TECHNICAL REPORT
Salmon Population Modeling and Aquatic Species for the NEPA DEIS Evaluation of Flood Protection in the Chehalis Basin

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[1] CVs are appended to "Review of Impacts on Fish and Fisheries as Presented in the SEPA DEIS Evaluation of Flood Protection in the Chehalis Basin" dated May 7, 2020. Both have extensive experience developing and reviewing fisheries, environmental, and ecological computer models, including EDT and the Hybrid models utilized to inform SEPA and NEPA.

Executive Summary

The US Army Corps of Engineers (USACE) released a draft National Environmental Impact Act (NEPA) Draft Environmental Impact Statement (NEPA DEIS) for public comment during a 60-day period ending November 17, 2020.

A technical team comprised of two well-qualified scientists with expertise is salmon management and modeling, Larry Lestelle and Gary Morishima, reviewed information presented in Section 4.5 "Aquatic Species and Habitats" and Appendix K, "Discipline Report for Aquatic Species and Habitats" of the NEPA DEIS. We provide comments on information, data, and materials provided by the NOAA and ICF individuals involved in performing supporting modeling work reported in the NEPA DEIS to evaluate impacts of the FRE and NAA on four salmonid species (spring and fall Chinook, coho, and winter steelhead). For convenience, all of these species are collectively referred to as salmon unless we specifically have reason to differentiate steelhead impacts.

Our report does not provide an in-depth review of the NEPA DEIS, but rather supplements two technical reports produced by Lestelle and Morishima[2] for the Washington State Department of Ecology's (ECY) Draft Environmental Impact Statement (SEPA DEIS).

For convenience, the NEPA DEIS and SEPA DEIS are referred to as "NEPA" and "SEPA", respectively.

<u>Alternatives Evaluated</u>

NEPA and SEPA assessments focus on impacts of an expandable flood retention (FRE) facility and airport levee improvements proposed to reduce flood damage in a portion of the upper Chehalis River Basin in Washington State compared with a No Action Alternative (NAA). While both NEPA and SEPA identified a third alternative, neither provided substantive evaluation. Following closure of the public comment period for SEPA, Governor Inslee requested that a non-dam basin-wide alternative be developed.

NEPA does not provide an alternative that attempts to address the twin goals of reducing flood damage and restoring aquatic species under the Chehalis Basin Strategy.

<u>Methods Employed for Evaluation of Impacts</u>

Both NEPA and SEPA rely on the same methods and models (the Ecosystem Diagnostic Treatment (EDT) and integrated EDT-Life Cycle Model (LCM) Hybrid (hereafter referred to as "Hybrid") to evaluate impacts of the FRE and NAA. Both utilize the same population structures, geographic area, and time periods for reporting impacts (during FRE construction, and at mid and late century), and assumptions regarding early action habitat restoration, culvert removal, and future degradation resulting from development.

The major difference in methods used in NEPA and SEPA model-based assessments is due to their treatment of climate change effects. NEPA does not attempt to evaluate impacts of climate change, while SEPA included a superficial evaluation of changes in future precipitation, temperature, flood peak flows, and streamflow for mid and late century.

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[2] "Salmon Population Modeling for the SEPA EIS Evaluation of Flood Protection in the Chehalis Basin" dated April 18, 2020; and "Review of Impacts on Fish and Fisheries as Presented in the SEPA DEIS Evaluation of Flood Protection in the Chehalis Basin" dated May 7, 2020.

The number and kinds of errors that became apparent in our reviews cause us to question the quality assurance and control procedures applied in both NEPA and SEPA. This alone is troubling but it draws into question the entire body of modeling findings reported.

Projected Impacts of Alternatives

FRE: For salmon populations originating above Crim Creek (the area that would be inundated by the FRE facility), both NEPA and SEPA conclude that populations of spring and fall Chinook, coho and steelhead originating in the vicinity of the FRE facility and upstream of it, would be significantly and adversely affected beginning with construction activity. NEPA concludes that:

> *"Overall, the EDT model predicts that the FRE structure would have significant negative impacts on all four modeled species in the upper watershed (Above Crim Creek), and especially on spring-run Chinook salmon. While at a basin-wide scale impacts are predicted to be minimal for most modeled species, it should be considered that the upper watershed Above Crim Creek is currently beneficial salmonid habitat that can provide a buffer against future potential degradation, including climate change effects that were not included in this NEPA analysis, in the watershed. " pg. 251/374 Appendix K*

NAA: For salmon populations originating above Crim Creek, SEPA indicated that spring Chinook, coho, and steelhead populations were projected to decline by late century to very low levels that would pose high risk biological extinction. In contrast, NEPA projects increases in spring Chinook, coho, and steelhead and a slight decrease in abundance of fall Chinook. These disparate projections for late-century FRE and the NAA are due to different baseline climate change related assumptions employed for modeling.

The limited scope of assessment, the methods and assumptions employed likely underestimate potential adverse effects of the Proposed Project on salmon populations in light of the sensitivity of salmon to increasing variability and extremes in precipitation, streamflow, and temperature patterns.

Neither NEPA nor SEPA identify or evaluate mitigation actions to offset adverse impacts. However, we do not believe that the impacts would be biologically fully mitigable due to the impact from the loss of irreplaceable biological components of the populations important for viable salmonids. We conclude that the Proposed Project poses a critical threat to the future sustainability of salmon and related resources in the upper Chehalis Basin.

Impacts of alternatives are summarized Tables presented in Table ES-1 of NEPA (pg24/302). Key findings for Aquatic Species and Table ES-1 of Appendix K for aquatic habitat and species (pg14/374 and pg16/374, respectively. Section 4.5 of Appendix K summarizes "key findings" which include:

- High direct and indirect impacts to anadromous salmonids and lamprey in the study area
- High direct and indirect impact to spring-run Chinook at the Chehalis Basin scale from loss of habitat diversity in the study area

Section 3.6.2.1 of NEPA defines Direct and indirect impacts.

> *"Direct impacts are those that would occur as the result of, and at the same time and place as the activities authorized by a DA permit (40 CFR 1508.8). These impacts may be temporary or permanent in duration, and would only occur as a result of construction activities. Direct impacts would only occur within the flood retention facility and Airport Levee Improvements project areas."*

"Indirect impacts would occur later in time or farther in distance from the immediate project location but would be attributable to project actions authorized by the DA permit. These impacts could be temporary or permanent, and include secondary effects from construction, such as increases in traffic to and from construction sites. Indirect impacts also include those that would occur as the result of operating the alternatives, such as changes in downstream flooding, including effects in the Chehalis River 100-year floodplain area. Indirect impacts would occur later in time or farther in distance from the immediate project location but would be attributable to project actions authorized by the DA permit."

For purposes of impacts on fish or aquatic species, however, the distinction between direct and indirect impacts is immaterial.

Presentation of Impacts

The format and content of the information presented in NEPA are confusing and difficult to interpret. Both NEPA and SEPA modeling rely upon qualitative representations to quickly convey the degree of impacts in the main body of the DEIS reports, but differ as to how impacts are presented. The manner in which impacts are presented in NEPA suggests that impacts of the FRE are less dramatic than indicated by SEPA. The differences in baseline assumptions is partially responsible for the presentation, but the use of different terminology and symbols used qualitatively to express impacts add to the difficulty of interpretation and comparing results from NEPA and SEPA.

Presentation of impacts at the scale of the entire Chehalis Basin in terms of equilibrium spawner abundance conveys the impression that reductions in numbers of fish would be de minimus and obscures the potential impact on component populations and fails to discuss implications for biologically important considerations of productivity, spatial distribution, and life history and genetic diversity, which are paramount to concepts of viability and long-term sustainability.

Both NEPA and SEPA focus impacts on spawner abundance in the absence of fishing, and do not discuss potential implications for fisheries and the ability of the Quinault Nation to exercise its treaty protected rights.

Conclusions

- The full scale and scope of impacts of the Proposed Project on aquatic species, watershed and ecological processes have not been sufficiently analyzed.
- Impacts of alternatives evaluated in NEPA are highly uncertain, but no assessment of reliability and risk is provided. While the magnitude and rate of change in salmon populations cannot be accurately projected, it is certain that the abundance, productivity and diversity of salmon populations would be significantly and adversely affected under FRE relative to the NAA commencing with construction activity.
- Impacts of the proposed FRE and NAA by mid to late century are dependent on assumptions regarding effects of climate change which cannot be quantitatively evaluated with a high degree of certainty. The failure of NEPA to even attempt to evaluate climate change impacts is so scientifically unreasonable that the credibility of the analysis of impacts must be called into question.
- Numerous errors in methods and application of models and discrepancies between descriptions provided and actual modeling processes that were employed indicate a serious lack of stringent quality assurance and control measures.

- Omissions of important considerations, coupled with ambiguities and contradictions in presentation of results, lead us to conclude that NEPA does not provide a sound scientific foundation on which to base a decision regarding USACE permitting.

1 Introduction

An expandable flood retention (FRE) facility and airport levee improvements have been proposed as an alternative to reduce flood damage in a portion of the upper Chehalis River Basin in Washington State. The US Army Corps of Engineers (USACE) released a draft National Environmental Impact Act (NEPA) Environmental Impact Statement (DEIS) for public comment during a 60-day period ending November 17, 2020. The purpose and need statement and proposed alternatives are described in Sections 2 and 3 of the NEPA DEIS, respectively.

The study area of the NEPA DEIS is focused on the mainstem floodplain area of Chehalis River downstream of the proposed FRE facility (RM 108) to Porter Creek (RM 33) and the portion of the Chehalis River above the proposed FRE facility.

The focus of this report is centered on impacts of the proposed flood reduction project on four salmonid species (spring and fall Chinook, coho, and winter steelhead, as described in Section 4.5 "Aquatic Species and Habitats" and Appendix K, "Discipline Report for Aquatic Species and Habitats" of the NEPA DEIS. (For convenience we refer collectively to all of these species as salmon unless we specifically have reason to differentiate steelhead impacts.) In addition, our review encompasses comments on information, data, and materials provided by the NOAA and ICF individuals involved in performing supporting modeling work reported in the NEPA DEIS.

We do not provide an in-depth review of the NEPA DEIS, but rather have chosen to produce a report that serves as a high-level supplement to two Technical Reports produced by Lestelle and Morishima[3] in order to highlight significant differences in the information presented in the NEPA DEIS from that provided in the Washington State Department of Ecology's (ECY) Draft Environmental Impact Statement (SEPA DEIS) on the same proposed FRE and airport levee.

For convenience, we refer to the NEPA DEIS as "NEPA" and the SEPA DEIS as "SEPA."

2 Analysis

The analyses presented in this report are organized by topical areas. Comparisons and contrasts between the NEPA and SEPA assessments are provided along with comments regarding significant errors and omissions in NEPA.

2.1 Alternatives Evaluated

2.1.1 Issue: Different objectives between the NEPA and SEPA assessments.

There are differences in the ways the ECY and USACE framed the purpose and need and evaluation metrics which curiously led to the identification of different alternatives for assessment. SEPA identified an FRE, Local Action, and NAA; the narrower framing of the NEPA purpose and need statement led to consideration of two dam alternatives (FRE and FRO) and NAA and exclusion of a non-dam or local action alternative as identified in SEPA. The reasons for selection of alternatives, along with the determinations regarding scope and content of impact assessments are unclear. Nonetheless an explanation is warranted for disclosure to inform readers of both documents who are considering proposed actions.

[3] Ibid.

The framing of the purpose and need and metrics for evaluation preclude consideration of non-dam alternatives that would meet the twin objectives of the Chehalis Basin Strategy (reducing damage from flooding and restoring aquatic species of the Chehalis Basin). In addition, the purpose and need and evaluation metrics are based on the same statement by the project proponent, yet they differ in NEPA and SEPA, without explanation of rationale. There is a need for an integrated SEPA/NEPA analysis, or at the very least a crosswalk of impact determinations between the two common alternatives, FRE and NAA.

2.1.2 Issue: No alternative besides the FRE and NAA was substantively identified or evaluated in NEPA.

Both NEPA and SEPA identified three alternatives, but only the FRE and NAA alternatives were substantively evaluated. For SEPA, the Local Action Alternative was not substantively evaluated; for NEPA, the FRO alternative was substantively unchanged from the FRE, so in effect only two alternatives were actually evaluated.

2.1.3 Issue: Both NEPA and SEPA evaluated current, mid-century, and late century impacts of alternatives but NEPA excluded consideration of climate change.

Both the NEPA and SEPA assessments evaluated conditions and responses of the salmon populations for three general time periods: current, mid-century (circa 2040), and late century (circa 2080). The current time period was also used to represent conditions that would be present during construction of the Proposed Project (circa 2030).

The modeling done for both NEPA and SEPA incorporated assumed habitat degradation expected to occur over time as a result of human population growth in the Chehalis Basin, as well as some improvements to habitat conditions relating to shade from tree growth within managed commercial forests. The same assumptions about these effects were made for both NEPA and SEPA.

While SEPA modeling incorporated assumed effects of climate change over these time periods for a limited set of environmental attributes, NEPA modeling assumed no climate-related changes over time. The NEPA assessment acknowledges that climate change impacts are significant and uncertain, but is conflicted in whether and how to address expected long-term changes in climatic conditions. Page 44 of Appendix K (main body) states:

> *"Future climate variability is expected to result in an increase in air temperature across the United States with warming expected to be slightly greater in summer months and amplified in the northern parts of the United States (Vose et al. 2017). In the Pacific Northwest, potential increases in annual average air temperatures are projected to be between 3.7°F and 4.7°F by mid-century (2036 to 2065) and 5.0°F and 8.5°F by late-century (2071 to 2100; Vose et al. 2017). In the counties that contain the Chehalis Basin, projected average increases in the annual mean minimum (winter) air temperatures is expected to be 2.2°F to 2.8°F by 2040 and 4.1°F to 6.8°F by 2080 (USGS 2019b). The average potential increase in the annual mean maximum (summer) air temperature in the Chehalis Basin area is expected to be 2.2°F to 2.9°F by 2040 and 4.2°F to 7.0°F by 2080 (USGS 2019b). Overall, climate variability is expected to result in greater temperature extremes."*

Page 45 of Appendix K states:

> *"Climate variability is also projected to result in more extreme heat events in the summer and fewer extreme cold events in the winter. Historically rare extreme high temperatures are projected to become more common, with the Chehalis Basin potentially experiencing up to 10 additional days of temperatures above 90°F in the summer (Vose et al. 2017)."*
>
> *"Hotter summer conditions would also lead to higher water temperatures in rivers and streams. Warmer temperatures during the winter would cause wintertime precipitation to shift from snow to rain in the higher elevation portions of the basin. This shift could increase winter streamflow and contribute to higher downstream flows and increased flooding potential."*

Page 46 of Appendix K states:

> *"The projected increases in winter precipitation and the frequency and intensity of atmospheric river events would both contribute to an increased risk of winter and spring flooding in the Chehalis Basin. Decreased summer precipitation coupled with higher summer temperatures would reduce flow in rivers and streams and likely increase instream water temperatures."*

Despite a clear recognition that climate change patterns are projected to worsen certain environmental conditions for salmon, NEPA modeling made no attempt to address such changes. SEPA modeling did incorporate limited consideration of climate effects (the same modelers did the assessments in both DEIS documents). Page 46 of Attachment A (EDT Modeling Report) states:

> *"However, climate change modeling was not included in this EDT model. Climate change is expected to cause warmer temperatures especially in summer months in many areas of the Chehalis Basin, as well as shift the precipitation and flow regime toward flashier winters, early springs, and drier summers (Mauger et al. 2016). <u>Including climate change predictions in the mid- and late-century scenarios would dramatically alter species responses across the basin and might change conclusions about effects of the proposed project on the four modeled salmonid species."</u>* (emphasis added)

The reasoning for excluding consideration of climate change in fish modeling is unclear in NEPA, though it seems to imply that it is due to uncertainty in how to incorporate the effects (pg 46 of Attachment A); still the modelers did incorporate expected effects of riparian maturation and human population growth with similar uncertainty, stating:

> *"There is also inherent uncertainty in the details of how land use degradation and riparian maturation in managed forests may affect Chehalis Basin habitat, given that management regimes and land use practices and laws may change in the future."*

It is troubling that USACE chose to ignore effects of climate change while recognizing that their conclusions about expected effects of the Proposed Project would have changed. NEPA ignores the reality that environmental changes are certain, leaving impacts open to imagination without the benefit of any science-based assessment.

2.2 Evaluation Methods

2.2.1 Issue: Both NEPA and SEPA rely principally on the same two models—problems in the SEPA assessment using the models were largely uncorrected in NEPA.

Both NEPA and SEPA rely principally on the same two models, EDT and the Hybrid models, evaluate the same geographic areas, salmon population units, and time periods. Therefore, many of our comments that we submitted in our SEPA review technical reports regarding the modeling are applicable to the NEPA assessment. Our primary conclusions about the modeling methods that are applicable here are the following:

- Our review of available information regarding how the modeling was performed revealed numerous errors in modeling inputs and configuration, which suggest a failure of Quality Assurance and Quality Control (QA/QC) measures to provide adequate review and oversight of the modeling process. The errors that we found are not trivial and cast a troubling shadow on the overall assessment. Some of these errors are identified in Section 3 of this document. Others were detailed in our SEPA DEIS comments.
- NEPA, like SEPA, lacked sufficient, specific information and data to permit a thorough scientific evaluation of the modeling assessment. Lack of clarity in the documentation provided in both NEPA and SEPA made it difficult to fully evaluate the modeling procedures and outcomes. We were provided data files and additional explanations by the USACE contractors following the release of NEPA but the large volume of information, severe time constraints established by the comment period, and complexity of the models did not permit in-depth comprehensive review all of the material. We are aware, and NEPA acknowledges, that substantial uncertainties exist in how the modeling was performed and habitat attributes were parameterized. We do not believe the impacts of these uncertainties were adequately addressed in either the SEPA or NEPA assessments.
- The EDT Model was not designed to be used in the manner applied in Hybrid. EDT is a steady-state model that generates descriptive statistics for population performance under conditions that persist over the entire life cycle of a salmon species and over many years so that the population comes to a theoretical state of equilibrium abundance. In contrast, Hybrid is intended to model year-by-year responses of a salmon population from spawner to returning spawner over consecutive cohorts under conditions that can change by year, tracking abundances over time, thereby examining trends. To do this, Hybrid breaks EDT's life cycle steady-state outputs under different flow scenarios into life-stage segments that encompass a few months affected by different flow conditions, and then stitches the population performance statistics from the different flow scenarios together mathematically in a way intended to represent a full life cycle. The idea of doing this with EDT is made worse by a contrived way of trying to model EDT for specific flood recurrence intervals (2, 10, and 100 year flood scenarios), which was not done in the manner consistent with how EDT was designed; we discuss this in more detail later in this report.
- We lack confidence in the validity and utility of results produced by the Hybrid Model in particular. The Hybrid Model was developed to examine potential effects of variability in interannual stream flows and how that variability would affect when dam closure would occur. The frequency of dam closure and timing of such events potentially would

have very significant effects on fish passage and life-stage survivals, which in turn would drive overall population performance of the various species. We became aware that the procedure being used to model effects of different water year types in the model did not align with intent. As a result it is doubtful that the modeling done with Hybrid is credible to address the questions being evaluated with the model.

- The applications of both the EDT Model and the Hybrid Model in NEPA are flawed.

2.3 Baseline Conditions

2.3.1 Issue: Specifics are lacking for the environmental baseline.

The concept of environmental baselines is important for evaluation of alternatives and would be especially significant should listings under the Endangered Species Act (ESA) come into play. The National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife (USFWS) ESA Handbook describes the environmental baseline as:

> *"the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process."* 50 C.F.R. § 402.02.

Environmental baselines are critical to the actual FRE construction activity, but also for operation of the proposed dams, and consideration of impacts for ESA jeopardy determinations (pending petition for listing mussels, bull trout currently ESA-listed, and potential for future listings) and, given the decline and projections of further decline under FRE, a petition for listing of spring Chinook would not be unreasonable to anticipate.

2.3.2 Issue: Primary differences in impacts under NEPA and SEPA were due to NEPA not including any effects of climate change.

NEPA did not include climate change, while SEPA included it to a very limited degree (changes in precipitation, temperature, flood peak flows, and streamflow) as part of the baseline conditions for current and all future scenarios.

Of notable concern is the lack of evaluation of potential uncertainties and environmental variability anticipated under climate change.[4]

The vast majority of notable climate change publications concerning environmental changes expected to affect salmon since SEPA was published have centered on sea level rise, melting permafrost and sea ice, estuarine impacts, ocean acidification, risk to forests and wildlife due to wildfire, ecological and water drought, insect/disease, changes in phenology and species ranges and compositions, and ecological risk to species such as ridged mussels.

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[4] Appendix K, p14-15. *"None of the scenarios in the NEPA EIS analyses included projected effects from climate change. Climate change would be expected to have deleterious effects on most salmonid species. Chehalis Basin ASRP salmonid modeling, as well as other salmonid modeling efforts in the Pacific Northwest generally, have estimated significant negative impacts for the species included in this analysis as a consequence of projected changes to habitat conditions resulting from forecasted climate change. For example, Chehalis River spring-run Chinook salmon adults arrive in freshwater prior to spawning and hold during the warmer summer months, and the ability of Chinook salmon to survive and successfully spawn is very sensitive to warm water temperatures during this prespawning period".*

The lack of substantive treatment of climate change in NEPA ignores the reality that environmental changes will substantially affect the operation and impacts of the Proposed Projects under the FRE and FRO alternatives. It is not likely that the FRO facility would provide sufficient protection to meet the project purpose and evaluation metrics. For FRE, consideration of climate change would result in an increased clamor for expansion once construction activity starts; a cascade of impacts would be triggered and the door would be opened for arguments regarding minimal incremental damage.

From a biological standpoint, climate change would heighten concerns for viability and hasten declines of aquatic species of concern to QIN, while foreclosing opportunities for actions to restore habitat or improve resiliency to climate change. Appendix K acknowledges that climate change could result in impacts that differ substantially without considering climate change[5], but does not provide information as to how. Since climate-related change in the environmental and ecological processes are certain, NEPA provides no information of value for decision making that would take into account climate change

NEPA noted complexity and uncertainty associated with trying to address climate change but made no attempt to evaluate potential impacts. Impacts of FRE are not evaluated under conditions that can be reasonably expected to occur.

SEPA conducted a superficial evaluation that did not evaluate substantial changes anticipated under climate change and did not reflect best available science. Our Technical Reports provided for SEPA discuss concerns regarding the superficial nature of climate change modeling, noting factors that were not considered (e.g., increased frequency and intensity of storm events, alteration of precipitation patterns, frequency of water flow levels, low flows, temperature increases, ecological drought, extreme events – both within the basin proper as well as for estuarine and ocean environments, driving forces of changes in atmospheric and oceanic currents, sea level rise and consequential alteration of estuarine boundary delineations, salinity, heat wave blobs, alteration of food webs, alteration of forest character, increased risk of wildfire, disease, acidification).

SEPA treats climate change directly, while NEPA ignores climate change and assumes that current environmental conditions will persist indefinitely. While there are deficiencies in the manner in which SEPA evaluates climate change, the failure of NEPA to even attempt to evaluate climate change is unreasonable and scientifically indefensible. The NEPA justification for not considering climate change is based on uncertainty. Undoubtedly, there is great uncertainty regarding the ways that climate change will be addressed socially, economically, and politically, technological developments, scientific knowledge, and how they may affect the environment and species. NEPA does not even acknowledge or describe the risks and uncertainties associated with climate change, and dismisses them out of hand as being too hard to deal with so resorts to assuming that the status quo that exists now will persist. This is tantamount to the proverbial ostrich that puts its head in the sand pretending that nothing else

[5] Appendix K, p46: *"climate change modeling was not included in this EDT model. Climate change is expected to cause warmer temperatures especially in summer months in many areas of the Chehalis Basin, as well as shift the precipitation and flow regime toward flashier winters, early springs, and drier summers (Mauger et al. 2016). Including climate change predictions in the mid- and late-century scenarios would dramatically alter species responses across the basin and might change conclusions about effects of the proposed project on the four modeled salmonid species. There is also inherent uncertainty in the details of how land use degradation and riparian maturation in managed forests may affect Chehalis Basin habitat, given that management regimes and land use practices and laws may change in the future."* (emphasis added)

exists – the failure to recognize the reality of climate change is scientifically preposterous and indefensible.

2.3.3 Issue: Approach to incorporating tree growth within riparian areas in commercial forests and future environmental degradation.

Both NEPA and SEPA made broad assumptions about how salmon habitat may change by mid and late century as a result of tree growth within riparian areas in commercial forests and general environmental degradation due to development outside of commercial forest. Tree growth influences shade and temperature, which influence critical attributes of salmon habitat. The assumptions were the same ones applied in EDT modeling used to evaluate the proposed Aquatic Species Restoration Plan (ASRP) by the Science Review Team (SRT). It bears noting that these assumptions about future changes are no more certain than expected changes to climate-related environmental conditions—likely less certain, yet NEPA included these in the assessment and excluded expected climate-related changes. We also note that the SRT included assumptions to account for climate change effects in modeling ASRP scenarios—the same assumptions were applied in the SEPA assessment.

The assumptions applied in the modeling did not consider any land use conversions that might be made over time, such as within commercial forests. All future development was assumed to occur outside of commercial forests.

No consideration was given to future development potential within the floodplain study area due to reduced risk of flood damage under FRE. It is likely that pressures for development within floodplain area would increase resulting in greater salmon habitat degradation. Both the SEPA and NEPA modeling assumed no increase in development due to the operation of a flood-damage reduction action for any scenario.

2.3.4 Issue: Restoration actions.

Both NEPA and SEPA incorporated early action measures identified through the ASRP process, but these actions are largely outside the study area and early actions were only generally described, lacking specifics as to actions, locations, or timing. We are aware of the details of the proposed actions through our involvement with the ASRP process. It bears noting how NEPA describes the uncertainty associated with these projects and despite that uncertainty incorporated the proposed actions into the assessment, but ignored climate change effects; page 57 of Appendix K states:

> *"There is uncertainty in the parameters used to define the changing No Action Alternative baseline over time. For example, maturation of riparian areas in managed forests was included in the model as well as land use degradation and early action restoration projects in five sub-basins. There is inherent uncertainty in the details of how land use degradation and riparian maturation in managed forests may affect Chehalis Basin habitat because management regimes and land use practices and laws may change in the future. As such, future conditions assumed in the EDT model could turn out to be different. Climate variability modeling was also not included."* (emphasis added)

We note that the NEPA documents states in a number of places that the early action projects were included as part of the NAA—but we find no mention that the actions were also included as part of the specific project-related alternatives. Including these limited actions would affect basin-wide results. The presentation of NAA results focus on basin-wide effects rather than effects within the study area. Reasons for including certain types of effects in the NAA are not made clear.

2.3.5 Issue: Modeling of U.S. v Washington, culvert case Injunction List removals.

NEPA explicitly incorporated removal of some culverts included on the Injunction List required under the U.S. v. Washington decision affirmed by the U.S. Supreme Court (2018), referred to as the culvert case, with half the culverts being replaced by mid-century and replacement of the remaining culverts by late century. However, it is unclear whether NEPA included this culvert removal schedule as part of its evaluation of all alternatives. SEPA did not specifically mention the schedule for culvert removal as part of its assumed environmental baseline conditions.

2.3.6 Issue: Neither NEPA nor SEPA evaluated salmon population impacts on fisheries and the ability to exercise treaty-protected rights of the Quinault Indian Nation (QIN).

Salmon population impacts were evaluated in both SEPA and NEPA in the absence of fishing. Consequently, potential implications for fisheries coast-wide and in terminal areas of Grays Harbor were not addressed in either assessment. NEPA did not consider changes in productivity of component populations, the potential impacts of these changes on the viability and resilience of the component populations or on the overall aggregate populations (by species), the consequences of these changes on potential listings under federal or state conservation statutes, and how these changes would affect the ability of QIN to exercise its treaty-protected rights.

2.4 Mitigation

2.4.1 Issue: Both the NEPA and SEPA assessments fail to present mitigation plans for adverse impacts.

Both NEPA and SEPA fail to present mitigation plans for adverse impacts, both deferring to future consultations and permitting processes. As a consequence the technical and financial feasibility to offset adverse impacts was not evaluated.

The types, locations, and timing of actions to be taken under any mitigation plan are not identified; instead NEPA leaves the determination of technical and financial feasibility of mitigation to consultation and permitting processes that would be undertaken should permitting of the Proposed Project proceed. Therefore, it was not possible for us to in any way evaluate impacts of mitigation that might be proposed for this Project.

We note, however, that the Proposed Project as presented in NEPA would have very severe consequences on the spatial structure (distribution) of salmon populations in the upper Chehalis River Basin, their genetic diversity, and population resilience to not only existing environmental conditions but for those projected with climate change (as discussed in the ASRP Phase I document (ASRPSC 2019) and in SEPA).

Irreplaceable biological components of the populations would be lost. We do not believe that the extent and types of expected impacts are biologically fully mitigable, particularly those associated with loss of genetic resources important for aspects of Viable Salmonid Populations (VSP) consideration (McElhany et al. 2000), mainly related to biological and spatial diversity. We must conclude that the Proposed Project poses a critical threat to the future sustainability of salmon and related resources in the upper Chehalis Basin.

2.5 Presentation of Model Results and Impacts

2.5.1 Issue: Lacks sufficient detail for credible scientific scrutiny.

The information provided in the NEPA and discipline reports lack sufficient information at the level of detail required for credible scientific scrutiny. Although more information is contained in Appendix K of the NEPA than the comparable discipline report for the SEPA, the amount of detail is still insufficient for scientific scrutiny

2.5.2 Issue: Both NEPA and SEPA present impacts in qualitative terms, but impacts are harder to interpret under NEPA.

The scope and presentation of results differ in NEPA and SEPA. In contrast to SEPA, NEPA does not provide quantitative impacts of the proposed dam alternatives or attempt to evaluate climate change.

Both NEPA and SEPA modeling rely upon qualitative representations to quickly convey the degree of impacts, but differ as to how impacts are presented. NEPA modeling results rely principally on up and down arrows with the direction indicating the direction and number of arrows indicating the degree of change. SEPA modeling results were expressed in terminology conveying degree and direction of significance e.g., "significant and adverse" The primary differences is that NEPA did not provide threshold values for its rating system to aid interpretation and few results are presented quantitatively compared to SEPA. In NEPA, impacts are presented in qualitative terms which are even less informative and more difficult to interpret than the ratings employed by SEPA. Qualitative ratings are based on professional judgement without qualification or explanation; Appendix E provides no quantitative thresholds for interpretation, despite representations to the contrary.

2.5.3 Issue: Basin-level statistics presented in NEPA and SEPA obscure differences between alternatives and biologically important impacts.

In both NEPA and SEPA, basin-level statistics are presented which obscure differences between alternatives and attempt to portray differences in terms of de minimus impacts on abundance. Declines or losses of population components would affect important characteristics of viability (productivity, spatial and genetic diversity) reducing resiliency to environmental change, the ability to sustain harvests, and the opportunity for restoration actions to alter population trajectories.

2.6 Impacts and Conclusions Regarding Proposed Alternatives

2.6.1 Issue: NEPA impacts are shown as being less severe than in SEPA because climate change effects are not considered.

Both NEPA and SEPA indicate that the Proposed Project will adversely affect salmon during construction and operation. However, impacts presented in NEPA are characterized as being less severe, due to SEPA's assumptions regarding climate change.

In contrast with SEPA, impacts reported in NEPA are not confounded by climate change so comparison of alternatives is more apparent. However, the failure to consider impacts of climate change fails to provide a reasonable expectation of impacts of the Proposed Project. Negative impacts are less severe, but are likely underestimated.

Both NEPA and SEPA indicate substantial negative impacts during construction, indicating that persistent declines in some populations will be precipitated by construction activity. See Section 3.3.2.1 of Appendix K, and figures 2-9 of Attachment B to Appendix K.

SEPA hedged on annual duration of the construction period while NEPA assumed that construction would occur from July through the end of September – this period would encompass periods of holding, migration, rearing and spawning of salmon species of concern, notably spring Chinook.

Neither NEPA nor SEPA considered the possibility that 10 or 100 year water flow events would occur during the five-year construction period

2.6.2 Issue: Neither NEPA nor SEPA evaluated impacts of an expanded FRE facility.

Impacts were evaluated assuming that a larger FRE would undergo a future environmental assessment. If expectations for increased frequency and severity of extreme storm events as climate change progresses materialize, it is likely that the FRE would need to be expanded to reduce flood damage in the study area. The NEPA should evaluate impacts of construction and operation of an expanded FRE because initiation of FRE construction would have irreversible environmental impacts.

2.7 EDT Model

Results of EDT modeling are concisely summarized at page 251/374 of Appendix K of NEPA:

"Overall, the EDT model predicts that the FRE structure would have significant negative impacts on all four modeled species in the upper watershed (Above Crim Creek), and especially on spring-run Chinook salmon. While at a basin-wide scale impacts are predicted to be minimal for most modeled species, it should be considered that the upper watershed Above Crim Creek is currently beneficial salmonid habitat that can provide a buffer against future potential degradation, including climate change effects that were not included in this NEPA analysis, in the watershed. "

2.7.1 Issue: Inadequate analyses of effects on salmon populations.

The EDT modeling as applied in NEPA does not adequately assess the likely effects of the alternatives on salmon populations produced in the study area. The modeling suffers from a variety of deficiencies, errors, and lack of interpretation and explanation.

The modeling approach, procedures, parameterization, and analyses are essentially unchanged from those applied in SEPA. Comments that we made to the SEPA analysis highlighting the errors and deficiencies have gone largely unaddressed with a few exceptions made to modeling inputs for NEPA. Major deficiencies in how the EDT Model was used to assess the likely effects of the proposed action for the NEPA assessment include the following:

- Likely watershed and ecological effects of the proposed action have not been adequately incorporated into the model. Consequently the modeling does not adequately address downstream effects on sediment transport, changes in river channel structure (spawning and rearing habitats), and riparian structure—and how these changes are likely to affect salmon performance. Adverse effects on population performance of the proposed action are therefore likely underestimated.
- Many other factors affecting salmon performance have been omitted from the modeling and from the interpretation of the results. As a result, the NEPA assessment largely ignores potentially very significant cumulative effects that would greatly

compound the adverse effects of the action on salmon populations. These factors include fishery harvests (both in the ocean and the river), estuarine habitat losses and degradation (see ASRP Phase 1 report), the burgeoning populations of centrarchid fishes (such as basses) throughout much of the mainstem Chehalis River (SRT position paper on exotic species, October 2020), hatchery fish interactions (SRT memorandum on prioritization of actions for the ASRP, October 2020), hybridization that is occurring between spring and fall Chinook (Thompson et al. 2019; QIN *in preparation*; SRT position paper on hybridization, October 2020), and climate change (Mauger et al. 2016). All of these factors have been extensively discussed by the Science Review Team (SRT) working on the Aquatic Species Restoration Plan (ASRP) and are believed to be important causes of declines in species performance in the Chehalis Basin. The result of all of these factors is that the adverse effects of the proposed action would be compounded by cumulative effects related to these factors. Consequently, the impacts associated with the Proposed Project are being significantly underestimated.

- No consideration was given to variability in interannual survival in different life stages of the salmon species other than the muted (because of errors in the approach) effects of the WY differences incorporated into the flood scenarios. These effects can compound the effects of the proposed action. One simple way of addressing this in EDT would have been to simply look at the effect of changes in ocean survival on life cycle cumulative productivity and resulting equilibrium abundance levels. The prospect of declining marine survival as a result of climate change is real. The analysis as it was done was inadequate without such consideration.

2.7.2 Issue: Model parameterization in NEPA and SEPA for FRE scenarios and NAA substantially similar.

Both the NEPA and SEPA parameterizations of the EDT Model for the FRE scenarios and the NAA were substantially the same for current conditions, and, with the exception of climate change for SEPA, for the mid and late century periods. Certain differences for a few attributes in EDT were made in the model inputs, but these differences were few.

The failure to adequately differentiate the FRE scenarios and the NAA scenario in the model is discussed further in subsequent issues described in this section. The effect of this inadequate attention to important details is the following:

- Salmon population performance for the current, mid and late century periods is likely being substantially overestimated in EDT for the 10- and 100-yr flood scenarios for the NAA and FRE alternatives.
- This result in EDT—muted effects of the flood scenarios—would be carried over into the Hybrid Model, where the effects would also be dampened because of how that modeling was done. The overall effect is likely a substantial underestimation of adverse effects of the proposed action based on the modeling employed.

2.7.3 Issue: Flawed model parameterization for flood scenarios.

The EDT Model is a steady-state model, meaning it does not directly take into account how environmental conditions vary over time, and it does not assess population response to a set of conditions that would occur in one specific year. The model considers an average set of conditions that might be experienced by a salmon population over a relatively short period of years, such as over a 10 year period (Lestelle et al. 2004; Lestelle 2005). Within that period of time, the model was designed to take into account a normative range of interannual variation, such as occurs with streamflow. The model was NOT designed to be used for the type of analysis that was done in either the SEPA or NEPA assessments. The scenarios being modeled both with the EDT and Hybrid models in these assessments include specific types of water years associated with certain flood frequencies, i.e., floods that would occur at a 2-yr, 10-yr, or 100-yr recurrence interval. EDT was not designed to assess effects that would occur during, say, a 100-yr flood (Lestelle et al. 2004).

Instead, EDT asks: if a certain set of average conditions, which vary from year to year within that period when the average would be assessed, occurred over something like a 10-year period, what would be the salmon population response if this average set of conditions were to then occur for an extended period. The model computes the expected population response over that extended period of time at its equilibrium level. In this sense, the model is addressing population response under steady-state conditions. Hence the model is theoretical in asking this because in reality environmental conditions can trend up or down over such time periods. The environmental attributes used in the model were NOT developed to reflect conditions associated with hypothetical 2-yr, 10-yr, and 100-yr flood frequencies under steady-state conditions.

This issue of flawed parameterization for the different flood frequencies is critical to how the EDT model was used in the SEPA and NEPA assessments. We discussed this in some detail in our SEPA comment report dealing with the models (see pages 16-19 in that document).

A portion of our comments made in our SEPA review report are warranted here to highlight how the ratings of certain EDT attributes were misapplied in the NEPA analyses:

> *"The Flow High attribute, by its definition and as it is was meant to be applied in the model, means that there is an assumed amount of interannual variability in annual peak flow over some averaged period of years. The actual name of this attribute in EDT is "Flow – change in interannual variability in high flows", recognizing that it considers the amount of interannual variability in peak flows (Lestelle 2005), implying a certain frequency of flood flows of given magnitudes over a period of years.*
>
> *But this begs the question: How would the attributes need to be applied for questions like those being addressed in the EIS if the attribute definitions and their associated biological rules integral to the model are not to be distorted? This author (Lestelle) is well aware of how the attributes and the associated modeling rules were developed because he was the principal developer of these modeling components.*
>
> *This question is best answered by example. The Flow High attribute, like most other EDT attributes, are rated on a 0 to 4 scale, as follows for this attribute (notice especially the meaning for a rating of 2):*

Rating	Meaning
0	Magnitude & frequency of peak flows much reduced from the unaltered watershed
1	Magnitude & frequency of peak flows reduced from the unaltered watershed
2	Magnitude & frequency of peak flows unchanged from the unaltered watershed
3	Magnitude & frequency of peak flows increased from the unaltered watershed
4	Magnitude & frequency of peak flows much increased from the unaltered watershed

Although the rating definitions seen above seem to be qualitative only, the rating is best accomplished using actual time series flow data and calculations described in Lestelle (2005), which was done for the Chehalis River as contained in Mobrand Biometrics (2003) for current conditions, as they existed at the time that report was done.

What then does it mean for rating this attribute if it is to be used in the model for a hypothetical condition for 100-year flood flows either under current conditions or projected in year 2080 under steady-state conditions? It necessarily would mean that the model would be projecting effects under a 100-year flood flow, meaning that since the model's calculations are all for steady-state conditions, that in effect the Flow High attribute would reflect a condition where the 100-year flood would occur every year over some averaged period of years."

The rating that was applied for the Flow High attribute for current condition in the current version of EDT used for the SEPA and NEPA assessments with a 2-yr flood flow was a value of 2.3, slightly higher than for an unaltered watershed. The <u>same</u> rating was applied to the current condition for a 10-yr and 100-yr flood flow scenario, however. Considering that the model is a steady-state model, the only rating that would make sense if a 100-yr flood flow were to happen <u>every</u> year repeatedly to determine the equilibrium response of the population would be a value of 4. In other words, given the structure of the rating system and the logic applied in designing the model, the 100-yr flood flow scenario would be a worst case compared to an unaltered watershed with a normative flow regime (i.e., with a normal range of interannual variability).

We discussed the problematic nature of the ratings that were developed for use in the SEPA and NEPA analysis with the EDT modelers in a virtual meeting on October 6, 2020. We pointed out these problems. We were informed that the ratings that were applied were developed through "group discussion" with people who were involved in doing the NAPA analysis. We were not told who those individuals were or what qualified them to weigh in on how to address the EDT ratings. We commented that it was unlikely the people involved understood the theoretical basis for how the rating system was developed and how it was to be applied in the model.

We therefore conclude the following:

- The parameterization of the flow-related attributes in EDT to reflect conditions associated with at least the 10-yr and 100-yr flood scenarios is flawed.
- The parameterization of certain other attributes in the model suffers from the same underestimation of ratings for both the 10-yr and 100-yr flood scenarios; these include Bed Scour and Fine Sediment, among others.
- The effect of these flaws in how key environmental attributes were rated for the 10-yr and 100-yr flood flow scenarios (all scenarios, including the FRE scenarios) would be to <u>underestimate</u> the adverse effects of these flood scenarios on salmon population performance. This would likely be particularly significant for how the EDT modeling results are carried over into the Hybrid Model and to the results of that modeling.

2.7.4 <u>Issue:</u> Inadequate interpretations and explanations of modeling results.

The EDT Model produces modeling outputs for three performance measures of a salmon population's performance: equilibrium abundance, productivity (intrinsic), and life history diversity. These outputs are consistent with the concepts of salmon population performance used by NMFS (McElhany et al. 2000). All are important to understanding how population performance is changed by environmental alterations (Mobrand et al. 1997). However, the

NEPA provides poor definitions of the terms, in some cases wrong definitions, and makes little or no attempt to explain or interpret the modeling using the combination of these different metrics of population performance.

EDT Model descriptions are provided in at least four documents within the overall set of NEPA documents: (1) the main NEPA report, (2) the main report of Appendix K (Discipline Report for Aquatic Species and Habitats), (3) Appendix A to Appendix K (Fish Impact Modeling Report), and (4) Attachment A to Appendix A to Appendix K (EDT Modeling Report). Definitions provided among these various documents for population performance metrics are not consistent and some are wrong with respect to how these parameters are actually applied in EDT.

For example, productivity is defined in the main NEPA report (page 122) as "*the number of young fish that survive and return to spawn as adults*." Appendix K (page 56) defines productivity as applied in EDT as "*Productivity describes the number of juveniles that survive and return as adults to spawn per original adult spawner. A productivity of 1 means that each adult spawner replaces itself. If productivity is less than 1, the population abundance will decrease. If productivity is greater than 1, the population abundance will increase*." It appears that the authors of the report were confusing the term "productivity" as used in EDT (see specifically Mobrand et al. 1997 and Hilborn & Walters 1991 (page 271)) with a different application of the term when it refers to population growth rate (see McElhany et al. 2000). This confusion suggests that the authors do not understand the biological meaning of the term as applied in a steady-state model like EDT (see Mobrand et al. 1997). In EDT, productivity is the intrinsic productivity that describes the maximum expected (on average) adult recruits per spawner in the absence of all density-dependence. This population parameter largely defines the resiliency of the population to environmental variability, perturbation and harvest. Productivity values less than about 2.0 are likely to lead to extirpation when considering a normal range of variability.

Consequently, some parts of the presentation of EDT modeling results are convoluted, difficult to follow, and appear to reach the wrong conclusion. An example of a convoluted and misguided description of EDT modeling results is given on page 97 of Appendix K regarding effects of the proposed action on spring Chinook salmon. The authors are undecided on what the modeling results would mean to population sustainability. We find that the results are clear. The periodic complete wipeout of the population due to dam closure combined with very low productivity (<2), very low abundance (<50), and very low diversity in years when no dam closure occurs would invariably result in extirpation of the population. In interpreting the modeling results, the authors of the report also did not take into account the cumulative effects of other factors not explicitly considered in the report, such as harvest impacts in the ocean and river. With these factors considered, extirpation of the population would be certain.

In summary, we conclude the following:

- The report does not consider in any meaningful way the combination of EDT modeling results for abundance, productivity, and diversity to inform the reader and the conclusions about impacts.
- Without a more careful consideration of all of the information produced by the modeling, it appears that impacts to the populations from the proposed action are being underestimated.

2.7.5 Issue: Errors in EDT environmental attribute inputs to the model.

Aside from the issue of flawed parameterization of EDT attributes to accurately reflect steady-state conditions for the 10-yr and 100-yr flood scenarios described in Section 2.7.3 above, there are a number of other errors made for the environmental attributes that serve as inputs to the model. We described many of these errors, and their implications, in our technical report on modeling submitted for SEPA (see section on "Review of EDT Attribute Ratings" on pages 7-19 of that report). The errors involved the attributes: Fine Sediment, Bed Scour, Wetted Channel Width, and the three flow attributes, Flow High, Flow Low, and Flow Intra-annual Variability. These attributes are of particular importance in affecting salmon population performance due to how the Proposed Project would be expected to alter patterns and rates of sediment supply and transport, habitat quality and quantity related to streamflow, and other habitat characteristics related to flow patterns.

In considering our findings reported on here, it is important to note our background with the EDT Model and its development for the Chehalis Basin. Lestelle configured the model originally for the Chehalis Basin (Mobrand Biometrics 2003). He did all of the original ratings for all attributes and all stream reaches in the basin. He is aware of the attribute definitions and rationale used to assign the ratings to the environmental attributes. In about 2014, he was not involved personally with changes made to the model and attribute ratings as the model has been applied in the Chehalis Basin since the model was owned by ICF and Lestelle was not employed by that company. He became involved again in 2015 under contract to QIN and served to review and provide feedback to ICF as to how the model was being used in the basin. He became a member of the SRT to help develop the ASRP. In this role, he regularly reviewed changes being made to the model and to the environmental attributes to incorporate new information being collected in the basin.

We illustrate this issue of errors in the EDT Model inputs with the attribute Fine Sediment. This attribute characterizes the amount of fine sediment particles (<0.85 mm in size) that is mixed in with spawning gravels. Elevated amounts of fine sediment is a principal cause of reduced salmon egg survival during the incubation life stage in the Pacific Northwest. Watershed alterations due to land clearing, road building, agriculture, and logging produce large amounts of fine sediment that is routed through the stream system, becoming entrained into the streambed where salmon spawn. Salmon egg survival is particularly sensitive to elevated quantities of fine sediment (Jensen et al. 2009).

It is important to note that the rating system used for Fine Sediment in EDT employs a 0-4 scale, similar to the one described in Section 2.7.3 above. Low rating values (<2) indicate relatively clean gravels that would result in relatively high egg survival. Many areas of forested streams in the Pacific Northwest have rating values of 1.5 to 2.5. Only in exceptional conditions would ratings be less than 1.5. Values of 3 to 4 indicate dirty gravels and resulting low egg survival. A value of 3.5 or higher would mean that virtually all eggs would perish due to high sediment. (Lestelle applied values of 3.5 to reservoirs in the Chehalis Basin, such as Wynoochee Reservoir, due to the certainty that high sediment would exist and egg survival within the reservoir would be 0%. A rating of 0 would be exceptionally clean, a condition that almost never occurs anywhere in nature, even within a national park (Cederholm and Reid 1987).

The original EDT ratings for Fine Sediment (as the model was initially configured) in the Chehalis Basin were based on information in Smith and Wenger (2001), approximations of road densities throughout the basin (applying relationship from Cederholm and Reid 1987), and on field sampling of certain sites (Mobrand Biometrics 2003). We note that beginning in about 2018, data on fine sediment estimates from the NOAA Fisheries life cycle model (LCM) (Beechie et al. 2020) were supposed to be brought into EDT to standardize inputs being used in the two models. The LCM employed road densities calculated using GIS data with a relationship for fine sediment and road densities from Cederholm and Reid (1987). We note that the ratings originally developed for stream reaches in the basin (Mobrand Biometrics 2002) and those from the LCM were very similar, which is not surprising given that methods of derivation were similar.

Figure 1 is an updated figure from our SEPA modeling report (see Figure 1 on page 9 of that report) to illustrate differences between SEPA and NEPA EDT ratings used in the modeling. Here, we only show information for Fine Sediment for two alternatives: 2080 FRE 2-yr flow and 2080 FRE 100-yr flow. Table 1 provides landmarks associated with Chehalis mainstem river reach. The figure shows that differences exist between NEPA and SEPA that cannot be linked to how climate change was incorporate into SEPA, such as ratings of 0 for most reaches between the South Fork (Chehalis-63) and the upper end of the proposed reservoir in NEPA, a distance of about 26 miles.

Table 1. Landmarks and river miles associated with a subset of EDT stream reaches.

EDT reach	Adjacent landmark	River mile at lower end of reach
Chehalis-1	Chehalis R mouth	0.0
Chehalis-18	Satsop R mouth	20.2
Chehalis-38	Black R mouth	47.0
Chehalis-49	Skookumchuck R mouth	67.0
Chehalis-54	Newaukum R mouth	75.4
Chehalis-63	South Fork mouth	88.3
Chehalis-72	Rainbow Falls	97.0
Chehalis-86	proposed dam site	108.2
Chehalis-91	end of proposed reservoir	114.6
WF Chehalis-1	confluence of WF and EF	118.9

We note that NEPA did attempt to fix a serious error for the reservoir reaches for the 2080 alternative for the FRE with a 100-yr flood flow. In SEPA, a rating of 1.0 had been applied (meaning exceptionally clean gravel). In NEPA, a value of 3.0 was applied, which would be more realistic but still not reasonable for these conditions – a value closer to 4 would be more reasonable given this is the 100-yr flood flow scenario. We note that NEPA used a rating of 0 for the reservoir at 2080 with a 2-yr flow, which makes no sense.

Figure 2 compares Fine Sediment ratings for two groups of reaches between SEPA and NEPA under different alternatives (reservoir reaches and reaches downstream of the dam to Elk Creek). It is evident that changes were being made to the attribute ratings that have no link to reality. All of the ratings are much too low and change the alternatives in a way that make no sense. It is evident that either the ratings that we highlight were made by someone who did not understand the definitions of the ratings or by a mistake in updating the database.

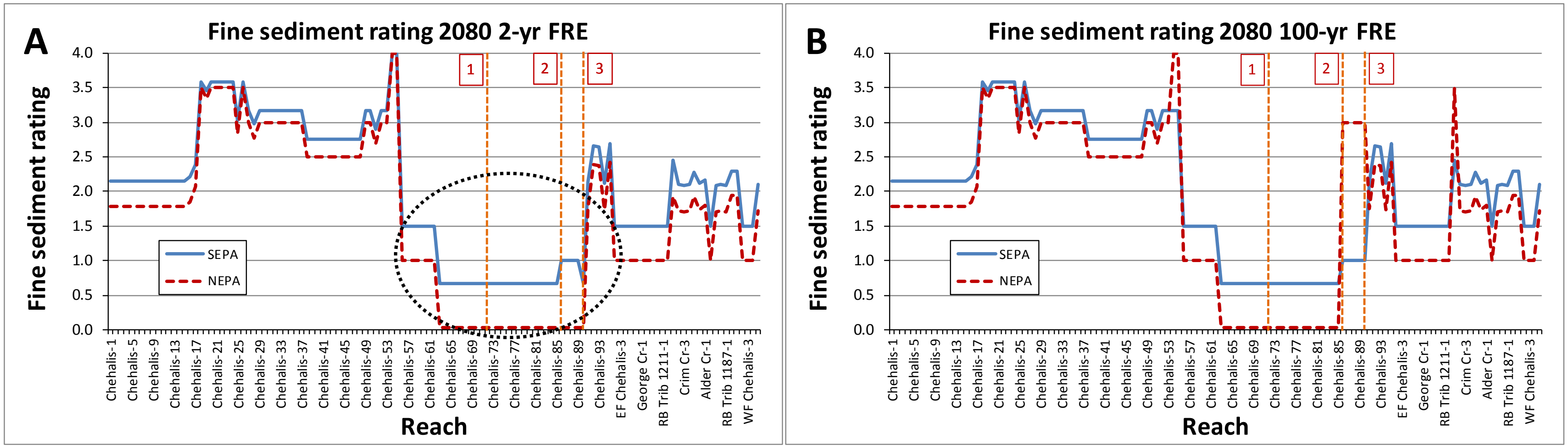


Figure 1. Comparison of SEPA and NEPA EDT ratings for the attribute Fine Sediment for all reaches in the mainstem Chehalis River from Chehalis-1 (at the river mouth) to Chehalis-94 (below confluence of forks) and other tributary reaches upstream of the proposed dam site. Ratings for two different modeling scenarios are shown. Dashed vertical lines indicate location of Rainbow Falls (1), proposed dam site (2), and the upper end of the proposed reservoir when filled (3). Dotted circle in A identifies reaches with Fine Sediment ratings that are clearly in error by a substantial amount (the problem is evident in both A and B of the figure.

Without any logical reason for the differences, we assume that errors were made in the model inputs. We found other puzzling differences for several other attributes. It appears to us that the EDT modelers made a number of errors in developing the inputs for the reaches closely associated with the FRE dam site and related reservoir. These errors raise troubling questions about the accuracy and validity of the modeling outputs. The errors that we identify would have significant effects on the outcomes of modeling fish population performance of fish originating in the project area or in reaches downstream of the Proposed Project.

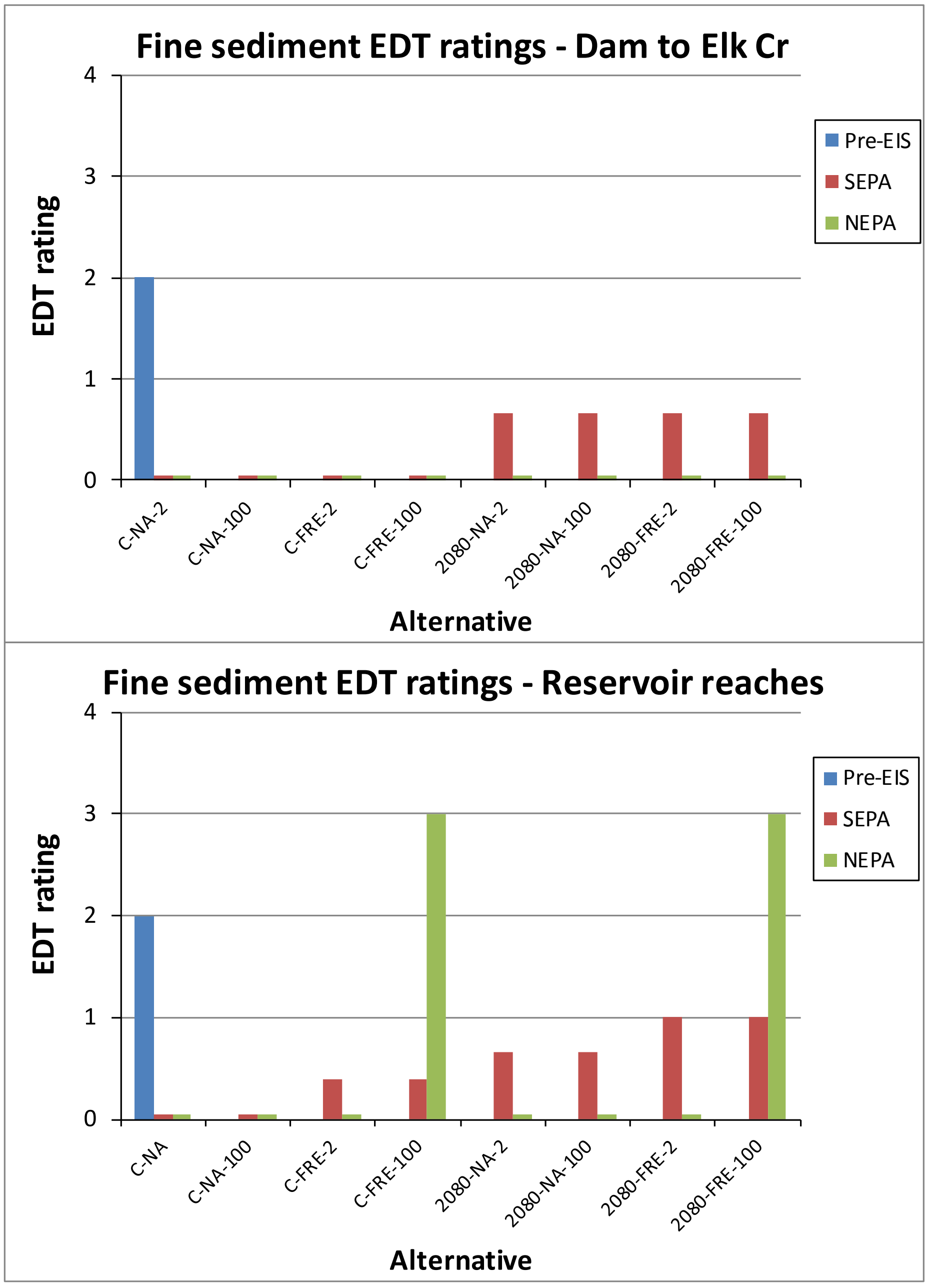


Figure 2. Comparison of SEPA and NEPA EDT ratings for the attribute Fine Sediment for two groups of reaches in the vicinity of the Proposed Project. Also shown is the attribute rating that was applied in the original EDT model for the Chehalis Basin (Mobrand Biometrics 2003) and derived by the NOAA Fisheries LCM based on application of road density. Codes for alternatives are C meaning “current”, NA meaning “no action”, FRE for FRE alternative, and 2 and 100 for flood flow recurrence intervals.

2.7.6 Issue: Inadequate Quality Assurance and Control for model use.

Our review of available information regarding how the modeling was performed revealed numerous errors in modeling inputs and configuration, which indicates a failure of Quality Assurance and Quality Control (QA/QC) measures used in the oversight of the modeling process.

We learned from our meeting on October 6, 2020 with USACE and their contractors responsible for the modeling that some of the EDT ratings had apparently been done through a group exercise involving a number of people. We question whether this would have been a reliable approach given that a number of people who participated in those meetings do not appear to be knowledgeable or experienced with the application of EDT attribute parameters (Attachment C to Appendix K “Salmonid Modeling Meeting Notes”).

Errors identified in our SEPA Reports were not properly corrected and new errors were introduced in NEPA’s EDT modeling.

2.8 Hybrid Model

2.8.1 Issue: Hybrid Model represents a curious “chimera”.

Hybrid represents a curious “chimera” that attempts to force fit steady state conditions evaluated by EDT over the entire life cycle of different species with annual variability in USGS wateryears (WY), which by definition by definition represent water flows recorded over twelve month periods that begin in October and end the September of the following calendar year. WY flow events are evaluated by altering parameters for stream width, floodplain habitats, and a few other parameters in EDT to represent different habitat conditions reflected by three specific WYs selected to represent 2, 10, and 100 year return frequencies.

- The trajectories evaluated by EDT presumes that the same WY flow conditions persist for the entire life cycle of different species which encompass three or more WYs.
- The structure of Hybrid attempts to couple productivity and capacity values from segmented life cycle stages of individual species to stitch the full life cycle together using results from different WYs. These life stage productivity and capacity values are then mathematically combined to generate productivity and capacities over the entire life cycle. NEPA does not describe the mathematical methods employed to stitch EDT steady state life stage results together, whether methods described by Moussalli and Hilborn (1986) or some other approach. These life stages do not correspond to WYs on a one to one basis. For example, the first life stage represented in Hybrid is spawner to smolt. For coho, that life stage encompasses roughly eighteen months; for steelhead, the spawner to smolt period can encompass two or more WYs (for steelhead, the introduction of annual WY variability is further complicated by a change in the representation of WYs to cover an April to March time period (12 months). Because the USGS WY variation employed by Hybrid is principally reflected by different flow conditions during winter months, this variability has little impact on productivity of winter steelhead which spawn later in the spring)

2.8.2 Issue: Neither the NEPA nor the SEPA provide sufficient information to understand the structure and parameterization of Hybrid.

Descriptions provided in NEPA and attachments were confusing and in some cases inaccurate. We are thankful for the generous assistance provided by individuals responsible for developing and running Hybrid, along with individuals that parameterized EDT to provide us with data and clarifications to try to help clarify our understanding.

Information provided by modelers after release of the NEPA for public comment revealed that:

(1) concerns and issues noted in our reports for the SEPA (see fn2) regarding errors, many of which are very significant, in parameterization of the EDT model had not been corrected; and

(2) there are discrepancies between descriptions of Hybrid contained in the NEPA and the actual procedures that were employed.

Despite the assistance of the modelers, we remain uncertain as to the logic and rationale underlying Hybrid's structure. Hybrid simulates changes in water flows through the use of life stage "flow conditions" that do not align well with USGS WYs. For coho, two flow conditions encompass 18 month periods. For steelhead, flow conditions encompass 12 month periods beginning in April and ending in March. Jeff Jorgensen from NOAA provided the figures below to depict relationships between life stages for different species and flow conditions.

○ .

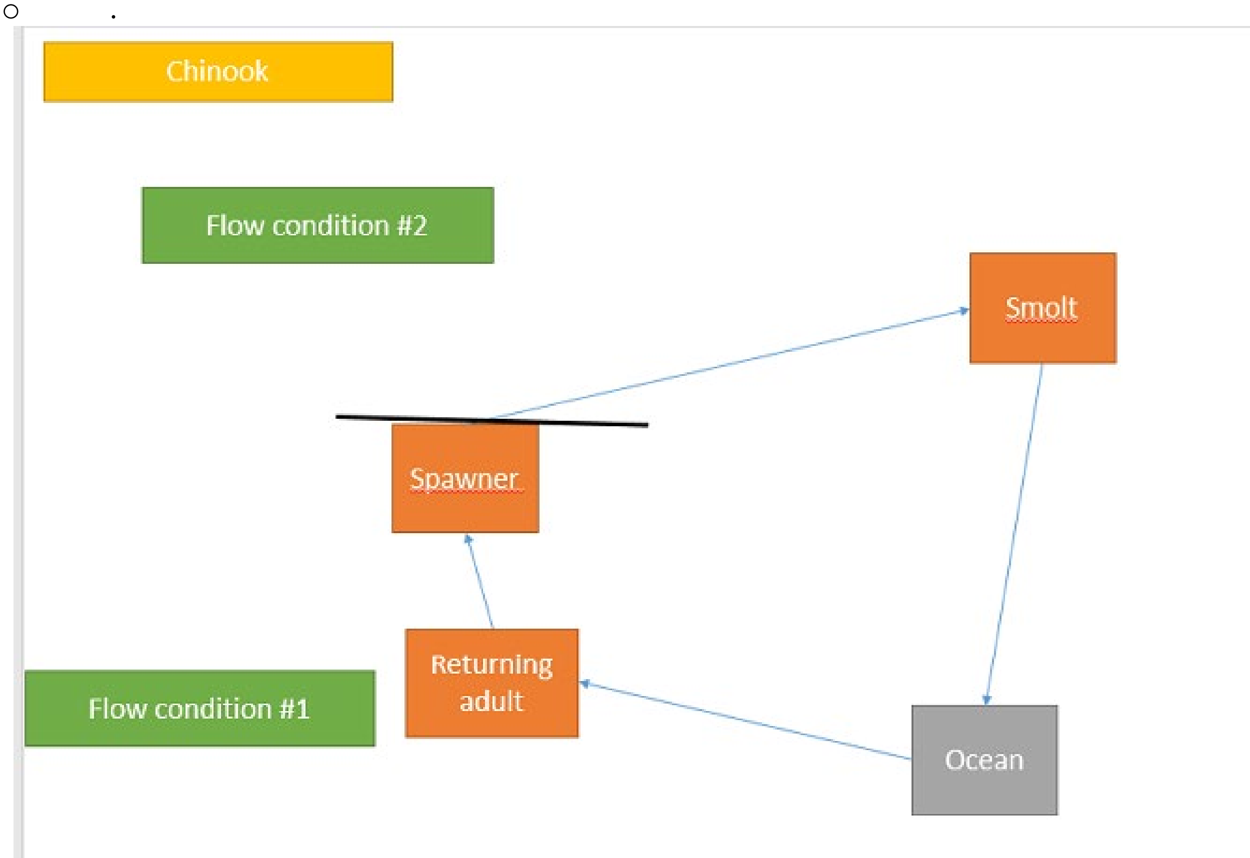


Figure 3. Chinook Life stages and flow conditions in Hybrid

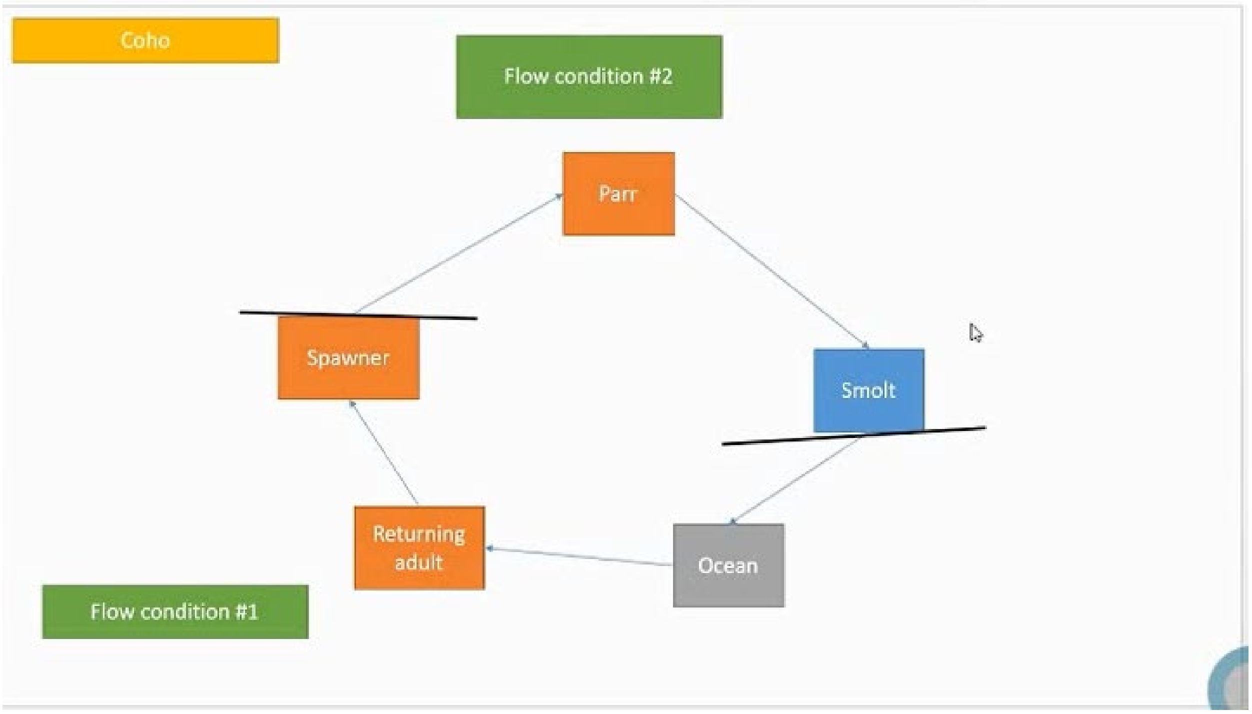


Figure 4. Coho life stages and flow conditions in Hybrid

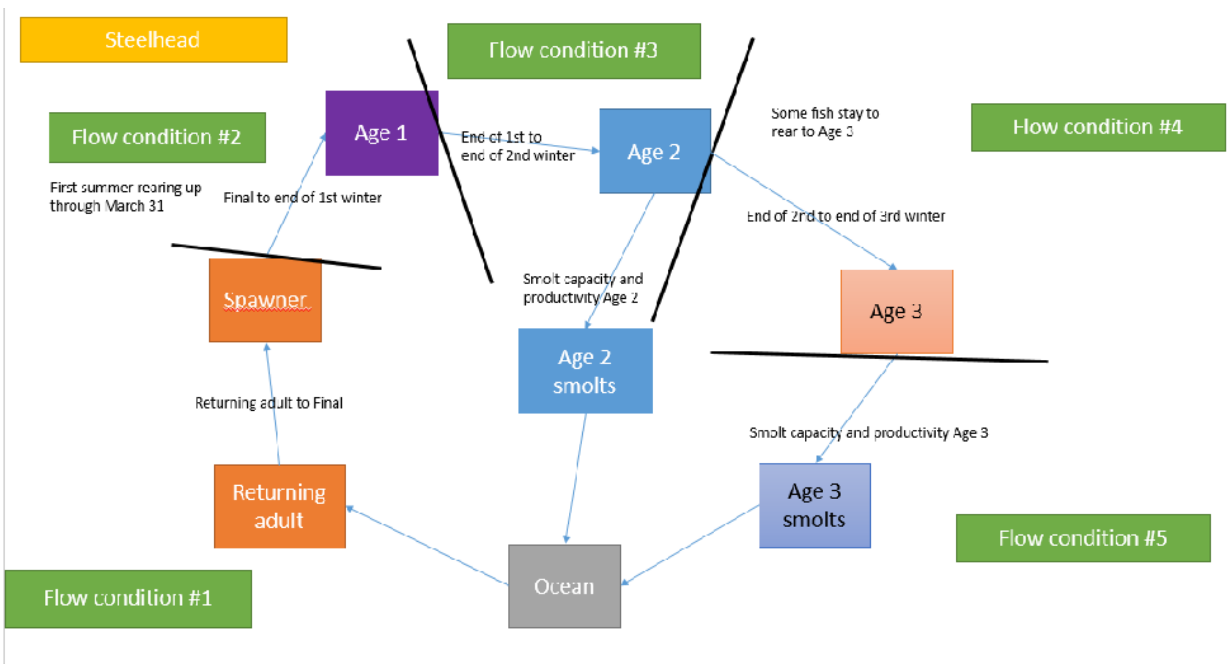


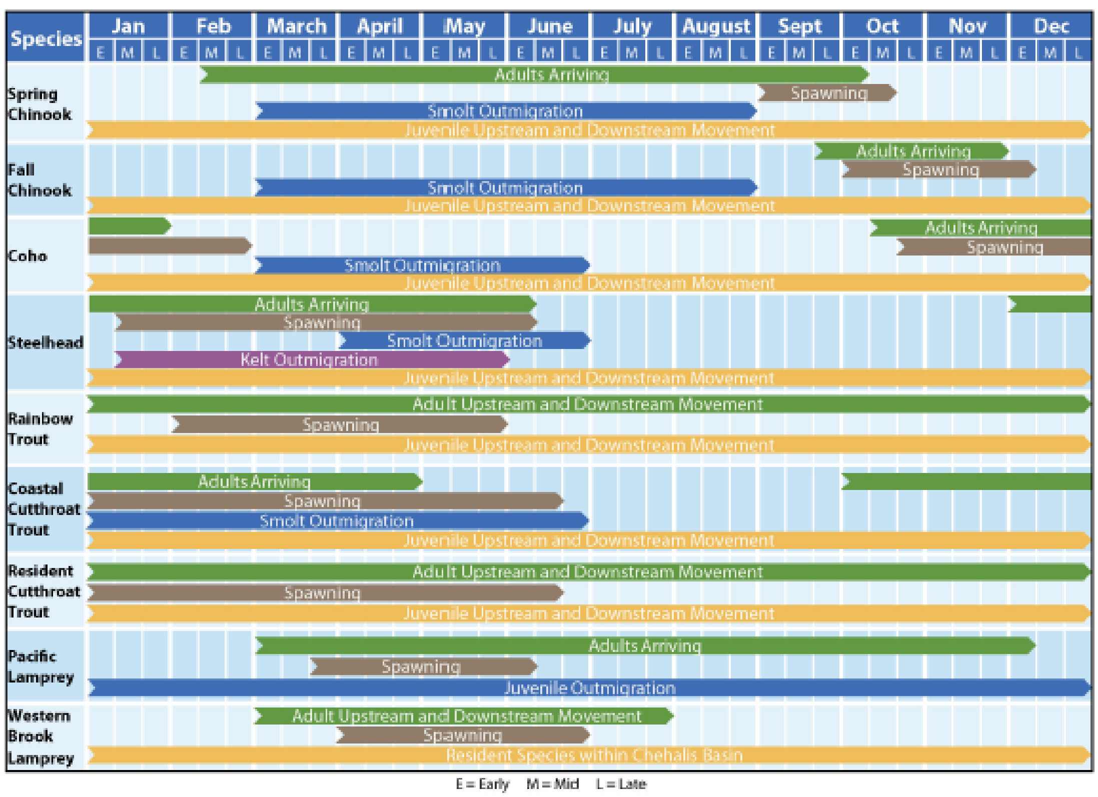
Figure 5. Winter Steelhead life stages and flow conditions in Hybrid.

The black lines in Figures 3-5 indicate start and end points from which to cumulative population parameters for productivity and capacity produced by EDT under steady state conditions are drawn for Hybrid. For Chinook, waterflow conditions encompass 12 month periods that correspond to USGS WYs. For coho and winter steelhead, however, Hybrid results for any given simulation year reflect waterflow conditions experienced by different life stages in previous simulation years. For winter steelhead, a single Hybrid simulation year would affect life stages from fish produced from brood escapements in previous years.

- We do not believe that the approach employed by breaking results from the EDT steady state model into smaller life-stage segments is scientifically credible or defensible.
- The productivities and capacities of the trajectories produced by EDT will vary in response to different environmental conditions. Hybrid assumes that environmental conditions change instantaneously with the random selection of the next WY, ignoring residual environmental effects such as bed scour and sedimentation. By simply stitching together segmented steady state EDT results mathematically, Hybrid fails to represent biological or ecological reality. Reasonable results cannot be generated by this approach. There is a fundamental and unresolvable mismatch.

The life stages employed in Hybrid do not correspond to those presented in Figure 5.3-1 at page 50/374 of Appendix K reproduced below for convenience. Since USGS WYs cover the period beginning in October and ending in September, the mismatch between WYs and life stages is readily apparent.

Figure 5.3-1
Anticipated Migration Periods of Selected Fish Species and Life Stages in the Chehalis Basin



The following matrix reflects our understanding of how WY variation is represented in Hybrid.

Flow Selection Criteria		
Simulation Yr	**Scenario**	**Flow Regime**
1990 to 1999	**Current – Initialization**	**Random 2, 10, or 100 return frequencies**
2000 to 2024	**Current**	**Random 2, 10, or 100 return frequencies**
2025 to 2030	**Construction**	**2 year**
2055 & 2056	**Current, FRE & NAA**	**100 year**
2030-2040	**Current, FRE & NAA**	**Mid Century Random 2, 10, or 100 return frequencies**
2040-2099	**Current, FRE & NAA**	**Late Century Random 2, 10, or 100 return frequencies**

2.8.3 Issue: Key EDT attribute parameters relating to flow effects were not considered.

Parameterization of EDT to reflect differences in WYs was limited primarily to the geographic study area in the three specific years selected to represent 2, 10, and 100 year recurrence intervals. Parameterization was centered on high flows during winter months and variability in timing, duration, location, and intensity of precipitation was not evaluated.

- Parameterization of EDT to represent WY variability did not alter the high flow and fine sediment attributes as would be expected under different flood levels, and made relatively minor alterations to bed scour which would be expected to vary significantly altered under major flood flows.

2.8.4 Issue: Hybrid Model not suitable for evaluation of environmental variability and uncertainty.

SEPA and NEPA rely on the EDT-LCM Hybrid model and similar methods to evaluate the effects of variability and uncertainty on the frequency of occurrence of water flow events. These methods are limited to superficial analysis that depends upon assumptions that the section of specific water year events provide a sufficient basis for evaluation of variability and uncertainty. These assumptions cannot be reasonably supported.

2.8.5 Issue: Misapplication of EDT Model within a time series application as in the Hybrid Model.

There are serious difficulties in Hybrid's approach to try to meld EDT's steady state, life stage results into an annual WY flows. Incompatibilities are summarized in the following matrix which represents our attempt to capture our understanding of relationships between Hybrid flow conditions, life stages, and EDT.

	Hybrid Model			EDT Model		
Species	Period	Flow Condition	USGS WY	Months	Life Stage	Year of Life
Spring Chinook	Mature Run	1	1	Apr-Sep	Retun/Holding	EDT Year 2-5
	Spawner to Smolt	2	2	To Mid-Oct	Spawnng	EDT Year 2-5
				Oct-Feb	Egg Incubation	Year 1
				Mar	Fry Colonization	Year 1
				Aprt-Sep	0+Rearing/Smolt	Year 1
Fall Chinook	Mature Run	1	1	Sep	Return/Holding	EDT Year 2-5
			2	Oct	Holding	
	Spawner to Smolt	2	2	Nov-Mar	Spawning	EDT Year 2-5
					Egg Incubation	Year 1
				Apr-Sep	Fry Colonization	
					O+Rearing/Smolt	
Coho	Mature Run	1	1	Sep	Retun/Holding	EDT Year 2-3
			2	Oct		
	Spawner to Smolt	2	2	Dec	Spawning	EDT Year 2-3
				Jan-Mar	Egg Incubation	Year 1
				Apr	Fry Colonization	
				May-Sep	0+Rearing	
			3	Oct-Dec		
				Jan-Apr	1+Rearing	Year 2
				May	Smolt	Year 2
Winter Steelhead	Mature Run	1	1	Dec-May	Return/Holding	EDT Year 3-7
	End of 1st Winter	2	1	Dec-May	Spawning	EDT Year 3-7
				May-Jun	Egg Incubation	Year 1
				Jul	Fry Colonization	
				Aug-Sep	0+Rearing	
			2	Oct-Dec		
				Jan-Mar	1+Rearing	Year 2
	End of 2nd Winter	3	2	Apr	1+Rearing	Year 2
				May	+Rearing/age 1Smo	
				Jun-Sep	1+"Rearing	
			3	Oct-Dec		
				Jan-Apr	2+Rearing	Year 3
	End of 3rd Winter	4	3	Apr	2+Rearing	Year 3
				May	2+Rearing/age 2 smolt	
				Jun-Sep	2+Rearing	
			4	Oct-Dec		
				Jan-Mar	3+Rearing	Year 4
	Smolt at Age 3	5	4	Apr	3+Rearing	Year4
				May	3+Rearing/age 3 Smolt	Year4

For Matched Trajectories, Cumulative Productivity & Capacity across EDT life stages for each Hybrid flow condition

Flow conditions involve multiple USGS Wateryears

Not Represented

- EDT evaluates performance of individual salmonid populations under steady state conditions, i.e., environmental conditions are identical during the entire life cycles of different species which cover periods ranging from three years for coho to five or more years for Chinook and winter steelhead. By its nature, EDT evaluates population performance for an individual species by simulating the cumulative productivities and capacities of a set of randomly selected “trajectories” in which progeny produced by fish that spawn in a particular section of a stream experience different freshwater habitats as they migrate downstream to estuarine and marine environment until the oldest progeny return as mature adults. Productivities represent density independent survivals of individual trajectories that are expected to produce more spawners than the parental generation in the absence of fishing. Capacity is typically represented as equilibrium spawning escapements, i.e., the number of spawners expected to be sustained under steady state conditions. EDT modeling did not evaluate:
    - intraspecific interactions with fish produced by hatcheries or inter-species effects except in a very minor way;
    - impacts of FRE and NAA on estuarine or marine environments which will be affected by the precipitation and temperature patterns driven by global oceanic and atmospheric currents; and
    - implications for ocean and terminal fisheries because the configuration of EDT as used for the NEPA and SEPA EDT results are valuated in the absence of fishing, consequently.
- Hybrid represents a curious “chimera” that attempts to force fit steady state conditions evaluated by EDT over the entire life cycle of different species with annual variability in USGS WYs.
    - Parameterization of the EDT to reflect differences in WYs was limited primarily to the geographic study area in the three specific years selected to represent 2, 10, and 100 year flow recurrence intervals. Parameterization was centered on high flows during winter months and variability in timing, duration, location, and intensity of precipitation was not evaluated.
    - Parameterization of EDT to represent WY variability did not alter the high flow and fine sediment attributes as would be expected under different flood levels, and made relatively minor alterations to bed scour which would be expected to increase significantly under major flood flows.
    - We do not believe that the approach employed by breaking results from the EDT steady state model into smaller life-stage segments is scientifically credible or defensible.

2.8.6 Issue: Incorrect parameterization of EDT Model for different WYs.

Example. Parameter changes primarily addressed stream width and flood plain. EDT parameters for high flow, bed scour, or fine sediment were unchanged or changed little without explanation even though these are the habitat attributes most likely to be affected by high water flows.

Example. There was a failure to account for carry over environmental effects – e.g., no remnant effects of catastrophic flooding

Example. Different definitions of WYs for chinook, coho, and steelhead and effect of different WY flows are obscured or not evaluated – e.g., steelhead spawning.

Therefore impacts under different waterflow years are muted and underestimated.

2.8.7 Issue: Misrepresentation of the nature of Hybrid Model evaluation.

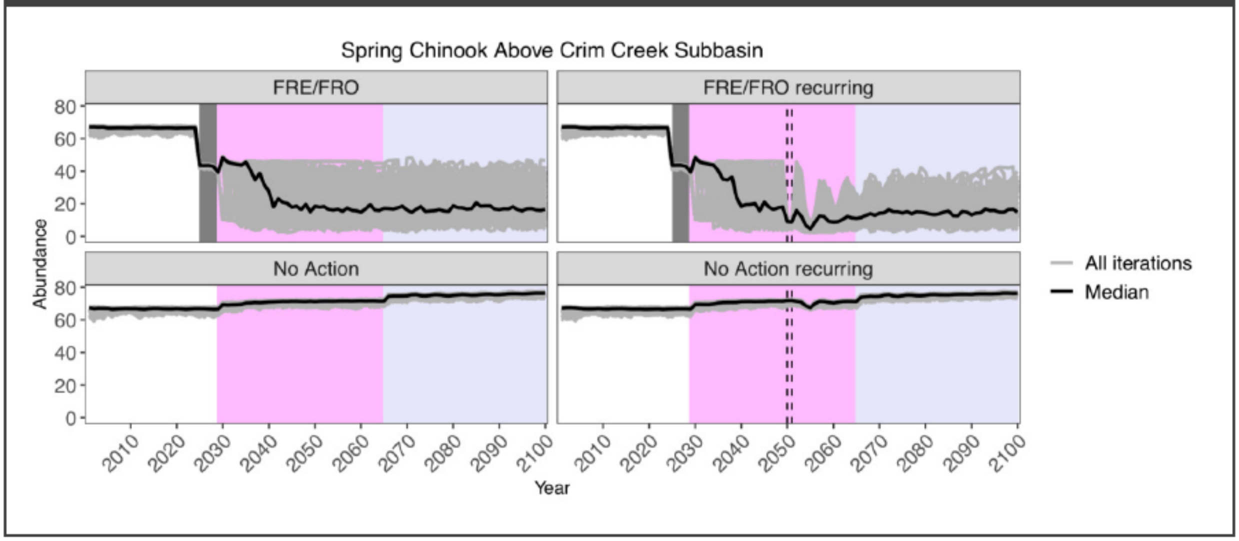
The Hybrid does not evaluate variability and uncertainty from variable WY flow events that would occur across the basin. There is limited consideration to the study area and no consideration of variation outside the study area. The consequences of ignoring this are that the basin-wide effects are misrepresented.

EDT and Hybrid did not evaluate multi-year consequential effects of WY flow events on fish habitats, e.g., bed scour and sediment deposition and transport

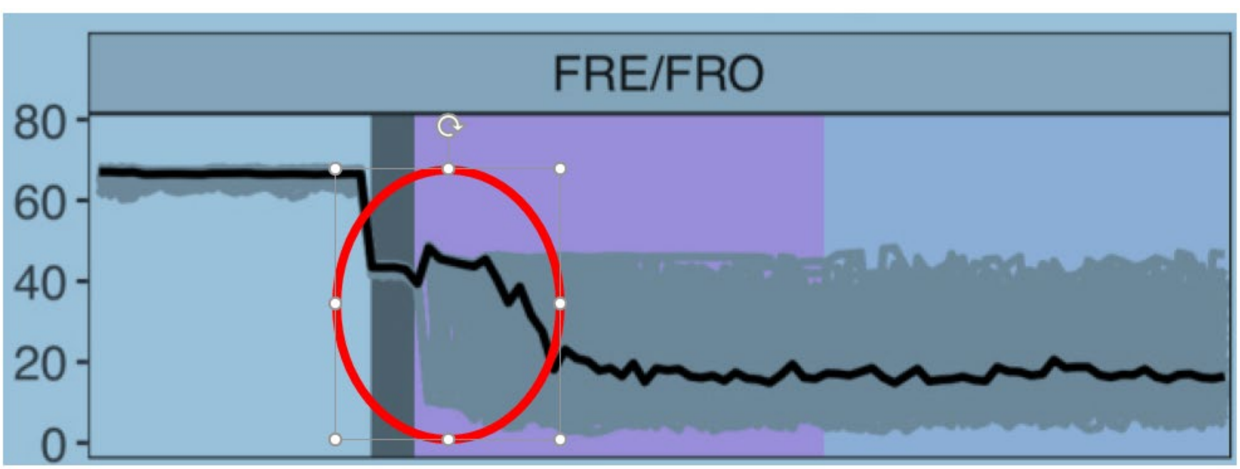
2.8.8 Issue: Hybrid Model results suggest serious underlying problems with modeling approach.

Lack of contrast in simulation results suggest errors in EDT model parameterization for 2, 10, and 100 year WY events.

Figure 2
Spring-Run Chinook Salmon Spawner Abundance of Subpopulations Above Crim Creek



Example – Figures 1-9. What's causing the abrupt drop and increase in variability in impacts at the end of the construction and mid-century points? Since WY variability starts at year 1 and variation is minor through construction, can't be attributed to WYs. Tree growth should be positive so something else is causing the pattern. From the descriptions provided in NEPA, the only remaining candidate is Development assumption, but magnitude of change in study area should not be that large. Are there other modulate century parameter changes that we were not informed about? What's the cause?



Example – Figures 1-9. Gray areas relative to median values and other observations suggest errors in EDT and Hybrid modeling.

Example – Figures 1-9. What is the cause of the lack of variability immediately after the FRE construction period in 2030?

Example – Error in steelhead modeling FRE 2080 10-yr flood abundance goes to zero while 100-yr floods indicate substantial increases for all ages at the end of period 1. What is causing this inconsistency?

3 Errors, Lack of Clarity, Gaps and Omissions

3.1 Errors

NEPA contains a number of statements and presentations of impacts of alternatives which may result in false impressions or misunderstanding of facts salient to conclusions important to decision makers. We refer to such statements as errors or misrepresentations that may intentionally or innocently characterize information in a way that may bias perceptions.

- Example. NEPA characterizes QIN's participation in model review under a Cooperating Agreement with the USACE. Page 178 of Appendix K section 2.2 states:

  > *"As a cooperating agency under NEPA and consistent with the terms of the Cooperating Agency Memorandum of Agreement, the Corps sought input relative to the QIN's area of technical expertise on the EIS. To this end, the Corps provided an opportunity for the QIN to comment on the input assumptions and parameters prior to running EDT. However, the QIN declined to comment. The Corps continued to work with the QIN throughout July and August to solicit technical input relevant to the salmonid impact modeling effort for Corps consideration. The Corps convened a meeting with QIN and the EDT modelers on August 6, 2019 to review the EDT model results. The Corps convened another meeting on August 14, 2019 with the QIN and the integrated EDT-LCMs modelers to discuss how EDT results would be integrated into the LCMs. The QIN withdrew as a cooperating agency on September 22, 2019." pg*178/374.

  In fact, during several meetings and conference calls, we provided numerous comments and concerns along with requests information for evaluation. The information we requested was not provided in a timely manner and the timeframe allowed for review and evaluation was wholly inadequate for credible review.

- Example. The description of Hybrid contained in NEPA does not accurately convey the methods, data, and procedures that were actually employed to perform the analyses.

- Example. Presentation of impacts in terms of Chehalis basin-wide metrics is inappropriate when the NEPA analyses are limited to component populations originating in portions of the Chehalis River in the immediate vicinity of the proposed FRE facility (for instance, see Appendix K, section 6.4.4.1.3). This characterization appears to be intended to emphasize that the potential losses are de minimus at the Chehalis Basin scale while ignoring the biological significance of effects on productivity and biological and spatial diversity critical to viability and resilience of the affected populations to environmental change. There is now clear evidence that genetic diversity varies significantly among subbasins within the basin for both steelhead (Seamons et al. 2017) and coho (Seamons et al. 2019)—and genetic differentiation is evident in the upper basin in the vicinity of the Proposed Project and upstream. Loss of these populations components that originate in that area would be major loss of genetic material in the basin.

3.2 Lack of Clarity

The presentation of impacts in NEPA leaves readers and decision makers without a clear picture of impacts of the alternatives considered.

- Example. In NEPA, modeling results are conveyed in qualitative terms to try to quickly convey the degree of impacts. The use of vague terminology (e.g., high, medium, low) and sets of up and down arrows with the direction indicating the direction and number of arrows indicating the degree of change leads to open interpretation as to significance. NEPA does not provide threshold values for its rating system to aid interpretation (Appendix E provides no quantitative thresholds for interpretation, despite representations to the contrary; qualitative ratings are based on professional judgement without qualification or explanation. While Appendix K provides some impacts in more quantitative terms, impacts are muddled by the manner of presentation.
- Example. NEPA mentions abundance, productivity, and diversity, these terms are improperly defined. Moreover, the lack of consideration for the importance of "productivity" separate from "abundance" is not scientifically credible; furthermore, the characterization of impacts of the proposed alternatives emphasize basin-wide abundance and do not substantively address population-level impacts (abundance, productivity, and diversity) of species affected in the study area and elsewhere in the Chehalis Basin. See comment above regarding loss of genetic diversity that would likely occur as a result of the Proposed Project.
- Example. NEPA section 6.5.5 characterizes impacts on spring Chinook as being "cumulatively Substantial" and without defining the significance of that term for decision making. Degradation of habitats throughout the basin is cited without reference as to where and to what degree and specifics as to additional effects of the proposed FRE. Impacts are described in terms of small quantities of spawning and rearing habitat by dam footprint and reservoir (2.05 acres of EFH, and 94 acres of reservoir) without disclosing biological effects of habitat losses during operation on component populations.
- Example. The manner in which impacts are presented in NEPA suggest that impacts of the FRE are less dramatic than indicated by SEPA. Disparate projections for late-century FRE and the NAA are due to different baseline assumptions employed for modeling; SEPA provided a limited, superficial assessment of climate change impacts while the NEPA did not attempt to even evaluate potential impacts. The importance of major changes in baseline assumptions from those employed in SEPA analysis are not explicitly or clearly disclosed.
- Example. The format and content of the information presented in NEPA is often confusing and difficult to interpret. For instance, Appendix K. Table 6.3-1 Modeled Habitat Potential in the Chehalis Basin Under the No Action Alternative" presents quantitative ranges for changes in equilibrium spawner abundance, while expressing impacts in terms of greatest percentage changes in abundance, productivity, and diversity, without providing specific information on the bases for measuring change; a similar format is employed in Tables 6.4-3, 6.4-4, and 6.4-5. Tables 6.4-10 and 12 present changes in terms of habitat potential, while presenting percentile changes in terms of abundance, productivity, and capacity; further these presentations are difficult to reconcile with depictions presented in Figures 6.4-1 to 8. Appendix K, Table 6.4-13 uses the term "about" without explanation or qualification.

3.3 Gaps and Omissions

NEPA suffers from a failure to substantively address important considerations. We refer to these as Gaps and Omissions that result in the lack of a fully informed basis for evaluating impacts of FRE and NAA.

- Example. No assessment of salmon impacts is provided to evaluate the implications of doing the analysis in the absence of fishing. Treatment in NEPA (4.5.2.2) is limited to information on Basin-wide natural spawning abundance and does not discuss how changes in abundance of component populations may affect the ability to conduct treaty and nontreaty fisheries and access hatchery production, both in terminal and pre-terminal fishery area. Of particular concern is the failure of NEPA to address how the alternatives would affect the ability of the Quinault Indian Nation to exercise its treaty reserved and protected rights to fish, hunt and gather or impacts on the ability of the United States to fulfill trust responsibilities to protect the health and productivity of the trust corpus.
- Example. Neither NEPA nor SEPA adequately evaluate impacts of climate change. SEPA performed a superficial assessment of climate impacts by assuming changes in peak flows and temperature in its evaluation of the NAA. NEPA acknowledged complexities and uncertainties regarding impacts of climate change, but did not attempt to quantify impacts. As indicated in our technical reports regarding SEPA, while climate impact projections are not available at the scale of the NEPA study area, global climate modeling and ample emerging evidence indicate a high degree of confidence in projections of increasing variability and directional changes in atmospheric and oceanic currents that would be expected to alter precipitation, storm, and temperature patterns. Neither SEPA nor NEPA provide information regarding risk and uncertainty from climate change or variability within the study area, much less throughout the Chehalis Basin. There is considerable variability and uncertainty in how water years will materialize and consequently affect different portions of the Chehalis Basin; the failure to consider these factors fails to inform how the Proposed Projects would be expected to affect flood damage within the Chehalis Basin and the cumulative effects to the fisheries resources.
- Example. The criteria employed to identify alternatives to the proposed FRE project resulted in the identification of the FRO alternative as not significantly different from FRE. The limited scope and criteria rejected the identification of alternatives consistent with the twin goals of the Chehalis Basin Strategy of reducing flood damage and restoring aquatic species throughout the Chehalis Basin. As a consequence, information on the proposed reduction of flood damage throughout the Chehalis Basin is not provided. The limited focus of NEPA on reducing flood damage to human-built structures fails to acknowledge or describe the important ecological processes related to flooding in the formation of habitats for aquatic species.
- Example. Environmental impacts on salmon are focused on spawning, reservoir, and local floodplain habitats. There is little to no evaluation of impacts outside these areas despite their importance in maintaining salmon populations; progeny produced by salmon spawning in the study area will utilize other habitats and be affected by ecological processes that are altered by the proposed FRE.
- Example. Consideration of uncertainty in NEPA is superficial; it does not substantively address the implications of uncertainties and risks. While section 6.2.1.1.3 “Model Uncertainties and Considerations” of Appendix K and Section 5 of Attachment B to Appendix K provides an extensive list of sources of uncertainty, and a disclaimer that uncertainties in EDT parameterization were not considered, the NEPA does not provide information as to how those uncertainties might affect impact assessments. NEPA identifies a number of statutes and

regulations that may become involved in permitting actions, but does not discuss potential consequences for administrative and regulatory processes or restrictions on actions that affect habitats should some populations decline to levels that would pose viability concerns under FRE.

- Example. Neither NEPA nor SEPA provide specifics regarding mitigation measures to offset adverse impacts. The NEPA mitigation section 7.2.5 lacks specifics for mitigation and instead defers to future development of mitigation proposals by the applicant; similarly, SEPA defers development of mitigation plans to permitting or future consultation processes. Consequently, it is not possible to evaluate the feasibility or effectiveness of mitigation actions to ameliorate or compensate for deleterious effects of the Proposed Project alternatives. Although some potential actions are listed, NEPA does not include analyses or assessments of impacts or expected outcomes.
- Example. NEPA fails to recognize, acknowledge, or respect co-management authorities and responsibilities of QIN (e.g., USACE & WDFW to establish the work window for dam construction); NMFS and WDFW determine fish passage design and operation; "governing fisheries agencies" determine fish transport requirements and operations.

4 Conclusions

- ➢ The full scale and scope of impacts of FRE on aquatic species, watershed and ecological processes have not been sufficiently analyzed.
- ➢ The limited scope of assessment, the methods and assumptions employed likely underestimate potential adverse effects of FRE on salmon populations.
- ➢ Numerous errors and inadequacies in the methods and evaluations employed for impact assessments indicate that stringent quality assurance and control measures were not applied. Concerns and issues noted in our reports for the SEPA were not corrected.
- ➢ NEPA does not provide a sound scientific foundation on which to base a decision regarding USACE permitting.

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