological, physiological, and histological methods to assess the maturation status of steelhead juveniles just prior to their release at age 1+. This 3-year evaluation revealed five juvenile phenotypes among fish leaving the program's acclimation sites. Three of these phenotypes (i.e., immature male and female parr, precocious parr, and males that attempted to mature and failed) were classified as "prospective residuals" and together accounted for only 3 to 4% of the fish released.

Based on the NOAA study, approximately 3 to 4% (i.e., 1,500 to 2,000) of the program's juveniles may become residuals. It was also reported that the hatchery population had a lower prevalence of residualism than the naturally reproducing population. A meta-review of residualism in steelhead by Hausch and Melinychuk (2012) reviewed 48 estimates of residualism in hatchery steelhead. Residualism in the reviewed hatchery populations varied from 0% to 17% and averaged 5.6%. This same study suggested that residualism could be reduced by choosing sites for acclimation and release that are close to the ocean or the confluence with a major river.

A study performed by Christie et al. (2011) found that only 1% of the genes in adult NOR came from residualized hatchery steelhead. This result suggests that few residuals exist or that they have low reproductive success.

The methods used to estimate the prevalence of hatchery residuals in this program include monitoring fork lengths of hatchery smolts at release, catches of program juveniles in RSTs during summer and fall months, apparent survival rates within the subbasin (i.e., $\phi 1$ in the CJS models), and the relative abundances of hatchery and wild 2+ smolts (which are negatively correlated). These methods detected an increase in prevalence of hatchery residuals during 2017, which was attributed to changes in hatchery operations and releasing juvenile steelhead at a smaller size than normal.

The proponents present photographs to "*demonstrate the typical condition of residual hatchery fish (Figure A-4) as well as the potential consequence of hatchery residuals interacting with wild parr (Figure A-5).*" Were the severely deteriorated caudal fins on the wild steelhead in Figure A-5 caused by aggressive residual hatchery steelhead? If so, this highlights the potential adverse effects of residuals on wild fish and warrants further discussion.

In summary, relatively low numbers of residual steelhead are produced by the program and they likely have few impacts on the natural steelhead population. Evaluations of other ecological effects (e.g., competition for food and space) are needed to obtain a more complete picture of the potential effects of hatchery residuals on natural-origin juvenile steelhead in the subbasin. The proponents are commended for undertaking a study within an adaptive framework to examine this key uncertainty. We support the cessation of transport and release of residuals at the mouth of the Hood River and encourage the proponents to remove residual steelhead remaining in the acclimation pond rather than allowing them to eventually enter the river. The study by Hausch and Melinychuk (2012) suggests that releasing a portion of the smolts from acclimation sites in the lower river might further reduce residualism.

Release protocol and location: Release protocols for winter steelhead juveniles have changed since 2008. Originally, juvenile steelhead were moved to acclimation sites in March and early April and were held for several weeks prior to volitional release. Non-migrants were collected, transported, and released into the mainstem to reduce residualism in the Hood River. This protocol was changed in 2009 as the proponents recognized that they could not easily distinguish smolts from prospective residuals.

Currently, juveniles are transported from the Oak Springs Hatchery (Deschutes River subbasin) to acclimation sites in the Hood River at the beginning of May. The change in schedule is intended to increase the size of smolts and to release them coincident with the wild smolt out-migration. The proponents hypothesize that that this approach reduces residualism as the fish are developmentally closer to smolting, quickly leave their acclimation site, and rapidly emigrate from the Hood River.

The response does not indicate how long the fish are allowed to acclimate under the new regime. Some time is needed for juveniles to recover from the stress of transportation and to facilitate imprinting. Have any studies been conducted to examine how the new release protocol may affect homing? Has straying increased or decreased from that observed when the original protocols for release were used?

Although the program produces only 0.8% immature parr (both male and female) on average (Larsen et al. 2017), the proponents acknowledge that the production of residuals may vary from year to year because of differences in hatchery rearing conditions. Data collected from the project indicate that increasing size at release (i.e., fork length or body weight) will decrease residualism. The proponents used this information to establish release size targets of 198 mm and 89 g (or 5.1 fish per pound). Besides these size criteria, the proponents are also using apparent survival rates from CJS analyses and RST catches to monitor possible changes in the occurrence of hatchery residuals in the Hood River subbasin. Low apparent survival from acclimation sites to the mainstem RST along with high summer and fall catches of program steelhead in Hood River RSTs have been used to detect increases in residualism.

In summary, the program appears to be limiting the production of residuals by its rearing and release protocols and has monitoring efforts in place to detect increases in their abundance.

Hybridization with cutthroat trout: The Addendum does not directly address the ISRP's request to investigate whether hatchery residual steelhead are contributing to the creation of cutthroat trout x rainbow trout hybrids in the subbasin. However, the proponents cite a study by Christie et al. (2011) that shows only 1% of genes in natural-origin returns came from residualized hatchery steelhead. Thus, genetic methods could likely be employed to address the concern about hybridization with cutthroat trout. Tissue samples of potential hybrids could be collected in RSTs or elsewhere in the subbasin for genetic analyses.

ISRP 2008 Comments on Rearing Studies – Spring Chinook

Include comparative release study results [for spring Chinook]. Facility improvements needed to implement the proposed spring Chinook rearing experiment are justified, but the construction of six permanent raceways at Moving Falls on the West Fork of the Hood River cannot be scientifically justified until the experiment is complete in 2018 and data analyzed. The six ponds are not needed for the experiment but are proposed for program implementation.

ISRP 2019 Comments on the 2019 Response:

The proponents justify construction of six raceways in their response to the ISRP concern. The

Addendum provides a good summary of the spring Chinook rearing experiment that was conducted for three broodyears (i.e., 2008, 2009, and 2010) by NOAA scientists (Spangenberg et al. 2014; Beckman 2017). Spring Chinook from the Hood River Production Program were reared at three different facilities: Round Butte/Pelton Ladder (Deschutes River subbasin), Parkdale (Hood River subbasin), and Carson National Fish Hatchery (Wind River subbasin). Substantial differences in smolt length, weight, and minijack prevalence were observed among the facilities consistent with differences in water temperature regime during rearing. High growth rates in fall and winter were linked with higher minijack prevalence. Fish reared at the Round Butte/Pelton Ladder complex consistently had the lowest minijack rates, were the largest smolts at release, and achieved the highest SARs of any of the rearing treatments. The researchers recommended that project managers aim to maximize growth during the first spring and summer but then reduce growth in the fall and winter prior to release the following spring.

At present, half of the spring Chinook production is being reared and released within the Hood River subbasin. The other half is incubated and reared in the Round Butte/Pelton Ladder complex and then transferred to the acclimation ponds located at the Moving Falls Fish Facility (MFFF). The within-subbasin group of spring Chinook are acclimated in raceways at MFFF that are separate from the Round Butte fish. It seems there is an opportunity, not mentioned in the Addendum, to compare homing fidelity between these two groups of spring Chinook with different rearing histories. It is known that salmonids imprint on their incubation water (Dittman et al 2015) and that stress due to handling and transportation may interfere with imprinting at the smolt stage. How long the Round Butte fish are acclimated at MFFF is not mentioned, but previous releases used a one-week acclimation period. Is this long enough for the fish to recover from being hauled and released into a new setting?

Monitoring and Evaluation of Adults

ISRP 2008 Comments:

- Much of what has been proposed to evaluate fish production in relation to plans for hatchery fish introduction and for effectiveness of habitat improvements or harvest management following dam removal will be dependent on adult trapping and enumeration, with some reliance on smolt sampling. There may be several improvements possible to make the projects and program evaluations more effective. Further exploration of options for adult and smolt trapping and counting facilities need to be developed in a revision of Chapter 4.

- Provide an **evaluation of recent adult trapping data** from the East Fork and MFFF weirs. How efficient have they been? Document the level of trapping and enumeration of adults required to provide analytical (statistical power) to adequately assess the program. Do the weirs meet the level of adult trapping needed to estimate the adult run size accurately and precisely?

  A primary concern for the ISRP was a lack of explanation of the **trap performance goals** in Table 18 (page 61). It is not clear how the M&E requirement of intercepting no less than 50% of the adult winter steelhead population meets the needs of the metrics evaluation in Chapter 6. The capture guidelines are vague, “meet brood collection protocols.” What specifically are the brood collection guidelines, and how will the trapping facilities be evaluated to meet these objectives? There is also no mention of summer steelhead assessment using these facilities, but there are goals for natural production of summer steelhead that will need to be measured somehow.

- For adults, there are **additional enumeration, sampling, and trapping options** to consider. For example, resistivity counters (see www.instream.net/counter.htm) or other electronic enumeration may be appropriate for this subbasin, where near-100% counting is possible, particularly if sub-sampling for adult fish can be incorporated by construction of partial trapping facilities. While 100% adult capture was possible in the past (albeit with possible delays to migration), the proponents must now consider options and sample sizes with less than 100% (and likely less than 50%) sampling on adults. If electric counters do not provide sufficient biological samples, then further engineering effort should go towards development of a full sampling facility, recognizing, however, that even the best design will affect fish behavior and survival.

ISRP 2019 Comments on the 2019 Response:

Evaluation of adult trapping data: The Addendum indicates that good progress has been made in adapting monitoring efforts following the loss of the Powerdale Dam monitoring site. The proponents adequately describe the new adult trapping facilities, operational procedures, and methods for estimating capture efficiencies. Two facilities are used to capture steelhead: the East Fork resistance weir and East Fork Irrigation District ladder and trap. Although designed to capture all the steelhead entering the East Fork, the resistance weir is inoperable during high flow periods. When such conditions occur, the East Fork Irrigation Ladder, a new facility located upstream of the resistance weir, is used to capture adult steelhead. Another new facility at Moving Falls on the West Fork is used to capture spring Chinook adults.

Trapping efficiency for adult steelhead at the East Fork weir has varied substantially from year to year (i.e., from 68.2% in 2015 to 7.7% in 2017) and is strongly affected by river flow as in 2017. A fish ladder and adult steelhead trap was installed at the East Fork Irrigation diversion in 2014 to capture and enumerate steelhead when the East Fork resistance weir became inoperable. In combination, the East Fork weir and fish ladder trap at the irrigation diversion appear to provide the proponents with infrastructure to sample adult steelhead and remove excess hatchery fish. However, the ISRP is uncertain how often the East Fork weir and trap facility is operated and asks the proponents to provide more details about the annual schedule of operation and numbers of HOR removed. We suggest the facility be operated every year as needed to achieve pNOB and pHOS targets.

The fish trap at Moving Falls provides the proponents with the capability to capture an average of 86% of the spring Chinook moving over the falls each year. However, NOR spring Chinook abundance was reported in only one year, and no explanation is provided for the lack of data. We understand that NOR spring Chinook are difficult to enumerate because they are much less abundant than HOR Chinook, but we urge the proponents to continue to strive to increase trap efficiencies or to examine other methods that could improve estimates of NOR Chinook abundance. For example, adding a second trap could enable escapements to be estimated by the Petersen mark-recapture method (or related method) without having to increase efficiency at each trap. Alternatively, and more crudely, abundance might be estimated from more reliable estimates of HOR Chinook abundance based on the observed ratio of NOR to HOR Chinook.

The proponents estimate adult abundance by using the Lincoln-Petersen (with Chapman's modification) mark-recapture model in combination with a Cormack-Jolly-Seber (CJS) analysis performed in program MARK. This approach is sound and routinely used in the Columbia Basin to estimate abundance. However, it is concerning that the relative standard error (RSE or CV) for escapement estimates have ranged from 19% to 35%, exceeding the NOAA monitoring criterion of 15%. Improving efficiencies at the adult weirs and traps to reduce the RSE may not be practical. Instead, the proponents suggest that more juveniles be PIT tagged and that detection rates at the mouth of the river be improved. We agree with both suggestions. In the latter case, we note that new methods for detecting PIT-tagged fish in large rivers have been developed and implemented and are now being evaluated in BPA projects 1982-013-01 (New Marking and Monitoring Technologies) and 1993-029-00 (Survival estimate for passage through Snake and Columbia River Dams and reservoirs). These technological advances might help the proponents to improve detections at the mouth of the Hood River and elsewhere in the subbasin.

Summer steelhead abundance in the subbasin was estimated using mark-recapture and CJS models for the past three years, but precision has been poor due to low rates of tag recovery. We suggest that the proponents contact CRITFC researchers associated with BPA project 2008-907-00 (Genetic Assessment of Columbia River Stocks) who may have data on the relative abundance of Hood River summer steelhead at Bonneville Dam. That information, coupled with other project data might provide an independent abundance estimate of summer steelhead.

Trap performance goals: The proponents' response clarifies adult trapping goals for winter steelhead and spring Chinook. For winter steelhead the goal is to intercept no less than 50% of the adults moving into the East Fork. This objective was met in two out of three years that trap efficiency was monitored. A new trapping facility at the East Fork Irrigation Ladder was made operational in 2014 to help capture winter steelhead. No information on the efficiency of this trap is provided. Its efficiency should be measured (or reported if known) to determine if the program's goal of intercepting 50% of the winter steelhead run is being reached when the primary adult trapping facility (i.e., East Fork resistance weir) cannot be operated. The proponents give three reasons for the 50% interception objective: (1) to remove HOR to meet the pHOS objective, (2) to collect NOR as broodstock to meet the pNOB objective, and (3) to detect PIT-tagged adults to estimate abundance and survival with the CJS model. The proponents also clarify the broodstock guidelines for winter steelhead (pNOB = 100%, and broodstock mining rate on NOR ≤ 25%). We are uncertain if the 50% trapping goal is sufficient to achieve the more critical pHOS and PNI goals.

For spring Chinook, the goal is to trap 100% of fish migrating to spawning habitat upstream of Moving Falls. A 3-year radio-tagging study indicates that the Moving Falls trap intercepted 86% of the Chinook, on average, because about 10% were able to avoid the trap (and bio-sampling) by ascending the falls directly. Broodstock collection goals for spring Chinook were described for both the 150,000 and 250,000 smolt release options. The broodstock guidelines for spring Chinook are pNOB = 10% and broodstock mining rate on NOR ≤ 25%. Because this is a reintroduction program, no goals have been established for pHOS or PNI. Incorporating more natural origin adults into the hatchery program may increase the rate of adaptation to conditions in the Hood River subbasin. We recommend that pNOB be increased above the 10% value whenever possible, and that goals for pHOS and PNI be developed as NOR increases.

Additional enumeration, sampling, and trapping options: The proponents describe the diversity of species and races of salmonids present in the subbasin and point out that existing electronic options for enumeration (such as resistivity counters or DIDSON) could not adequately identify these targets without subsampling them for physical or genetic identification. After trying DIDSON equipment both in the mainstem and in a smaller tributary, the proponents concluded that DIDSON equipment might work in smaller tributaries and are planning additional evaluations.

The ISRP strongly encourages the proponents to continue developing and testing adult enumeration methods. Robust escapement counts for HOR and NOR fish are critical to evaluating program success. We recommend they explore the feasibility of using newly developed PIT-tag antennas being developed and tested in BPA projects 1983-319-00 (New Marking and Monitoring Technologies) and 1993-029-00 (Survival Estimates for Passage through Snake and Columbia River Dams and Reservoirs). The new antennas might help to increase detection efficiency at the mouth of the Hood River and elsewhere in the subbasin. We also agree that the proponents should attempt to PIT-tag more smolts.

Monitoring and Evaluation of Juveniles

ISRP 2008 Comments:

- Previously, the ISRP identified that more precise smolt estimation is possible with rotary screw traps where there are separate sites for the marking and the recapture of smolts (Dempson and Stansbury 1991, Schwarz and Dempson 1994). Recently, Bayesian techniques for population estimation (Muthukumarana et al. 2008, Can. J. Stats. and see www.cmiae.org for a recent course announcement) have been shown to provide more precise estimation.

  In the future (post-dam removal), evaluations of wild fish capacity, hatchery introductions, and habitat improvement effectiveness evaluations will rely more heavily on smolt statistics than the full-count adult statistics previously available. Thus, a more precise calculation of smolt production is justified. Monitoring in the Revised Master Plan should consider smolt enumeration at several sites. The Revised Master Plans should consider strategic **placement of rotary screw traps** in tributaries to determine their relative smolt contribution, tributary capacities, estimate migration mortality, and in the relation of these fish production metrics to habitat improvement.

- Local expertise is required to carefully select treatment and control tributaries where rotary screw traps might be placed for fish marking to determine the relative contribution to overall smolt yield at a mainstem Hood River recapture and sample site. This could facilitate **assessment of habitat improvement, impacts of residualized steelhead, the introduction of hatchery Chinook and steelhead, and general assessment of fish population dynamics**. Some discussion and consideration of these options within the subbasin or in comparison to other subbasins in a cooperative Provincial context would be a great benefit that could also be an example and reference for others.

ISRP 2019 Comments on the 2019 Response:

Placement of rotary screw traps (RST): The proponents are now enumerating smolts with six RSTs placed throughout the subbasin (i.e., two in the mainstem, two in the West Fork, one in the East Fork, and one in the Middle Fork). Appropriate care was taken in the siting of the projects RSTs. RSTs are installed in the same four locations from one year to the next.

Steelhead (or rainbow trout) migrants >100 mm FL are captured, PIT-tagged and released to estimate their abundance and apparent survival as they move down the Hood River into the Columbia River mainstem and through the Columbia estuary. The precision of the smolt abundance estimates meets NOAA criteria (CV < 15%). We think it should also be possible to analyze scale and tissue samples collected from these smolts to distinguish winter and summer steelhead (and thus, to determine their relative abundance) and to detect the occurrence of steelhead x cutthroat trout hybrids.

In the next iteration of this Step Review, the proponents should explain why no estimates of winter steelhead smolts were calculated after 2014. They should also investigate why estimates of SAR for wild winter steelhead seem to have been consistently and substantially lower for the method based on tag detections at Bonneville Dam than for the method based on total smolt and adult return enumerations for the three years when both methods were used (i.e., smolt migration years 2005 to 2007, Table 2.2.2 in Appendix D, HGMP for winter steelhead)?

Spring Chinook migrants are also captured, counted, PIT-tagged if appropriately sized, and released. The proponents state that too few (198) Chinook smolts are tagged each year to produce reliable population estimates with the CJS model. How many PIT-tagged Chinook are needed in order to provide meaningful values? Can this tag rate be achieved? If not, perhaps it is still feasible to estimate abundance by expanding daily counts based on trapping efficiencies measured over a range of flow rates. For example, trapping efficiency is often estimated by applying temporarily visible marks such as Bismarck Brown dye to fish captured in the RST and releasing them upstream to measure recapture probability. Even imprecise estimates of smolt abundance could give the proponents some ability to detect trends in abundance and fit stock-recruitment relationships to estimate productivity and habitat capacity.

Assessment of fish population dynamics and habitat improvement: The proponents' response indicates that they have made good progress toward improving estimates of smolt production. However, the Addendum includes surprisingly few analyses of these data to evaluate factors affecting the productivity of naturally spawning steelhead and Chinook populations. More analysis will be needed in the next iteration of the Step Review to assess density effects (e.g., on growth, condition factor and survival of juveniles); ecological impacts of Chinook releases on natural origin steelhead; and whether habitat restoration activities listed in Appendix E can be expected to improve the productivity and capacity of natural steelhead in the absence of supplementation. Monitoring and evaluation are essential for measuring progress towards achieving a project's quantitative objectives; otherwise there is little point in having quantitative objectives.

Habitat Restoration and Monitoring

ISRP 2008 Comments:

An effective plan for evaluation of habitat improvement was not presented. According to the Revised Master Plan, habitat restoration will be pursued by placement of several hundred logs instream to improve the distribution of large woody debris. The restoration history, according to the subbasin plan and an excellent assessment and prescription plan seen in previous reviews, indicates many other past actions. Nonetheless, there appears a lack of attention to passive restoration techniques involving the removal of anthropogenic impacts (e.g., grazing in riparian areas) and allowing natural recovery processes to take place. A complementary passive habitat improvement prescription and rehabilitation is not mentioned, but is warranted, and could benefit from the involvement of professional hydrologists and fluvial geomorphologists. As presented, the treatment and evaluation emphasized log emplacements, hypothesized to increase carrying capacity, and was largely dependent on recruitment analysis (adult-to-adult), which will be confounded by out-of-basin effects. A comparison of smolts-per-spawner as a function of the number of spawners in treatment and control areas (tributaries or whole watersheds) may be a more useful approach to evaluation. Perhaps a Gorge Province experimental design is possible, particularly if efforts were combined with those in the Wind River subbasin, and if select tributaries can be involved. At least, some of the metrics for habitat improvement effectiveness evaluation should be incorporated (ISRP 2008-7[7]).

There is no empirical evidence of an increased natural production capacity currently, nor will one be detectable from adult returns alone, particularly with the confounding effects of current hatchery plans and dam removal. This potential increased capacity may be presented already within the subbasin plan's assessment section – if so, a concise summary is warranted. We suggest the recruitment and assistance of statisticians and Provincial workshops to further develop at Step Two an effectiveness monitoring program for habitat rehabilitation to evaluate changes to smolt and, ultimately, adult capacity.

ISRP 2019 Comments on the 2019 Response:

The response and Appendix E provide a good summary of habitat restoration activities. The Hood River Watershed Group has used a holistic watershed restoration strategy (i.e., the 2014 Hood River Watershed Action Plan) to identify restoration projects. These projects have included removal of the Powerdale Dam, screening of irrigation diversions, additions of large woody debris, culvert replacement, irrigation piping, riparian restoration, and instream and upslope restoration (especially decommissioning roads and storm proofing). The Hood River Watershed Action Plan also calls for regular monitoring of water temperatures, pesticides, groundwater, streamflow, water quality, and riparian habitat conditions. Although important, none of these environmental measures assesses how fish are responding to restoration.

In our 2008 review, the ISRP recommended that smolt production in reference and treatment streams (those without and with restoration actions) should be enumerated and compared to assess possible restoration effects. Because smolt production reflects changes in productivity within the subbasin during the freshwater life stages from spawner to smolt, it is a useful metric for measuring the effects of habitat restoration (e.g., ISAB 2018-1). In contrast, metrics for spawner-to-adult productivity are subject to large out-of-basin effects that may confound the effect of habitat restoration within the subbasin. The proponents state that juvenile catch data collected from the West Fork RST, together with parr abundance data from surveys of the

West Fork, will be used to measure how juvenile salmonid productivity and capacity may be changing due to the wide array of restoration actions that have been implemented in this part of the subbasin. It remains unclear if any reference streams will be used or whether the proposed experimental design has been reviewed by a statistician. These analyses must also consider density dependence.

The proponents conclude "*the distinct increase in wild winter steelhead smolt production in recent years (Table 4) clearly corresponds to the removal of Powerdale Dam in 2010."* They also note *"However, the mechanisms are somewhat in question as Powerdale dam was not generating or diverting water for several years before its actual removal, and thus was not expected to have a large impact on downstream juvenile survival (it was a low head dam with negligible reservoir). Eliminating adult migration delay, and handling and sorting at the Powerdale trap, may have provided the largest benefit for steelhead production.*" More analysis is needed to support these statements. Is it possible to compare the trend in production (or ideally productivity) in the Hood River to trends in other basins? Evaluation of the extent to which the productivity of natural steelhead has been or can be improved by habitat restoration is critical to justifying targets for the supplementation program.

Adaptive Management

ISRP 2008 Comments:

An important element of all project master planning is the need for formal decision pathways for managing adaptively. For example, the sponsors indicate that "the need to resume supplementation (following the decommissioning of Powerdale Dam) will be evaluated after two generations…" The ISRP agrees that such evaluations are important parts of any major change in the subbasin. However, we also recommend other strategies (all H's) be considered in addition to supplementation. Moreover, the sponsors should identify in advance what criteria will be used in the evaluation.

ISRP 2019 Comments on the 2019 Response:

The proposed process for adaptive management is conceptually reasonable, but the schedule and procedures for implementation are not described in much detail. The adaptive management process should include quantitative objectives with timelines, robust monitoring of performance metrics, and regular evaluation to assess progress toward achieving the objectives.

In the 2008 Master Plan, the proponents appropriately listed quantitative objectives to be achieved by 2018, but they have not used the 2019 Addendum as an opportunity to explicitly evaluate progress towards those objectives. In the future, the project's 5-year reviews will need to provide more detailed accounts of the results of analyses used to evaluate data on productivity, capacity, relative reproductive success, and effectiveness of habitat actions.

Increased harvest is a key goal and quantitative objective that was identified for steelhead. Footnote 17 in the Addendum indicates that monitoring of winter steelhead harvests will not occur in 2019 due to budget cuts. Because this monitoring is essential to evaluating program success, the proponents should describe how they plan to estimate future harvests.

What is the quantitative harvest objective for hatchery spring Chinook salmon given the proposed increase from 150,000 to 250,000 smolts released from the hatchery?

The goal of self-sustaining natural populations of both winter steelhead and spring Chinook implies the quantitative objective that the metric "returns-per-spawner" will equal or exceed unity (i.e., $R/S \leq 1.0$) on average. More robust monitoring of spring Chinook smolts and adults will be needed to evaluate progress towards this goal. For steelhead, a key question is the extent to which the natural origin component can be self-sustaining at the target level if hatchery fish also spawn in the river.

Quantitative decision rules are needed to specify the conditions and time frames that would trigger a reduction or termination of hatchery supplementation of winter steelhead. We commend the proponents for having acted quickly to discontinue hatchery releases of summer steelhead when it became evident that they were no longer warranted to meet harvest demand. That decision reassures us that the co-managers will consider data and adapt decision and programs appropriately as they acquire information on the status of natural winter steelhead. What we are asking for is more explicit contingency planning for "off ramp" options to discontinue hatchery production of winter steelhead. Appropriate triggers might include a continuing decline in natural origin returns that reduces pNOB to below a specified threshold or a continuing increase in natural spawners (i.e., both HOS and NOS) to densities that cannot be self-sustaining in the existing habitat.

The proponents should provide more details about how they will evaluate potential environmental impacts from increasing releases of spring Chinook salmon from 150,000 to 250,000 smolts, including potential impacts of releasing smolts from broodstock collected in another watershed (i.e., the Deschutes River subbasin) and of interactions between Chinook smolts and natural salmonids including steelhead in the Hood River. These details were not provided in the Addendum or the response to ISRP concerns

The proponents should also explain how their adaptive management process will enable review and refinement of specific methods, for example, how smolt and adult abundances are estimated, or how in-hatchery performance is measured.

Facilities

ISRP 2008 Comments:

Why were improvements at Moving Falls made prior to the completion of the Comparative Release Study?

ISRP 2019 Comments on the 2019 Response:

The proponents explain that the Moving Falls Fish Facility (MFFF) was intended to be used for acclimation and release of smolts used in the comparative survival study. A two-year delay in construction, however, required them to improvise and release fish at several alternative locations until raceways could be established at MFFF. Fiberglass raceways were installed initially, but they proved inadequate and were replaced by concrete raceways. The concrete raceways were used consistently for the last four years of the comparative survival study. Thus, changes to acclimation protocols at MFFF during the comparative survival study were necessitated by unanticipated construction delays and problems with existing infrastructure.

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