TECHNICAL REPORT
Critical Review of Construction Phase Upstream Fish Passage and 10% Design at Proposed Chehalis Dam

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Introduction

At the request of the Quinault Indian Nation, I have reviewed the set of documents prepared to advance the design of an upstream fish passage facility that would be used during the construction phase of a proposed Flood Retention Expandable (FRE) facility on the upper Chehalis River. The proposed FRE facility is being considered for construction authorization under the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA) by the U.S. Army Corps of Engineers and Washington State Department of Ecology (Ecology), respectively.

The documents reviewed here describe the process used by a consultant team to develop conceptual design alternatives for upstream fish passage that would be used during the construction phase of the FRE facility. The documents then present the analysis used by the team to compare the alternatives, recommend an alternative for adoption, and finally to develop the recommended alternative to the 10 percent design level.

The documents were prepared for the Chehalis River Basin Flood Control Zone District (FCZD) by HDR Engineering, Inc. (HDR). The consultant team that developed the fish passage analysis consisted of engineers and biologists from HDR and Anchor QEA, LLC.

The construction phase fish passage is needed for passing target species and life stages throughout the duration of the construction period. Construction is anticipated to last three to five years and fish passage must be provided during the entirety of this period.

The focus of the fish passage design work for the construction period was on upstream passage only. Downstream fish passage during construction is to be accommodated through the flow diversion tunnel (HDR 2018; FCZD 2019). The HDR technical memoranda appear to assume that downstream passage impacts would be trivial, and therefore are essentially ignored in discussions about expected impact levels. I would note, however, that the DEIS assumed a downstream passage survival of 85 percent during construction (DEIS, p.E3-5), which is a significant adverse effect. No explanation is given anywhere in the technical memoranda for why this matter is apparently being ignored in advancing the facility design for the construction phase.

My review is presented in three sections:

1. Summary of the stated need and proposed solution;
2. Analysis; and
3. Issues, implications, and findings.

Throughout this review, I use the word "subpopulation" to refer to the spawner aggregations of salmonid species that spawn in the upper Chehalis Basin. In doing so, I am not implying that the population structures of the salmonid populations are clearly understood—they are not. We know, however, that differences exist in how various spawner aggregations in different areas of the basin have performed over time. Some spawner aggregations are more robust than others and exhibit greater resilience to habitat alterations from land and water uses (McConnaha et al. 2017; ASRP Steering Committee 2019). Some have demonstrated steeper declines in recent decades (e.g., Lestelle et al. 2019). We also know that subpopulations spawning upstream of the South Fork in the Chehalis River exhibit notable genetic differences from those spawning downstream of that point (Seamons et al. 2017 and 2019).

Summary of Stated Need and Proposed Solution

The proposed FRE facility will block upstream movements of all fish species at certain flow levels during its operation. These species include all salmon and steelhead produced in the upper Chehalis Basin both upstream and in the vicinity of the proposed FRE location.

The upper Chehalis Basin in this area was a major producer of anadromous salmonids. Although their abundances currently are much reduced from historical levels for a variety of reasons, these subpopulations still have key roles in ensuring the long-term viability and natural production of these species in the Chehalis Basin. Their importance for ecological and biological reasons is undeniable. Their importance for treaty protected fisheries also is beyond challenge.

The FCZD has engaged its consultant team to design the fish passage facility to maintain fish passage during the life of the proposed project. The construction period poses unique challenges for maintaining fish passage because the need will run continuously over the entirety of the construction period and essentially all flow levels will need to be addressed.

The consultant team was asked to develop and compare alternatives for fish passage during construction, recommend an alternative, and develop the recommended alternative to a 10 percent design level. The construction phase fish passage is required to pass target fish species and life stages throughout the duration of the construction period. The following process was used to develop and evaluate these alternatives: (1) assemble data to establish project design objectives based on agency criteria and guidelines, (2) formulate an array of potential construction phase fish passage and barrier technologies, (3) define feasibility criteria and evaluate feasibility of passage and barrier technologies, (4) formulate alternatives from the array of fish passage and barrier technologies that meet minimum feasibility requirements (5) evaluate alternatives against established design criteria and recommend a single alternative for design development, (6) develop the recommended alternative to a 10 percent design level.

Three conceptual design alternatives for a trap and transport facility with a velocity barrier downstream of the diversion tunnel outlet were developed and compared against evaluation factors. Ultimately, Alternative 3 – Trap and Transport Facility at Location 1 Using Permanent Facility Elements was recommended. Following FCZD concurrence with the recommended alternative, this alternative was developed to a 10 percent design level. The description of the 10 percent design of the construction phase fish passage includes: refined design criteria, preliminary design of the facility, theory of operation for the facility, and construction sequencing.

Analysis

The documents that provide background information and specifics for the proposed action were reviewed along with key reports that give details of passage criteria and guidelines from the National Marine Fisheries Service (NMFS) and Washington Department of Fish and Wildlife (WDFW). I also reviewed again previously completed technical review reports of which I was a co-author pertaining to the effects of the proposed FRE facility on Chehalis Basin fisheries resources. These documents are listed below:

- Anadromous Salmonid Passage Facility Design. (NMFS 2011)
- Fish Passage and Surface Water Diversion Screening Assessment and Prioritization Manual (WDFW 2009)
- Fish Passage Inventory, Assessment, and Prioritization Manual. (WDFW 2019)
- Fish Passage: CHTR Preliminary Design Report. Prepared for the Washington State Recreation and Conservation Office and Chehalis Basin Work Group. (HDR, February 2018)
- FCZD (Chehalis River Basin Flood Control Zone District). 2019. Proposed Flood Retention Dam Construction Schedule Supplemental Information. Submitted to the Washington Department of Ecology and the United States Army Corps of Engineers (FCZD, August, 2019)
- Review of Impacts on Fish and Fisheries as Presented in the SEPA DEIS Evaluation of Flood Protection in the Chehalis Basin (Lestelle and Morishima, 2020)
- Salmon Population Modeling for the SEPA DEIS Evaluation of Flood Protection in the Chehalis Basin (Lestelle and Morishima, 2020)
- Existing All Species Fish Passage Facilities Research Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, March 1, 2021)
- Description of Construction – Phase Fish Passage Facility Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, August 20, 2021)
- Temporary Construction Facilities Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, August 23, 2021)
- WA Ecology: Information from FCZD Related to SEPA Final EIS, 5. Fish Passage Design – Response to Requested Information. Prepared for Chehalis Basin Flood Control Zone District. (HDR, November 15, 2021)
- Temporary Construction Facilities Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, December 17, 2021)
- DRAFT - Construction Phase Upstream Fish Passage Alternatives Selection Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, January 28, 2022)

- Construction Phase Upstream Fish Passage Alternatives Selection and 10% Design Technical Memorandum. Prepared for Chehalis Basin Flood Control Zone District. (HDR, February 25, 2022)

Issues, Implications, and Findings

1. Salmonid subpopulations are particularly vulnerable in the upper basin: Salmon and steelhead populations are generally declining throughout the Chehalis Basin (McConnaha et al. 2017; ASRP Steering Committee 2019). In particular, spring Chinook have exhibited sharp losses over the past several decades in areas upstream of the confluence of the South Fork and the mainstem Chehalis River (Phinney and Bucknell 1975, Weyerhaeuser 1994, Ronne et al. 2020, Gilbertson et al. 2021). The decline of spring Chinook in these areas is believed to be due mainly to legacy effects of logging, combined with continued intensive timber management (ASRP Steering Committee 2019). Other effects from factors dispersed over the species life cycle, including harvest, have contributed to the decline. Recent genetics analysis of Chinook fry produced in the upper Chehalis River indicate that the abundance of remaining spring Chinook in that area is fewer than estimated based on spawning ground surveys (Gilbertson et al. 2021). The decline in abundance has apparently also increased the rate of hybridization between spring and fall Chinook (Gilbertson et al. 2021), which has further eroded the viability of spring Chinook spawning there (Thompson et al. 2019a and 2019b).

   In contrast, the steelhead subpopulation produced in the upper mainstem Chehalis River has appeared more stable—but it too, like all wild steelhead populations along the Washington coast, is now demonstrating steep declines (various news releases in 2020 and 2021 by WDFW). Heightened concerns exist about the long-term viability of coastal Washington steelhead given these declining patterns. Concerns about the upper Chehalis subpopulation are especially elevated because of its role as a core subpopulation within the overall Chehalis Basin.

   The implications of these declines in salmon and steelhead in the upper Chehalis Basin—including those upstream of the proposed dam—are significant. The subpopulations in that area are particularly vulnerable to any adverse effects of the proposed dam. Their weakened condition makes them much more susceptible to loss in viability—and extirpation—compared to more productive subpopulations because of their low intrinsic productivity and increased interannual variation (Mobrand et al. 1997; Lestelle et al. 2018; Lestelle 2021).

   The analyses of alternative fish passage solutions presented in the HDR technical memoranda provide no consideration of implications of possible adverse effects of the proposed action on the affected subpopulations. A recommendation is made to FCZD on the preferred alternative without any such considerations (HDR, 2022b; p61).

2. Complexity of proposed solutions: The FRE facility—in concept, design, and implementation—is complex (Ecology 2020). As proposed, it is not a conventional dam. Its components and operations, if built, would be far from conventional. Consequently, the fish passage components, particularly with respect to the upstream passage components, are complex.

   In some ways, the proposed upstream fish passage facility recommended for the construction phase is more complex than for the permanent FRE facility and likely would have much greater adverse impacts than the permanent facility. During the construction phase, upstream fish passage would need to be accommodated over an extremely wide range in flows, whereas the permanent facility would only be operating at high flows (aside from the aspect of passage through the dam via dam outlets or conduits at low to moderate flows).

Upstream fish passage operations at the permanent facility would not operate every year since dam closure is projected to occur approximately once every seven years, only during major flood events. In such an event, upstream passage operations might last for about a month. In contrast, upstream fish passage operations would run continuously during the construction phase—year-round during essentially all flow levels—for a three to five-year period. Upstream movements of fish, by either adults or juveniles or both, can be expected every month of the year. Thus, opportunities for adverse effects on fish attempting to move upstream are greatly increased compared to the permanent facility due to a greater likelihood for equipment malfunction, manpower shortages, or other unforeseen events.

Upstream passage of all fish species, including all of their mobile life stages, is required by Washington State law at all structures placed within a flowing stream (WAC 220-660-200). It appears that WDFW tightened its guidance to the fish passage consultant team after the draft SEPA EIS (DEIS; Ecology 2020) was released. For the draft SEPA EIS, the conceptual design for upstream fish passage during the construction phase used a picket type weir to attempt to block upstream moving fish and guide them into the collection and transport facility. The DEIS did not specify what type of a picket weir would be used, but presumably it would be a resistance-board type structure. Picket weirs, including resistance-board types, are typically ineffective during freshet conditions (Wilson et al. 2019; Lestelle and Morishima 2020; HDR 2022b). I note that passage provisions during the construction period are required to be just as effective as for post-construction operations (NMFS 2011).

The fish passage consultant team as part of the DEIS concluded that it would be unlikely to achieve the same criteria during construction (Appendix E3 of DEIS, p.E-10-11). The fish passage team assumed that passage effectiveness would be substantially lower during construction than during post-construction for all species but particularly for coho and steelhead (Tables E3-4 and E3-5 of DEIS, p.E3-12 and p.E3-14).

In January 2021, WDFW requested FCZD to “set the bar high” in developing passage alternatives for final design by providing passage for all species and life stages (HDR, 2022a; p5). However, there is considerable uncertainty about the behavior and passage requirements for some species and life stages (HDR 2021, p2). Consequently, a list of “target species” and target life stages was developed and used for facility design. The fish passage consultant team assumes that this “meets both the intent and letter of WDFW’s request” (HDR, 2022a; p5).

To address this need during the construction phase, the consultant team developed a set of components intended to provide upstream passage under all flow conditions that would need to be accommodated. The components were developed to accommodate the target fish species and life stages identified here in Table 1. I note that this table was originally formulated in 2018 (HDR 2018)—it is not clear to me how this may have been updated following guidance given by WDFW in January 2021.

Table 1. Target fish species and life stages targeted for the construction phase upstream fish passage facility (from HDR 2022b; p7).

Species	Upstream Passage
Spring-Run Chinook Salmon	Adult, juvenile
Fall-Run Chinook Salmon	Adult, juvenile
Coho Salmon	Adult, juvenile
Winter-Run Steelhead Trout	Adult, juvenile
Coastal Cutthroat Trout	Adult, juvenile
Pacific Lamprey	Adult
Western Brook Lamprey	Adult
Resident fish, including: River Lamprey, Largescale Sucker, Salish Sucker, Torrent Sculpin, Reticulate Sculpin, Riffle Sculpin, Prickly Sculpin, Speckled Dace, Longnose Dace, Peamouth, Northern Pikeminnow, Redside Shiner, Rainbow Trout, Mountain Whitefish	Adult

The construction phase trap and transport facility were designed to include six main components:

- Velocity barrier - This is a concrete channel-spanning structure located downstream of the diversion tunnel outlet (used to diver flow away from the dam construction site). It prevents upstream fish passage into the construction site, including the diversion tunnel, during construction while allowing for unimpeded downstream passage of fish. This structure took the place of the picket weir, which was proposed in the DEIS. The velocity barrier, if designed properly, should be effective at preventing undesired upstream passage over the structure.
- Water supply – The facility requires a constant supply of water with the amount varying substantially depending on flow level in the river. The amount needed can vary greatly on a daily basis. Water is supplied to most elements of the facility via either gravity or from pumped intakes. Water is collected at two separate locations, one located downstream of the velocity barrier and the other located upstream. Some pumping occurs at all times. The system is complex; it appears that it will require a high level of monitoring and maintenance, which is likely to vary by flow level in the river. Disruption to the water supply for whatever reason would effectively shut down the upstream passage facility.
- Fish entrances – Two separate entrances from a pool located just downstream of the velocity barrier are intended to attract fish from the river into the passage facility. Water velocity and size of the entrance may differ between the two entrances but this will depend on the flow level in the river. One entrance is intended to draw adult fish in, while the other is designed to encourage entry of resident and juvenile sized fish. A lamprey ramp is also associated with the entrance structure for resident and juvenile fish. Some specifics of these

entrances are still in design and uncertainties exist about how well the structures will work. I comment further on these structures under the issue "Low flow solution especially problematic."

- Collection, holding, and sorting facilities – The fish entrances lead into holding pools, in which fish can be crowded and forced into either an adult or juvenile hopper. Once in a hopper, a gate closes and a gantry crane lifts the full hopper 60 to 80 feet vertically to a fish transport pipe with separate pipes for adults and juveniles. The fish are then transported to sorting and holding buildings via the transport pipes. In a sorting building, the fish would then be processed, including any sampling as desired. The adult fish are then moved to overhead holding tanks located in the sorting building or to the juvenile and resident fish transfer station.
- Vehicle with a transport tank of water - Transfer of the collected target species to the transport trucks would take place via water-to-water transfer from the holding stations.
- Designated release locations - The transport trucks would then move the adult salmonids and steelhead, juvenile and resident fish, and lamprey upstream to predesignated points of release. Release sites have not yet been identified.

The fish passage consulting team developed three alternatives for evaluation with each alternative comprised of the six main facility components described above. Some differences among the alternatives are the location of the velocity barrier and locations of certain other elements. Using an evaluation procedure, one alternative was recommended to FCZD, which was then adopted by FCZD and moved into the 10 percent design phase.

I have reviewed the evaluation process and the various criteria and guidelines that are described in HDR (2022b). Overall, I find that the criteria and guidelines are consistent with those given in NMFS that would be applicable to ESA-listed species (NMFS 2011); NMFS states "If passage facilities are designed and constructed in a manner consistent with these criteria, adverse impacts to anadromous fish migration will be minimized." I largely concur with the conclusions and findings applied but I still have some serious concerns. My major concern under this issue is that the facility is complex, both in design and operations. Some of the proposed elements are unproven and experimental (e.g., the trap and transport elements for resident and juvenile fishes and lamprey). It is likely that there will be various items that will need some redesign and reconfiguring to achieve the intended objectives, if indeed all of the objectives can be achieved. Assuming such a need, it can be expected that there will be some disruption to upstream passage during the construction phase of the FRE facility. HDR (20022b) did not discuss possible disruptions to upstream passage. I have other concerns, which are described below.

3. Critical uncertainties with some aspects: There are many uncertainties with various aspects of the proposed facility for operations during the construction phase. Potentially some of these might be resolved during startup and initial operations but considerable uncertainty exists with new fish passage designs (e.g., Appendix E3 of DEIS, p.E-21-22. It is important to recognize that new fish passage facilities at dams typically require multiple years, sometime many years, to work out the "bugs" in the designs and achieve the desired passage effectiveness objectives. Three categories of uncertainty bear particular attention here and these are not likely to be resolved during startup.

- Effectiveness for passing resident and juvenile fish and lampreys – I noted this uncertainty above but it bears elaboration here. I consider this a critical uncertainty for the facility as the design and proposed operations for these species and life stages are largely experimental. This point is made in a number of places in the technical memoranda, as stated here in the design process:

  "Designing the facility for smaller, resident and juvenile fish would be an experimental undertaking, but is anticipated to be possible through careful consideration of fish swimming behavior and selection of trap and haul components." HDR (20022b, p37)

  Recognizing the lack of knowledge about these species and life stages warrants some level of commitment by FCZD to continue to gather data and improve understanding. WDFW should be provided funding to continue studies on these species in the upper Chehalis basin.

- Potential for landslide at the site of the upstream passage facility – The selected alternative shares a significant footprint with the proposed permanent upstream passage facility, at the toe of an identified landslide (Shannon & Wilson 2016) (HDR 2022b, p54). Shannon & Wilson (2016) note that more substantial retrogressive-type failures for this landslide are unlikely, but nonetheless, they recommended implementing mitigation measures such as monitoring the landslide for movement and installing deep drains, structural reinforcements, and stability berms. HDR (2018, p24) considered the recommendations by Shannon & Wilson (2016) as preliminary and recommended further evaluation of the stability issue as design moves forward. I am not aware of whether or how this matter has been further evaluated.

- Potential for impeding passage of spring Chinook – During the construction phase of the FRE facility, the species that will likely be most impacted by impeding upstream passage is spring Chinook. Upstream passage of spring Chinook will be important for the entirety of the April to early October period of each year. These fish may be moving upstream at any time in this period. Unfortunately, it is not known with greater clarity what their temporal migration pattern is in the general vicinity where the facility would be located. Moreover, the pattern may change between years with differences in flow levels. The difficulty in passing adult spring Chinook would likely be greatest when river flow is low. At that time the attraction flow being discharged from the adult fish entrance was stated to be approximately 3 cfs (HDR 2022b, p68). This low amount of attraction flow likely will be a problem. There is very significant uncertainty about how effective the facility will be for spring Chinook when flows are relatively low.

  It bears noting that no mention of this uncertainty and its possible adverse effects were mentioned in the HDR technical memoranda.

  This uncertainty requires further discussion, which I give immediately below.

4. Low flow solution especially problematic: As noted above, this issue poses an especially critical problem for upstream passage of spring Chinook during low flow periods. Two reasons bear on this issue. The first is that during low flows, the flow leaving the holding pool and exiting through the adult fish entrance would be minimal, as little as 3 cfs. This amount would be <20 percent of the flow in the river at that time. The amount would provide very little attraction for wild adult Chinook and it seems likely that passage would be impeded. My own observations on upstream migrating

adult Chinook in rivers on the Washington coast over many years support this view. Wild adult Chinook rarely enter small tributaries with low flows of this level.

The problem of low attraction flow during relatively low flow periods is significantly compounded by trying to draw the fish through a relatively narrow opening in the fishway entrance and then through a fyke into the holding pool. HDR (2022b, p68) states "*Once fish swim through the appropriate fishway entrance, they pass through a fyke and enter a fishway holding pool*." This statement is an assumption, not born out by cited evidence or by any discussion in the HDR document. It is given simply as a statement of fact. (Note: a fyke is a constriction within a device, such as fish trap, used to allow fish to enter but then once they enter making it difficult for them to turn around and exit.)

Recent discussion by a committee of fish scientists working on a spring Chinook issue in the Skookumchuck River bears this out. Dr. Mara Zimmerman, former chief research scientist with WDFW and now with the Coast Salmon Partnership, described the problem of trying to induce adult Chinook through a constriction in an upstream blocking weir:

"I have been thinking more about past lessons learned regarding how to set up a system for adult Chinook salmon monitoring. WDFW has operated river spanning weirs (resistance board) for multiple years on the Lower Columbia River tributaries primarily for the purpose of managing hatchery/natural spawner composition. From that work, there has been a lot learned about the impacts of river spanning weirs and trap boxes on Chinook migration behavior. In short, adult Chinook will stack up behind the weirs and they don't like to go into trap boxes. More than any other salmonid species, Chinook avoid the trap boxes." (M. Zimmerman, personal communications via email dated May 8, 2022).

It is very likely that the proposed facility for passing adult spring Chinook during relatively low flows, as well as during higher flows, will impede upstream passage. In effect, the facility combined with the velocity barrier is likely to act as a complete or near complete blockage to upstream migrating spring Chinook. This would pose a high, significant risk to spring Chinook in the upper Chehalis Basin.

I would further note that this same issue is likely to adversely affect the passage of fall Chinook during the construction phase of the project. Although fall Chinook would be migrating during higher flows during September and October, they too tend to avoid entering small entrances in weirs or other obstructions. Migration is often delayed, or even prevented, when such obstructions are encountered, resulting in a redistribution of spawning occurring downstream (Wilson et al. 2019).

It bears noting that HDR neither identified nor discussed any of this issue in its technical memoranda.

5. <u>Proposed passage solutions will accelerate declining abundance trends</u>: As described in the issues listed above, there would likely be significant, adverse effects on the salmon species produced in the upper Chehalis Basin, most notably for spring Chinook, by building and operating the construction phase passage facility. These effects would occur through increased mortalities as well as a redistribution of spawners from their natal sites. Adverse effects would also occur on resident fish species. Effects would occur over a continuous three to five-year period. However, adverse impacts

could be expected to be still higher for other reasons not listed above. These effects would be the result of a variety of factors such as trapping and handling stress, transportation effects, and associated release and delayed mortality.

HDR (2021, p5) assumed that the estimated passage survival of the trap and transport facility during the construction phase would be the same as that of the permanent facility passage facility as originally developed by the Fish Passage Technical Subcommittee (Table 2). It might be argued that the total survival values would be somewhat less due to break-in issues that are likely to be encountered during the construction phase for the FRE facility. It is important to note that there is considerable uncertainty associated with the values in Table 2. This is illustrated by another table (Table 3), published by the same subcommittee in Appendix E3 of the SEPA DEIS (Ecology 2020); values in this table were used in the EDT modeling applied in the DEIS. Table 3 is recreated from the original table used in the DEIS with a column removed that gave the assumed trapping efficiency values associated with a picket weir used for the DEIS; cumulative passage effectiveness values are recomputed in this table without the passage efficiency values. Note that the values for spring and fall Chinook in Table 3 are much different that the total survival values given in Table 2. This illustrates the level of uncertainty that exists and that the values are simply educated guesses.

Table 2. Capture, handling, transport, and release anticipated performance and survival (from HDR 2021; p5). Total Survival is the product of Performance and Survival. This definition was adopted by the Fish Passage Technical Subcommittee as part of the 2017 fish passage alternatives assessment (HDR 2017).

TARGET SPECIES	PERFORMANCE	SURVIVAL	TOTAL SURVIVAL
ADULT UPSTREAM			
Spring Chinook	93%	98%	**91%**
Fall Chinook	93%	98%	**91%**
Coho	93%	98%	**91%**
Winter Steelhead	93%	98%	**91%**
Coastal Cutthroat	88%	98%	**86%**
Pacific Lamprey	60%	90%	**54%**
Western Brook Lamprey	60%	90%	**54%**
JUVENILE UPSTREAM			
Spring Chinook	60%	90%	**54%**
Fall Chinook	60%	90%	**54%**
Coho	60%	90%	**54%**
Winter Steelhead	65%	90%	**58.5%**
Coastal Cutthroat	60%	90%	**54%**

Table 3. Estimated upstream passage effectiveness for adult salmonids applied in passage analysis for the SEPA DEIS (recreated from DEIS, Appendix E3, pE3-12).

SPECIES/RUN	HANDLING AND TRANSPORT TRUCK LOADING SURVIVAL	TRANSPORT, RELEASE, AND DELAYED MORTALITY	CUMULATIVE FISH PASSAGE EFFECTIVENESS (SURVIVAL)
Spring-run Chinook Salmon	0.90	0.80	0.72
Fall-run Chinook Salmon	0.95	0.85	0.81
Coho Salmon	0.95	0.95	0.90
Steelhead	0.95	0.95	0.90
Cutthroat	0.95	0.95	0.90

Assuming, however, that the survival values listed in Table 2 are essentially correct, it is important to recognize that the related mortalities (or 9 percent loss in performance to the subpopulation) are not trivial. A 9 percent loss in performance for a productive subpopulation can be absorbed, much like a harvest rate without an overall loss in production potential, but the same loss for a subpopulation that is in decline and possibly spiraling toward extirpation is very significant. In that case, overcoming that additional loss poses a high risk to the viability of the subpopulation. The status of Chehalis River spring Chinook is such that it may not be able to sustain much if any new, on-going mortality without driving it to extirpation. The HDR technical memoranda provide no assessment of the implications of effects of performance loss given in Table 2 or of the cumulative effects to be incurred combined with the other issues above. The real problem, of course, is the cumulative effect of all of these factors added to the already poor intrinsic productivities of the subpopulations due to other habitat impacts. Those other impacts occur both upstream and downstream of the proposed FRE facility. The combined cumulative effect of all of these impacts is the reason why salmon and steelhead populations in the Chehalis Basin are in decline.

I conclude that proposed passage solutions during the construction phase adds significant risk of loss in biological viability to the salmon and steelhead subpopulations produced in the upper Chehalis Basin.

6. No-net-loss in aquatic habitat function unattainable: FCZD has made a formal commitment to achieve no-net-loss of aquatic habitat function as a result of building and operating the FRE facility (letter from FCZD dated August 30, 2021 sent to Rich Doenges with Ecology and Brandon Clinton with the U.S. Army Corps of Engineers). This includes any adverse effects that would be incurred during the construction phase.

   The FCZD letter states that the commitment would be fulfilled through a combination of impact avoidance, minimization, and compensatory mitigation. Based on a preliminary assessment, FCZD believes that mitigation is technically feasible and economically practicable, and that sufficient opportunities are available to mitigate for the project impacts to habitats and species. Mitigation would employ the same kind of habitat restoration and enhancement techniques as the Aquatic Species Restoration Plan (ASRP) and other regional salmon recovery efforts.

The FCZD provides no explanation of what no-net-loss means or analysis or evidence to back up its claims; nor does the memorandum from the Kleinschmidt Team addressing the same matter (Kleinschmidt 2021).

This commitment is unattainable if the FRE facility is built as proposed. The reason is that FCZD is using faulty rationale in assessing what the true impacts would be from the facility. As explained in the technical report entitled "Review of Impacts on Fish and Fisheries as Presented in the SEPA DEIS Evaluation of Flood Protection in the Chehalis Basin" (Lestelle and Morishima 2020), FCZD is assessing the impacts based largely—if not entirely—on loss in abundance of the subpopulations produced upstream and in the vicinity of the proposed dam. In effect, FCZD is overlooking the critical importance of spatial structure (distribution) and biological diversity (e.g., genetic diversity) that is provided by the production of salmon and steelhead in this area. These two characteristics are key aspects of a viable salmonid population (VSP), as specified by NMFS in McElhany et al. (2000). Loss in these characteristics of a VSP are not biologically fully mitigable.

The types and amount of mitigation that FCZD appears to be basing its commitment on for no-net-loss is that current levels of production of fish in the area of the proposed FRE facility, and notably of spring and fall Chinook, are extremely depressed. Spring Chinook may be moving toward extirpation in the area unless steps are taken to reverse the pattern. So, the logic seems to be that the total loss of a few more fish should be easily mitigated if the measure of loss is based only on the abundance as it currently exists. But it is clear that the upper Chehalis Basin subpopulation of spring Chinook was once a major production area of spring Chinook (Weyerhaeuser 1994). And it is likely that this subpopulation is critical to the recovery and long-term viability of spring Chinook in the Chehalis Basin (Lestelle and Morishima 2020). For this reason, the ASRP has placed a high priority on restoration of habitats in that area (ASRP Steering Committee 2019).

Beginning with the construction phase of the FRE facility, and then continuing for decades into the future, the proposed project would effectively foreclose restoring both habitat and spring Chinook to the upper basin in the vicinity and upstream of the project.

7. <u>Lack of clarity on differences between construction and post-construction aspects</u>: As a final remark, I am highlighting that the HDR technical memoranda do not make it clear the differences between the construction phase of the passage facility and the passage elements in the permanent facility, and why certain aspects differ between the two. After carefully reading and re-reading the various documents, including those published in 2017 and 2018, I was able to understand the differences. Still, it would have been very helpful if the writers had made the differences, including the rationale for the differences, more transparent in the most recent documents.

References

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