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January 2, 2012

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SUBJECT: Draft Chehalis River Fish Study released November 30, 2011 and Draft Appendices (A-F) released November 17, 2011

Mr. Schlenger:

The Washington Department of Fish and Wildlife (DFW) appreciates the opportunity to review the above-referenced documents and offers the following comments for your consideration at this time.

DFW has developed comments for the Draft Chehalis River Fish Study *(109 pp.)* and the following associated appendices; Appendix A. Draft Hydrologic and Hydraulic Modeling Report, Appendix B. Draft Geomorphology/Sediment Transport/Large Woody Debris Report, Appendix D. Draft PHABSIM Instream Flow Study, Appendix E. Draft Upper Chehalis River Watershed Fish Habitat Evaluation, and Appendix F. Draft Fish Population Model. Other comments may be offered in the future.

<u>Draft Chehalis River Fish Study</u>

Page 14, pages 8-14. This section should better explain that the December 2007 flood data exceeds the 100-year flood at the Doty gauge (and other gauges as determined). In Table 2-3, both the 100-year flood and the December 2007 flood are shown. Table 2-3 also appears to have an error in the 100-year flood row for existing conditions. The 1-day average flood flow cannot exceed the peak flow.

Page 16, line 4. Typo : "t0068at"

Page 16. The statement is made that since the 100-year flood (~39kcfs) does not fill the proposed flood storage reservoir, the reservoir size could be reduced to optimize for flood storage. However, the real flood of December 2007 greatly exceeded the statistically determined 100-year flood by approximately 50%. Although dams have consistently been detrimental to salmonids, reducing the planning scale would be unlikely to fulfill the proposed dam's intended primary purpose: protection of Centralia-Chehalis and surrounding communities from extreme floods.

Page 17, Anchor QEA states its opinion that the December 2007 flow was overestimated. In fairness to readers and decision-makers, it should be stated that the estimate Anchor disputes was made by the USGS, the nation's authority for hydrology (see 2.3, pp. 25 ff). In preliminary reviews of the flood *hydrology for the Army Corps of Engineers, another agency with national and international credibility in flood hydrology, a consultant to the Corps has not discredited the USGS estimate. In Table 2-6 (p. 21) the December 2007 flood is not included, apparently because of this disagreement over the magnitude of the 2007 flood, but it is again a disservice to readers and decision-makers to exclude the 2007 flood, even if it is specified with upper and lower estimates.*

Page 17-20, In 2.2.1.2 the median September flow with the multi-purpose reservoir is stated as 122 cfs. This statement should be corrected to indicate that this projection is based on assumptions about flow releases from the reservoir. However, flow releases from the reservoir in a multi-purpose reservoir would be subject to Clean Water Act section 401 Water Quality Certification, including specification of instream flow releases varying by season to protect fish and other instream values. Without detailed analysis of instream flow studies, it is not possible to state what those flows would be. The instream flow studies reported in this report might be used in part for the determination of suitable instream flows, but because of time limitations that may have influenced model sensitivity and quality, additional instream flow studies may be required before Section 401 instream flows could be determined. This could modify the right side of Figure 2-3.

Page 24, lines 14-16, The statement that "The recurrence interval of floods … during the 1996 flood was … approximately 33 to more than 100 years at the Doty gage" should either be corrected or explained.

Page 29, lines 24-28. As with flows, management of woody debris would likely be addressed if a multi-purpose dam with hydropower generation were licensed by the Federal Energy Regulatory Commission, so the assumption on p. 29 (lines 24-28) that "large wood and coarse sediment from the upstream watershed would be trapped in the impoundment" might require modification.

Pages 44-47. By deploying water temperature probes in September 2011, the warmest conditions were missed. It would be useful to compare magnitude, frequency, and duration of air temperatures from August 1, 2011 at Centralia (or whatever reference data are being used) with a comparison to magnitude, frequency, and duration in other years to show how late summer 2011 compared to other years. Was 2011 unusually warm, cool, or typical? This is an important point in reference to the inordinately high modeled temperatures (e.g., >30°C – see Figure 4-5). Were air temperatures sufficiently high to account for the high modeled water temperature? The high modeled temperature for August 15 in Figure 4-5 is highly suspect and sheds significant doubt on the temperature model. It has the potential to be misused to claim a modeled benefit to salmonids that is greater than is realistic. The greatest modeled temperature change is portrayed as 16°C between "base case" and "hydropower case". The benefits in temperature and in salmonid habitat value are less if the base case is closer to the measured temperatures (<26°C). Figure 4-7 shows modeled temperatures with surface release do not exceed 30°C.

Page 53, lines 20-21. Wording is unclear about habitat: "Instead, their results indicated that the most habitat for coho salmon occurred at very low flows, then declined as flows increased." It would be more clear to replace "habitat" with "WUA, the habitat index calculated by PHABSIM".

Page 53-54. The first paragraph in 5.3 is an important one. WUA indexes part of habitat, but it is generally at a microhabitat scale and seldom includes meso- or macrohabitat. Temporal connectivity can be critical for egg incubation beginning with spawning. WUA with unsuitable temperature or other water quality (macrohabitat) is of little value. WUA does not provide an indication of flows needed for maintaining suitable mesohabitats (pools, riffles, etc.).

Page 59, Figure 6-1. Figure 6-1 should include the pink triangle in the legend symbolizing dam location.

Page 60, lines 20, 27-29. As mentioned at the December 12 workshop, downstream migrant survival is greatly overestimated on p. 60 (line 20). This will lead to gross errors in the Shiraz model. Instead of the model showing that multi-purpose dam construction and operation will result in extirpation or near extirpation of steelhead in the Chehalis and of a significant proportion of coho and chinook, the model with the gross overestimate of downstream migrant survival will lead to the erroneous impression that salmonid production would be minimally impacted. In lines 27-29 the statement implies that 80% downstream migrant survival has been achieved, while such a survival rate has not been achieved with decades of effort and millions of dollars in construction and modification at several Northwest dams.

Page 61-63. In 6.1.1.3 the integration of WUA from PHABSIM into Shiraz is described, but it is not clear if maximum WUA or some other value is used for each reach, since WUA depends on flow. As discussed above, WUA should be used with great caution. WUA should really only be used as an index of relative habitat value at a given site across a series of flows. If the purpose of WUA in Shiraz is to estimate carrying capacity of different reaches, WUA might be more valuable if only binary suitabilities were used (however, the type of PHABSIM model done in this study is useful for estimating flows that provide better habitat). Use of binary criteria with emphasis on the most preferred depths, velocities, and substrates as done in this study is appropriate for evaluating flows and comparing flow release schedules from the reservoir. Large areas of low suitability do not necessarily equate ecologically to small areas of high suitability, yet both could result in the same WUA but different carrying capacity.

Page 62, lines 4-18. The report discusses gradual decline of habitat over time as a result of geomorphic influences of dam construction and operation. This topic was briefly discussed at the December 12 workshop. The following publications may be relevant to this analysis: Petts, G.E. 1979. Complex response of river channel morphology subsequent to reservoir construction. Progress in Physical Geography 3: 329-362. Petts, G.E. 1980. Long-term consequences of upstream impoundment. Environmental Conservation 7 (4): 325-332. Petts, G.E. 1984. Impounded Rivers: Perspective for Ecological Management. John Wiley and Sons, Chichester. Petts, G.E. 1989. Perspectives for ecological management of regulated rivers. Pages 3-24 in: J.A. Gore and G.E. Petts (editors). Alternatives in Regulated River Management. CRC Press, Boca Raton, Florida. Petts, G., P. Armitage, and E. Castella. 1993. Physical habitat changes and macroinvertebrate response to river regulation: the River Rede, U.K. Regulated Rivers: Research and Management 8: 167-176.

Pages 63-68, lines 10-14 and 28-30, Table 6-1. The report states that "The approach taken to characterize habitat productivity in this study was to use available data sets that are documented in the scientific literature to contribute to the habitat needs of salmonids and to develop a predictive model that relies upon as few habitat parameters as necessary to effectively calibrate to previous observations of salmonid returns to the river." Citation of the relevant literature would improve credibility and elucidate uncertainties. In Table 6-1 the single habitat parameters input to affect productivity do not always make sense. For returning adults, temperature is listed as the most influential parameter, and this might be quite important for some stocks some places, but for the three stocks modeled in the Chehalis the case is unconvincing because of run timing, particularly for steelhead. On p. 68 the equations should be adjusted to exceedence flows for August-September so that survival is low at low flows (high exceedence percentages) and high at high flows (low exceedence percentages) instead of the cfs values listed on lines 28-30.

Pages 70-73, Figures 6-3, 6-3 and 6-4. In 6.2.1 matching of model predictions to WDFW fish return estimates should be indicated by some statistic for how well they match, since matching is being touted as the indication of model quality. The matching in Figures 6-2 is not convincing, and 6-3 and 6-4 are only somewhat better (see also discussion of Figures F-3, F-4, and F-5 below).

Pages 73-77, Figures 6-5, 6-6, 6-7. There are several issues to be resolved in this report. Therefore, conclusions in 6.2.2 are premature. The conclusions from Figures 6-5, 6-6, and 6-7 lack credibility when the most productive salmon and steelhead habitat in the Chehalis River would be blocked, yet salmon and steelhead productivity is portrayed as nearly as great as with existing conditions.

<u>APPENDICES (A,B,D,E,F)</u>

APPENDIX A - Draft Hydrologic and Hydraulic Modeling Report

Appendix A presents the results of hydrologic modeling with a reservoir routing component (HEC-RESSIM) for simulation of proposed flood storage on the upper Chehalis River above Doty, WA. The modeling includes two scenarios, a flood storage alternative and a multi-purpose (hydropower) alternative. The report also includes one-dimensional, water surface modeling (HEC-RAS) of flood flows downstream of the proposed reservoir.

The flood storage alternative considers an 80,000 acre-ft reservoir 6.8 miles upstream of the Doty gage. The hydropower alternative considers a 145,000 acre-ft reservoir in the same location. The overall study reach extends from the area tributary to the proposed reservoir (River Mile 108.6) downstream about 50 miles to the USGS gage at Porter, WA (RM59). The report concludes that the proposed flood storage would reduce the 100-yr flood (39,353 cfs) by 50-60% (to 17,433 cfs) at Doty, WA. and reduce flood elevations by 0.9 to 1.3 ft. near the City of Centralia.

In general, Appendix A presents a detailed analysis of reservoir alternatives and flow influences in selected reaches of the middle to upper Chehalis River. For purposes of this review, WDFW considers large floods (>10-year recurrence interval), medium floods (on the order of 2-year recurrence interval) and annual high flows on the order of mean annual flows to be of particular interest with regard to channel processes, fish migration, and fish spawning.

Page A-1, Section 1.1 Methodology and Page A-6, Section 2.2.2 Operation of Proposed Reservoir. The report does not present a configuration of the hydropower alternative with proposed locations of penstock, powerhouse, or tailrace. The effects of reservoir operations on flow and flood levels in a bypass channel, if applicable, could be considered in this analysis.

Page A-5, Section 2.2.1 Estimate of Inflow into Proposed Reservoir. The report notes that the 2007 flood was an extreme, localized precipitation event in the upper Chehalis River Basin on the order of twice the amount of a 24-hour 500 -yr event (Table A1). The report would benefit from some discussion of whether this was a rain-on-snow event and potential variability in runoff from future events of this magnitude.

Page A-11, Section 2.3 Flow Data and Hydrographs Used in Hydrologic Analyses. The report suggests that use of the 2007 flood data makes the peak flow data conservatively high and the effect of the reservoir understated. The report should note as well that use of the 2007 precipitation and flood data weights the upper Chehalis River basin disproportionately to a similar event in other, larger tributaries downstream. The occurrence of such a flood in the South Fork Chehalis River basin or Newaukum River basin could make the effect of the proposed reservoir of little or no significance to flooding 35 to 40 miles downstream in the Chehalis to Centralia reach.

Given the 2007 event did occur, it is important to identify impacts and opportunities from dam construction to model and present the effects of the dam on this event, equally as the 1996 flood was modeled as the previous record flood event. We suggest the actual USGS estimate of 63,100 cfs be presented a viable flood event in the same manner as the estimated peak of 39,353 cfs for the “100 year” flood that was modeled.

Page A-21, Section 2.5.1.1 Flood Storage Alternative. The report notes that flood storage significantly reduces the maximum flows (at Doty) while flows less than 3,000 cfs are not significantly affected. The report would benefit from clarification that peak flows greater than the 10-year recurrence interval (19,857 cfs) are eliminated or reduced to flows on the order of the 2-year recurrence interval (9610 cfs). As a result, channel forming processes (bank erosion, meanders, and avulsions) would be essentially eliminated in the reach.

Page A-31, Section 2.5.2.2 Multi-Purpose (hydropower) Alternative. The report notes that the highest flows are decreased in magnitude to 16,393 cfs (less than the 10-year flow of 19,857 cfs) and the 2-yr flow is reduced by greater than 50%, with higher median flows in winter and higher flows in May to October. As a result, channel forming processes associated with these high flows would be essentially eliminated and channel maintenance processes (particularly sediment entrainment and transport) diminished downstream of the reservoir. At the same time, the magnitude, duration, and timing (seasonality) of channel flushing flows carrying organic matter and fine sediment, and comparable flows for fish migration and spawning, would be significantly altered in frequency and timing (seasonality).

Page A-32, Table A-15 and Page A-33, Table A-16. These tables would benefit from including the column for Maximum Flows (as in Tables A-12 and A-13) for comparison of higher flow magnitudes.

Page A-43, Section 3.3 Flood Reduction Benefits from Flood Storage Reservoir Alternative. The report notes the reservoir could reduce flooding by 0.9 to 1.3 feet in the City of Chehalis to City of Centralia area. The report would benefit from clarification that the reduction in flood level is based on computation of water surface elevations given several important model assumptions. For example, the computations are based on flow characteristics and channel hydraulics only and do not include changes in flood carrying capacity due to recent channel changes, movement of sediment and wood in the river, or recent filling of the floodplain for development. The report could also note that portions of the area are behind levees and that flooding frequently occurs as a result of breaks or failures in the levee. The report would benefit from some caution that the 0.9 to 1.3 ft reduction in modeled flood levels is an interesting element of an ongoing discussion but at this point should not be relied on with a high degree of confidence.

APPENDIX B - Draft Geomorphology/Sediment Transport/Large Woody Debris Report

Appendix B presents an analysis of proposed reservoir alternatives on bedload and large woody debris transport in the middle to upper Chehalis River. It includes a survey of historical (1876 to 2009) channel changes and recent (2009) gravel bar sampling at selected locations upstream of Grand Mound, WA. Additional sampling of upland sites for sediment derived by mass wasting was conducted in 2011. The report presents a comparison of sediment transport capacity based on a 7-day 100-year hydrograph at two sites on the river. The report also includes an inventory of LWD within the bankful channel at selected sites on the river.

Page B-1, Section 1, Introduction. Appendix B notes that the proposed reservoir alternatives would alter peak flows and the input and transport rates of sediment and LWD downstream. The report takes a limited approach to defining geomorphic effects of flow alterations on unregulated, alluvial bedded rivers. It generally quantifies bedload transport as a percent of suspended sediment measurements. This section would benefit from discussion of the larger context of alteration of flow and flow influences on geomorphic processes. For example, input and transport rates for sediment are only a subset of other important flow and sediment dynamics. Sediment transport processes include entrainment, transport, deposition, and storage of a wide range of organic and mineral sediment size classes derived from in-channel, riparian, floodplain, and upland sources. It is not necessary for this study to address every aspect of potential changes in flow-sediment dynamics due to proposed reservoir operations, but it could be made clear that these other processes may be equally deserving of future study.

Page B-5, Section 2.3, Sediment Inputs and Suspended Load. The study includes no direct measurement of bedload inputs (which is not unusual) and assumes a 5 to 10% proportion of bedload to measured suspended sediment loads, depending on location in the watershed. This assumption needs to address the limitations of the period of record (1961-1965) for suspended sediment measurements. USGS records of peak flow for the period are fairly uneventful (only slightly exceeding 2-year recurrence interval peak flows) compared to later flow records (1979-2007). Suspended sediment measurements from 1961 to 1965 may not be representative of long-term conditions. Another concern with the assumption of proportional bedload calculations is that bedload transport is more episodic than suspended sediment transport and may need longer periods of record to characterize average annual volumes.

Page B-10, Section 2.5, Large Woody Debris. The study notes that LWD was inventoried by counting pieces within the bankful channel. The report would benefit from noting if any distinction was made for pieces with or without rootwads, or for orientation of the pieces to the channel, or if pieces were "bridging" the channel above bankful. The report could also discuss if wood sources outside of the bankful channel (i.e. in the riparian zone, floodplain, or channel migration zone) were or were not considered in the study.

Page B-15, Section 3.1.1.1, Channel Migration. The report notes up to 300 feet of channel changes in Geomorphic Reach 3, upstream of the SF Chehalis River. It notes channel changes of 600 to 1000 ft in the active zone of Geomorphic Reach 4 downstream of the SF Chehalis River. The report could note more specifically that these areas are also expected to have significant reductions in peak flows (by 50% or more) due to the proposed reservoir alternatives, in effect preventing channel migration in the future. It is not clear how deposition and aggradation due to flow reductions would increase channel migration without peak flows necessary to drive the process.

Page B-21, Section 3.2.2.1 Existing Grain Size. The report notes that 800,000 tons of sediment from recent landslides in the headwaters will continue to be reworked and transported downstream for many years. The report could note that flow reductions of 20 to 50% of peak flows in the river, and elimination of flows greater than 2,000 cfs at the reservoir site, will significantly reduce the rate of movement of this material downstream. The report could note that without the peak flows necessary to mobilize these deposits, they may quickly become revegetated and further resistant to entrainment and transport.

Page B-41, Section 4, Discussion. The report notes that under existing conditions, bedload transport in Reach 2 is estimated to occur in 50 to 55% of the years in the current record. The report could note that a 50% probability of occurrence is the 2-year recurrence interval event, or about 9,967 cfs at the Doty gage. The report notes that under the reservoir alternatives the bed would be mobilized in 5 to 23% of future years. The report could note that flows reduced to 2,000 cfs at the proposed reservoir and on the order of 4,700 cfs at Doty would not be expected to mobilize bedload through most of Geomorphic Reaches 2 and 3. The recruitment, entrainment, and transport of LWD could likewise be significantly reduced in most of Geomorphic Reaches 2 and 3.

Page B-42 Section 4.1, Study Limitations. The study notes that there has been no bedload sampling to verify the transport modeling. The study could note that the bedload transport capacity calculations and yield comparisons are uncalibrated and derived from suspended sediment sampling for a very limited period (1961-1965). Topographic information for the flow analysis, as noted in Appendix A, is derived from surveys in 1980 to 2001 and may not represent current conditions. The report would benefit from clarification that the results from the bedload and LWD transport analyses are useful for discussion purposes but should not be relied upon as a complete or highly accurate assessment of potential effects of the proposed reservoir operations on geomorphic processes and characteristics downstream.

APPENDIX D- Draft PHABSIM Instream Flow Study

Page D-11 and Attachment B. In order to adequately evaluate PHABSIM instream flow study, calibration details must be provided, not just summary calibration statistics.

Page D-15, Lines 2-3. Statement that spawning substrate was too mobile needs further explanation.

Pages D-29 and D-30, Line 4 and first line in last paragraph. Figure numbers in text and figures do not match but appear to be off by one.

Pages following A-30 and B-30. Attachment cover pages are not matched to the appropriate attachments.

APPENDIX E - Draft Upper Chehalis River Watershed Fish Habitat Evaluation

Page E-8. Habitat variables for Chinook salmon habitat evaluation were selected based on data availability, but this process resulted in exclusion of some habitat variables included in the Shiraz model (e.g., temperature).

Page E-9. Description of spawning gravel computation is unclear. It appears that A and B each applies to two different concepts: first, gravel particle size, and second, area of habitat occupied by gravel. It is unclear how spawning area and rearing area are delineated or distinguished from total area.

Page E-14 ff. The report refers to the East Fork Chehalis River. Cartographers have named the branch that enters the Chehalis near Adna the East Fork Chehalis, but have also designated a branch upstream of Pe Ell the East Fork Chehalis, and this could lead to confusion. The branch upstream of Pe Ell should be designated the East Fork Upper Chehalis River.

Attachment 1. Attachment 1 has the uncorrected spell-check false correction of HIS instead of HSI.

APPENDIX F- Draft Fish Population Model

The spawning distribution of Winter Steelhead was correctly identified as (91% above the dam, 7% between the dam and Elk Creek, and 2% from Elk Creek to the South Fork Chehalis), however, assumptions are made in Table F-3 on Page F-14 that do not reflect this data and lead to substantial errors in predicting the effects of the dam on steelhead based the SHIRAZ model.

Significant spawning areas, specifically 58,609 square meters between the dam and Elk Creek, and 84,309 square meters between Elk Creek and the South Fork Chehalis are identified using PHABSIM as existing steelhead spawning habitat, without accounting for the observed data that this area is utilized by only 9% of the steelhead in the mainstem Chehalis.

Moreover, in the remaining 4 downstream reaches, where no documentation of steelhead spawning exists, a total of 201,703 square meters of existing steelhead spawning habitat is identified, including 6465 square feet of spawning habitat. This area is between the Newaukum and the Skookumchuck and is characterized as "one long pool", where no record of spawning exists. This suggests that even if access to the 148,570 square meters of spawning habitat above the dam that is used by 91% of the steelhead is eliminated by the dam, spawning steelhead would redistribute downstream. This is misleading and not representative of steelhead ecology. Steelhead have a very high fidelity for spawning location. The elimination of the steelhead spawning habitat would negatively impact 91% of the steelhead spawners and the long-term viability of this stock in the Chehalis basin.

Similar results would be expected for coho, as again there is limited suitable spawning habitat in the mainstem below the South Fork of the Chehalis, even though 141,167 square meters were "estimated", and only 10% of the Chehalis mainstem coho spawning population spawns below the South Fork and the dam location in the 71,674 square meters estimated there. 90% of the Chehalis mainstem coho spawn above the dam location as well. Currently, there is only a 10% survival rate documented for downstream migrant coho at Cowlitz Falls dam.

On Page F-12 fish passage facilities are discussed, and claims are made that a facility that provides downstream migrant passage at 80% survival would be provided. This high survival rate is based upon some best case scenarios observed on low head run-of-the-river dams in the Columbia Basin reported in Cramer and Beamesderfer (2006). Survival rates of 80% and greater are rarely achieved in high head dams with a storage reservoir, such as the one proposed for the Chehalis in this location. The more applicable survival rate surrogate would be Wynoochee Dam, a high head water supply dam in the Chehalis system. 3% of juvenile coho tested survived the fish passage facility at Wynoochee (WDFW Technical Report, Dunn et. al. 1975).

It is likely that significant mortality will result for the progeny of any fish passed upstream due to ineffective downstream passage of juveniles. With 91% of the mainstem steelhead and 90% of the mainstem coho spawning occuring above the dam, this proposed facility would have significant negative impacts on these species.

The SHIRAZ model developed for this study is severely compromised with the inclusion of inaccurate temperature, spawning, and fish passage data. The utility of this model in predicting impacts, both positive and negative, of a dam constructed on the upper Chehalis River is unclear.

There have yet to be any documented increases in native salmonid populations noted in any anadromous salmonid river located in the Pacific Northwest as a result of damming, even with improved minimum base flow and stability. On the contrary, several salmonid population losses and ESA listings have been the documented result in dammed rivers throughout the region.

Page F-8, 2.2.2.1.2. Report has steelhead incubation through September. Even with July spawners, higher TUs are likely to result in emergence in August.

Page F-11, Table F-2. This table is unclear. The text explaining it is limited. The data basis for it is extremely limited. The assumptions for populating the table do not appear to be stated and any rules (e.g., use is proportional to reach length between emergence and estuary, or modified by a summer temperature rule) are not stated. If Table F-2 is a foundation for the remainder of the model effort, then it should be clearly explained. The lower right corner (intersection of Tributaries and Tributaries) implies tributary fish never leave tributaries until they smolt.

Page F-14, Table F-3 and 2.2.3.1.2. Average (mean) flow is not a good indicator for typical flow conditions; median is much more realistic (typically lower flow) because the distribution of flows is not normal, but skewed so that a few very high flows drive a mean up much higher than is typical of the season. Median flow should have been used for ecological assessment (mean flow may be more appropriate for engineering considerations).

Page F-14, Table F-3. Table F-3 does not adequately account for flow accretion (or it is not explained). If flow is 97 cfs in the upper watershed during spring Chinook salmon spawning, then flow will be greater than 97 cfs below Elk Creek and below the South Fork confluence. If these are flows at particular gauges, then the gauges should be identified. The spawnable area may be indexed to a flow at a particular gauge, in which case the index rate should be stated.

Page F-15, last paragraph. The guess that equates tributary rearing area to South Fork Chehalis to Newaukum River should be justified. GIS tools are available to provide some more reasonable and supportable estimate.

Page F-16 through F-17, Tables F-4 through F-6. Report uses mean flow during spring, summer, and winter rearing as a basis for calculating rearing area from WUA. Instead, median flows are a better representation of typical hydrologic conditions during a season in Tables F-4 through F-6. Use of WUA to estimate winter rearing habitat (Table F-6) should be done cautiously because WUA is based on summer habitat selection and use by rearing salmonids. Winter behavior is different and sensitivity to crowding is less during winter when metabolic needs are lower. Coho rearing habitat is reported in Tables F-4 through F-6, but WUA for juvenile coho was not generated in the instream flow/PHABSIM study (Appendix D) because WUA calculations for juvenile coho salmon are known to be misleading (Beecher et al. 2010).

Page F-18, 2.2.3.2.1. As with rearing area, it is more appropriate to use median, rather than mean, flows to assess available spawning area, with the possible exception of coho salmon.

Page F-19, 2.2.3.2.2 Tables F-8 through F-10, Again, rearing area should be based on median, rather than mean, flows and juvenile coho salmon rearing should not be based on WUA. Information in Tables F-8 through F-10 is difficult to track. It would be helpful to graph, for example, steelhead rearing within a reach through the three rearing seasons, perhaps with reaches starting from the top and going down to Porter, resulting in three graphs, one for each species. In the end readers will want to track changes in those patterns with different management options.

Page F-21, 2.2.3.3 Table F-11. What is the rationale for the flow releases specified in this section and table? Instream flow requirements determined for 401 Water Quality Certification process, hydropower generation capacity, and flood reduction are all factors in determining actual flow release, so the tentative placeholder nature of these figures should be made clear.

Page F-24 and F-25, 2.2.4. Caveats stated in this introduction are important. On the other hand, it is important to make management decisions that are based on assumptions and models that emphasize the risk in making perpetual or at least long-term commitments to habitat.

Page F-25 through F-29, 2.2.4.1, Table F-16. Use of temperatures from the Dryad station may be an overstatement of temperatures in the reach upstream of Pe Ell. If temperatures in the reach above the dam site are overestimated in summer, then the model will be misleading by understating the value of adult holding habitat and underestimating the fish impact of dam alternatives. This is particularly a problem in Table F-16 as spring Chinook salmon spawning overlaps the end of summer.

Page F-28, Table F-17. The temperature of 19.5 is not appropriate for steelhead spawning. Typically in western Washington steelhead spawning peaks in April and May when temperature is much lower (2-6 C, rarely 8-10 C). Incubation time is driven by temperature so that warmer incubation leads to faster development, allowing fry to emerge at suitable temperatures rather than remaining confined in redds at unsuitably high temperatures.

Page F-31, 2.2.4.3. The statement about steelhead fry emergence timing in relationship to summer rearing is misleading. Although steelhead spawning extends from winter through June into July, the peak of wild steelhead spawning is typically late April and May. Warming water, including hyporheic flow, accelerates development, leading to shorter incubation times as the season progresses. Many steelhead fry emerge in June and early July, some earlier. A smaller percentage emerge in August, usually the progeny of the late June-early July tail of the steelhead spawning temporal distribution. In sum, steelhead fry are present throughout the summer, although only by late in the summer have all emerged. In 2.2.4.4, the seasonality is presented somewhat more accurately and it is in 2.2.4.4 that summer rearing is addressed.

Page F-33, Table F-20. Values in this table for spring (March through June) appear unrealistically high. An appendix of real temperatures at the two stations during these months should be included if these temperatures are to be used in the model.

Page F-34, 2.2.4.4. The listing of rearing survival factors for rearing coho salmon is unclear, perhaps as a result of typographical errors. Are the temperature and flow criteria on p. F-34 taken together (multiplied flow x temperature)? Is there a missing temperature value? Where is the flow measured? Should the flow factor be scaled to channel size? (Yes, by reach.) Toward the bottom of p. F-34 it appears wording was copied from elsewhere as it relates to months when adults are present, even though summer rearing is being discussed.

Page F-35, Table F-21. Table F-21 refers to summer rearing as March-June, which is springtime.

Page F-37 through F-39, 3.1. No actual statistics are provided to show whether one model run was better or worse than another in its ability to track WDFW population estimates. Figures F-3 through F-5 are inconclusive, given the range of possible options. I used rounded estimates of the values on the graphs and entered them in a spreadsheet (see below for individual figures).

Page F-38, Figure F-3. For 20 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.25 and R^2 is 0.06. The year to year direction matches 53% of the years. Based on these figures the model does not do a good job of estimating adult Chinook salmon return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.

Page F-39, Figure F-4. For 13 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.004 and R^2 is very small. The year to year direction matches 69% of the years. Based on these figures the model does not do a good job of estimating adult steelhead return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.

Page F-40, Figure F-5. For 10 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.67 and R^2 is 0.45. The year to year direction matches 67% of the years. Based on these figures the model does a fair job of estimating adult coho salmon return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.

Pages F-45 to F-63, 3.3 and 3.4, Figures F-11 and F-12. Figure F-11 shows some Chinook rebound after dam construction with passage and only flood control. The question about the quality of the model (see 3.1) remains and it is unclear whether the modeled future Chinook population is lower than the average of the WDFW estimates of recent run sizes. It is noteworthy, although not necessarily statistically significant, that the range of modeled future Chinook run sizes does not reach the retrospective modeled peaks, a possible indication of adverse impact of flood control only dam operation with passage. The projected decline is more pronounced in Figure F-12 (without fish passage). Steelhead and coho conclusions seem plausible, despite the same questions about model quality.

Pages F-63 to F-67, 3.5, Figures F-29 and F-30. In Figures F-29 and F-30, modeled numbers of Chinook salmon and steelhead spawners modeled with a multi-purpose dam with colder water release and passage is lower than modeled without passage! Only for coho salmon is modeled fish passage favorable to production with a multi-purpose dam with cold water release.

Thank you for this opportunity to provide this initial feedback on the evaluation of the fish study and proposed project actions. Please contact me directly at 360.902.2390 or Travis.Nelson@dfw.wa.gov if you have any questions or comments.

Regards,

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cc: Vickie Raines - CRBFA
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BOB BURKLE COMMENTS **Project and Deliverable Name:**	Draft Chehalis River Fish Study
Review Date:	Comments Due by: Monday January 2, 2012

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment
A	WDFW-BB	11	14,26	A-5	I understand the reason for wanting to work with a peak flow for a 100 year event that appears more reasonable to your hydraulic modelers, but I still would like to see the actual USGS estimate of 63,100 cfs presented as a viable flood event in the same manner as your estimated peak of 39,353 cfs for the "100 year" flood that you modeled. The 2007 event actually happened, and it is important in identifying impacts and opportunities from dam construction to model and present the effects of the dam on this event, just as important as modeling, as you wisely did, the 1996 flood, which also happened and was the previous record flood event. Even more important is to model and present the effects of the dam on the 2009 event, another event that actually happened and covered I-5 with water also. Since the rainfall that drove this event originated primarily in the Newaukum River and Dillenbaugh, Salzer, Coal, and China Creek drainages, it would be particularly interesting to see if any of the benefits in reducing flooding from the installation of a dam in the Mainstem Chehalis headwaters would translate to reducing damages from this flood, and particularly if the dam would have reduced flood elevations enough to prevent flooding of I-5. In addition, in the presentation of these events, I would appreciate it if you refrained from
A	WDFW-BB	41	4,9		Same comment as above.
B	WDFW-BB	11	7		Change Skookumchuck Creek to Skookumchuck River
B	WDFW-BB	11	9,14		Include the percentages of land in timber production, agricultural, residential/urban, and light industrial. The vast majority of the basin is in commercial timber production, I believe it is somewhere around 97% but that needs to be researched and presented here. The main reason for this is that the most beneficial flood reduction strategy identified in the Chehalis Basin Ecosystem Valuation conducted by Earth Economics in 2011 is reducing forest rotation frequency, which could be accomplished by paying commercial timber companies the difference between current 35 year rotation and a 50 year or longer rotation. The other reason is that it is quite apparent, when the very low percentage of watershed in a developed state is highlighted, that it is still possible to reduce flood damage by both avoiding flooded areas and removing high risk developments from frequently flooded areas.
C	WDFW-BB	2	17,25		In the flood-only option, the area of river bed that is seasonally inundated (I believe this is supposed to be around 8 miles) will remain devoid of stream shading vegetation in the summer, as several months of winter time inundation will kill any trees that try to grow there. This will cause an increase in exposure to sunlight during the hot low water months over the present situation, and a corresponding increase in water temperature. This needs to be identified and the temperature model simulations for the flood-only scenario should be adjusted appropriately.
C	WDFW-BB	3	17,21		You need to state clearly and up front here that real temperature data were only collected from September 19, 2010 through March 31, 2011 and that no temperature data from the warmest low flow months of spring and summer were collected. You also need to clearly state that the simulations are based upon the 5 weeks of data collected from September 19 through October 31, 2010. Extending a "simulation" is no substitute for collecting real data
C	WDFW-BB	29	3,4		The Ecology water sampling station at Dryad is well downstream from the proposed reservoir inflow location, at least 18 miles downstream, and is right next to your Rainbow Falls Tidbit location, less than half a mile away. It is also located below Elk Creek. This location can hardly be expected to represent water temperatures 8 miles above the dam site at the reservoir inflow location, particularly since Dryad is downstream of 10 miles of denuded riparian area in a broad agricultural/residential valley and the proposed reservoir inflow location is located on private timber land in a narrow forested valley with no residential or agricultural development and largely protected with a Forest/Fish HCP compliant riparian area.

C	WDFW-BB	52	Footnote 4		The failure to take temperature data throughout the year, combined with the failure to use most of the data collected, adds up to a failure of your entire effort to simulate temperatures. The "funding could not be procured" excuse is not acceptable, you could have anticipated this and used the excellent long term temperature data sets from Ecology, like the one at Dryad, to construct temperature simulations that have a chance to represent something real. Instead, the simulations you constructed from little more that 5 weeks of data collected during the fall are producing results that are not even close to Ecology records, and do not even reflect the little data you did collect. For example, you have "average" simulated temperatures on the warmest day of the year in late August ranging from 24.5 degrees C at Dryad to 33 degrees C at Chehalis 22 miles downstream, yet your Tidbit data for the warmest day you sampled on September 19 has the temperature at 21.5 degrees C for both locations. This seems to indicate that the temperatures at each location should be the same, not nearly 9 degrees different. At this point you need to use the Dryad data as representative of the average temperatures expected to occur in all four geomorphic reaches upstream of the Skookumchuck, reduce the temperature as indicated by your Tidbit data as the
C	WDFW-BB	54		C-24	I assume that what you are calling the "Upstream Boundary" is the Ecology data collected at Dryad. The average highest day of temperature appears to be around 20.5 degrees C. Data from the Newaukum, also I assume from the Ecology station, averages 19.5 degrees C at it's highest, which seems about right. Both of these appear to follow the graph of their respective data sets. Data from the South Fork appears problematic, first off I know there has to be a lot more data points than those represented, but even if there aren't any more, why is the "average" temperature set at 23 degrees C, above the highest temperature (22 C) ever collected? It looks like the incomplete data set, specifically one high temperature outlier on September 19, skewed the data beyond all reality. This is another example of the failure of the modeling approach you are using.
C	WDFW-BB	56	1,11		I completely disagree with the statements you make in lines 1 through 11. The simulations you constructed have nothing in common with the data collected by Ecology, or even with your own limited data you collected using Tidbits, none of which was of course collected during the warm months of summer that you are trying to model. First, a high daily average temperature of 33 degrees C has never been documented anywhere in the river, the highest temperature ever taken at Dryad by Ecology was 28 degrees C, and the average at that location is 20.5 degrees C. The fact that you "simulated" this 33 degree average annual high temperature 22 miles downstream of Dryad, when your own Tidbit data for the highest temperature recorded has 21.5 degrees C at both Rainbow Falls (a half-mile downstream of Dryad) and Chehalis (22 miles downstream of Dryad) on the same day, proves conclusively that the simulations and real data do not agree.
C	WDFW-BB	57	7,8		Should read: "The model predictions were in general very close to these data, for the 5 weeks of data actually used."
C	WDFW-BB	58		C-26	I am concerned that you used only the real time temperature data collected from September 19, 2010 through the end of October 2010 to model the simulations presented on Page C-58. The use of such an incomplete data set clearly has a high potential to compromise the ability of the model to accurately predict high temperatures, especially since no temperatures were taken during the historic highest temperature months of the year. The highest historic temperature anywhere in the river that was actually recorded and presented in the study appears to be 26 degrees C in the month of August, and is presented in a dense set of historical Ecology data in a graph on page C-54 as being at the "Upstream Boundary" (I assume that this is the Dryad data set). The lowest temperature ever recorded at this location on the same date in some cooler year in this data set appears to be 14.5 degrees C, which, given the density of the data between these two extremes, would place the average high annual temperature at around 20.5 degrees C, pretty close to the line depicted on the first graph n Page C-54. This would indicate a wide possible range of maximum annual high temperatures for any given year, the majority of which would be below 21 degrees C (70 degrees F), which is the upper comfortable limit for salmonid rearing. The highest
C	WDFW-BB	62	14,21		The correct approach would have been to use real data, from Ecology's data set, for the time periods from 2001 to 2010 being SHIRAZ modeled, possibly using the technique suggested in the previous comment. The failure of the simulations to even approach a reality check against actual Ecology data completely invalidates the rest of this section, including all the tables presented from pages C-63 through C-70.
C	WDFW-BB	63		C-29	Invalid, see previous comments.
C	WDFW-BB	64		C-30	Invalid, see previous comments.
C	WDFW-BB	65		C-31	Invalid, see previous comments.
C	WDFW-BB	66		C-32	Invalid, see previous comments.

C	WDFW-BB	67		C-33	Invalid, see previous comments.
C	WDFW-BB	68		C-4	Invalid, see previous comments.
C	WDFW-BB	69		C-5	Invalid, see previous comments.
C	WDFW-BB	70		C-6	Invalid, see previous comments.
C	WDFW-BB	71	7,11		My understanding is that the "meteorological forcing functions" used were those obtained from data at the Chehalis/Centralia Airport, located in the center of the developed Chehalis Valley at around RM 70. Temperatures and wind conditions at the Airport, where the surrounding land has been denuded of forest vegetation for agricultural and development purposes, are going to vary radically from those likely to occur in the upper Chehalis Valley 38 river miles upstream, located in a canyon in commercial forest land. Thus the claims of "no uncertainty" are hardly valid.
C	WDFW-BB	72	19,21		**On the contrary, the reach of the Chehalis River between the Newaukum and Skookumchuck has been intensively studied by Ecology, and records of fatally low DO in this reach, at times approaching 0.0 mg/l, exist. Ecology needs to be consulted and this data included in the study, this is really going to look silly otherwise.**
C	WDFW-BB	75 through 79		C-34 through 38	Given the problems with the temperature simulations and DO simulations, especially for the Chehalis Reach, all of the results presented in these tables are invalid and need to be re-done using existing data as recommend in previous comments.
E	WDFW-BB	Entire section			This section contains no line designators, so I am commenting on the entire section here. It is also basically well done, I much prefer the HEP methodology used here to IFIM used in the river below the dam, as IFIM is really not a habitat evaluation tool per se, it is a methodology to categorize habitat for the purposes of determining what river flow does to the productivity of that habitat, not to characterize the productivity of the habitat by itself. But I digress. The main problem with the results of the HEP analysis on the river above the dam are twofold, there was limited analysis of the affected habitats, including no temperature logging or fish presence studies, understandable due to budget and time constraints, and in the event any of this moves forward a much more detailed HEP will need to be performed including these elements. This is acknowledged in the study and I accept this limitation for now. The other problem was the unfortunate timing of the evaluation, pretty much right after two of the most severe flooding events in history, and one of them the flood of record by a long shot. This has severely damaged many of these habitats in the short term, and to your credit this is acknowledged several times. It was also acknowledged that the former well known limiting factor of spawning gravel quantity was improved by this event, as there now seems to be a lot of gravel in the river compared to previous analyses, demonstrating that extreme system wide disturbance has both positive and negative effects on productivity. What is not mentioned is also important. The entire area upstream of the dam is private large scale commercial forest land, and as such is subject to the Forest/Fish HCP, which requires road maintenance and abandonment, particularly of stream adjacent parallel roads, and requires buffers of both F and NF waters and water sources. This law had been in place less that 10 years when these flood events occurred, and the emerging buffers were pretty much re-set, along with many forest roads put to an early grave not exactly using abandonment techniques favorable to fish. This does not mean that irreversible damage was done, in a few years the riparian area will revegetate if left alone (i.e. not covered with a reservoir), certainly many bad roads and blocking culverts disappeared with extreme prejudice, and the most limiting factors in the analysis will be vastly improved in the future as a result. The entire watershed within and above the dam supports 90+% of the mainstem Chehalis populations of Coho and Steelhead, this area is vital to the maintenance of these runs, and given the track record of the severe negative effects of hydroelectric damming on wild fish and the abhorrent failure of fish passage facilities on other high head regional dams (90% downstream migrant mortality at Cowlitz falls dam for example), it is pretty evident that 80+% reductions in Coho and steelhead populations are inevitable if this project is constructed. This somewhat overwhelms the calculated HSI values and renders the results a bit moot.
F	WDFW-BB	7,8		F-2	In the discussion on spawning timing for these 3 species it needs to be emphasized that the ranges for spawning include extremes on either end, when very few if any fish spawn most years, and only when environmental conditions are favorable. Spawning follows a steep bell shaped curve with the vast majority spawning in the middle of the range. This becomes quite important when you later try to attribute benefits to spawning fish from lowering temperature at spawning.
F	WDFW-BB	9		F-1	While the data depicted in Table F-1 for spring Chinook and steelhead are reasonably accurate, there are significant errors in the data presented for Coho, which is particularly concerning as it is being presented as having been provided by WDFW. 90% of the Chehalis Mainstem Coho spawn above the dam location, 9% spawn between the dam location and Elk Creek, and 1% spawn from Elk Creek to the South Fork of the Chehalis, actually the lowest redd seen in the system is at Rainbow Falls. Downstream of this point in the remaining 4 reaches no Coho have ever spawned in the mainstem, as this system does not contain suitable mainstem spawning habitat for Coho.

F	WDFW-BB	11		F-11	The way this table is laid out appears to preclude upstream juvenile salmonid migration during their rearing period. Juvenile salmon frequently migrate both upstream and downstream to find both cold water refugia and preferred rearing conditions, which is why upstream juvenile fish passage criteria is used to design and size culverts and other water crossing structures. Making the assumption in the model that juvenile salmon only migrate downstream severely skews the results, and in particular ignores the impact a dam will have on the ability of juvenile salmon that emerge from the gravel below the dam to migrate above it to find suitable rearing habitat. There is no know technology to get juvenile salmon over a high head dam.
F	WDFW-BB	12			Basing the passage survival of both adult and juvenile salmon on studies of low head river-run dams in the Columbia system is not appropriate, and results in an extreme over-estimate of survival. In the Chehalis system, there is a dam on the Wynoochee River that incorporates downstream migrant juvenile fish passage facilities, these were studied by WDFW (Dunn, 1975) and found to kill 97% of the juvenile salmon using them. This dam is lower in head, has more minimum flow (200 cfs) and the reservoir is located in the Olympic mountains and fed by glaciers and so is much cooler than the one proposed for this location, so I would expect the survival to be worse at this location, although it could hardly get much worse that 3%. The most recently constructed dam in Washington State is the Cowlitz Falls dam, where in spite of many years of effort the best downstream passage survival that has been able to be achieved is 10%, even though again this is a smaller dam than the one proposed here and was constructed with specific state-of-the-art passage facilities in mind to achieve recovery of salmon blocked from the upper watershed by impassible dams constructed downstream in the 60s, and again this is a structure located on a glacial river with significantly cooler water temperatures. Even if a survival rate like this could be achieved on the Chehalis, no more 10% is the maximum downstream survival I would expect from this facility. Similarly, upstream passage, using trap and haul which is all that is practical, is never remotely as efficient as that achieved at a low head river-run dam on the Columbia using a fishway. The worst problem with trap and haul is the inevitable delay in migration, as headwater tributary spawning fish like steelhead, and particularly Coho, concentrate their migration to coincide with natural high water events that will take them into suitable spawning habitats high in the watershed where they prefer to be. The inevitable delays caused by trapping conditions, such as limited capacity in trucking, limited personnel during high migration periods, and delay/damage to fish as they attempt to surmount the dam by jumping against it until they are too exhausted to resist being trapped, will result in considerably fewer fish reaching the spawning grounds, and almost none will reach them at the optimal time in the high/low water cycle they would normally choose to spawn in. Add this to the drop back problem, which occurs basically because salmonids migrate by following scent cues that are integrated into their protein as they feed and grow during downstream migration. When trapped and released upstream they invariably drop back downstream to figure out where they are. In many cases they drop back over the dam, as they are so confused by the interruption of their migration by trapping that they instinctively return to the area where they were trapped to begin again to figure out where they are. This has been extensively studied and is in the literature, and I would appreciate a literature search that brought studies forward of trap and haul, along with downstream migrant passage, that were conducted using comparable reservoir types on a high-head storage dam, instead of substituting a study of a completely different type of facility on a low head river run dam - one with a fishway even and not trap and haul - that apparently was picked as the one to characterize this facility because it is the one that produced the best looking results.
F	WDFW-BB	13			**Here is where this study starts to go significantly off the tracks. For some reason a decision was made to calculate spawning area for Chinook, Coho, and Steelhead below the dam while completely ignoring the fact that 90+% of the Coho and Steelhead spawn above the dam, and no Coho or steelhead at all spawn in the reaches below the South Fork Chehalis River.**

F	WDFW-BB	14		F-3	This table is completely erroneous. While it is tempting to assign spawning grounds to fish based upon "criteria", doing so while ignoring the fact that fish have never been found spawning in these "grounds" completely invalidates any modeling results that were hoped to be achieved. For example, in this table you have 238, 530 square meters of "spawning area" for spring Chinook above the dam site, when only 6% of the mainstem Chehalis spring Chinook spawn there, and every place they have been documented to spawn will be covered up by the footprint of the reservoir in either scenario. So essentially, after the dam is constructed, there is 0 square meters above the dam for Chinook to spawn in. You also have winter steelhead spawning in 201,703 square meters of "spawning area" downstream of the South Fork, where steelhead have never been documented spawning. Similarly, for Coho you have 139,367 square meters of downstream mainstem "spawning area" where no Coho have ever spawned. Only Chinook spawn in these mainstem reaches. Finally, in the reach between the Newaukum and the Skookumchuck, which is basically flat and silt bottomed, you have over 6000 square meters for Chinook and steelhead and over 2000 for Coho, and no salmon is capable of spawning in any of this area. This right here pretty much invalidates any conclusions you can draw from this portion of the model.
F	WDFW-BB	15			This "estimate" of rearing area above the dam, based on a guess of 10 times the habitat of the 2.3 miles below the dam, has no measurable validity, neither does the arbitrary assigning of the rearing value of the mainstem from the South Fork to the Newaukum to the rearing value of the tributaries. Any modeling based upon this "data" is never going to come close to any realities in the river. If no data exists, it might be best to acknowledge this and not make any up.
F	WDFW-BB	16,17		F-4 through 6	Again, assigning "rearing area" while ignoring the biology of the fish that are supposed to be using this area, compromises results. If, for example, only 4% of the spring Chinook are going to overwinter, why the huge area for them to do so? Also, steelhead are not going to rear in the slow water mainstem, they prefer fast headwaters, and Coho are going to seek out off-channel areas and pools, and would be distributed far and wide during flood events to habitats they would normally not be able to reach. I realize you have to do something if you want to model the effects of the dam, but the building blocks of the model have to mean something in relation to the affected fish, and these don't.
F	WDFW-BB	17			An arbitrary "habitat decay factor" was applied here. I think there are enough case histories in the literature of the impacts of damming on salmonids to zero in on the "decay factor" of salmonid populations after a dam is built across their river. I really wanted to see some case histories of abundance of native salmonids in a river pre and post damming in this study, it certainly would not have been hard to do. Among other things, it would be found that there has never been a case where Pacific Northwest salmonid populations were in any way benefitted by the construction of a dam in their river.
F	WDFW-BB	18		F-7	The spawning area calculations for steelhead and Coho are completely invalid, especially downstream of the South Fork, where no steelhead or Coho ever spawn in the mainstem. No salmonids of any kind spawn between the Newaukum and Skookumchuck, and only Chinook spawn in 3 of the 4 reaches downstream of the South Fork.
F	WDFW-BB	19,20		F-8 through 10	**Since 90+% of the Coho and steelhead spawn above the proposed dam site, it is unreasonable to expect that the vast majority of them are now going to rear below the dam site. Steelhead juveniles in particular will seek to stay in the headwaters exclusively to rear, and Coho will seek off-channel habitat.**
F	WDFW-BB	21			**The same reduction in high flows will occur in both the single and multi-purpose facilities, and the habitat loss expected from the increase in small sediment would be expected to be the same in both these scenarios, I don't know why it is mentioned for the multi-purpose facility and not for the single purpose facility.**
F	WDFW-BB	22		F-12	**Spawning areas for Coho and steelhead are all invalid as previously pointed out.**

F	WDFW-BB	26			**The use of the "maximum water temperature observed in the months of the year that the adult of each species are understood to be in the river (i.e., from earliest river entry to latest spawning)" in the model completely invalidates the results. Just because a steelhead, for example, has been found spawning in the river in July does not mean one will spawn in July when temperatures are at 20 degrees C, the record high temperature ever recorded for that month. Quite the contrary, only an extremely cold winter will cause steelhead to delay spawning for that long, and the vast majority spawn in April when the water is 9 degrees C. But what really looks bad about this is by picking the highest temperature ever recorded over a 10 year period, including of course 2009 when the highest temperatures by far were ever recorded, along with kills of adult spring Chinook trying to hold in them, you have biased the study towards temperature being the major limiting factor in salmon productivity in this watershed. Nothing could be further from the truth, in the vast majority of years the temperatures are completely suitable for salmonids, and are always suitable for fall and winter spawning Chinook, Coho, and steelhead, as they simply wait until temperatures are suitable to spawn, and get it over with before**
F	WDFW-BB	27		F-16	**No Chinook will spawn in water this warm, they will wait until the water cools. Moreover, you have purposely picked the maximum temperature as indicated on page 26 and converted it to the average temperature in this table. This completely invalidates the temperature difference predictions in the rest of the table. To achieve a legitimate result, pick the average temperature for mid to late September (15 degrees C at Dryad), when most Spring Chinook spawn and use that.**
F	WDFW-BB	28		F-17	This is the most ludicrous table in the study, steelhead never spawn in temperatures this high, and this illustrates the problem with the extreme bias in the temperature selection and calculation methodology used in his study. Pick the average temperature in mid-April (9 degrees C at Dryad), when most steelhead spawn and use that. And do bear in mind that the change in temperature regime imposed by the dam affects only the 9% left to spawn below the dam, as 91% spawn above.
F	WDFW-BB	29		F-18	Coho of all the species have the most leeway in spawning time and of course will avoid spawning in any temperatures at the edge of acceptability, the most legitimate temperature to use in this table is one in mid-winter (8 degrees C), although none of this really matters anyway as 90% spawn above the dam location and almost none will spawn willingly in the mainstem below that except in unusually low water years when they are unable to ascend the many more suitable small tributaries, where the vast majority of Coho prefer to spawn.
F	WDFW-BB	31		F-19	In any discussion of fines one has to factor in the loss of gravel. Gravel loss is completely ignored here. The sediment transport analysis indicates that gravel input will be reduced at least 50% (even though the transport analysis also indicates that no gravel will find it's way through the reservoir and thus immediately below the dam gravel loss will be total). So essentially, in the two most important reaches for spring Chinook spawning (from the dam site to Elk Creek and from Elk Creek to the South Fork) gravel will decrease 50% and fines will increase 14%. This will effectively give you 38% fine sediment impacting the gravel in these reaches (10% at present, add 14% and cut the amount of gravel in half), not 24% as calculated without reducing the amount of gravel appropriately, and will just as effectively prevent survival of 95% of the eggs spawned there. Since Chinook spawning upstream of the dam will be eliminated by the footprint of the reservoir, and 95% of the Chinook spawning downstream of the dam will be eliminated by a significant decrease in gravel combined with a significant increase in fines, the logical conclusion to be drawn here is that 95% of the Chinook will be unable to spawn effectively, period, and would be extirpated to 5% of their present run almost immediately.
F	WDFW-BB	32,33		F-20	Once again you are purposefully selecting the "maximum water temperature observed between March and June" and presenting it in the model in Table F-20 as the "Average Temperature". In other words, the highest temperature observed in June becomes the average over this time period. This makes the study appear to be specifically rigged to emphasize the benefits of temperature reduction on fish survival, benefits that are non-existent if the real average temperatures over the last 10 years of Ecology data are used. Moreover, this also completely ignores biology, as in years with a warm spring fish growth will be rapid and migration will be over early, while in cold years growth will be slow and fish will migrate late, thus compensating for any unusually high or low temperature periods.

F	WDFW-BB	34,35		F-21	Here at least the "average" summer rearing period temperature appears reasonable, in spite of the completely nonsensical statement "The maximum water temperature observed between July though June was used…". Since Table F-21 that this refers to is labeled "Average Temperatures Predicted During Summer Rearing Period (March through June) Period" I have to assume that an error was made somewhere. Once again, attributing any kind of survival value to having temperatures either reduced or increased ignores the fact that juvenile salmonids will seek out suitable habitats at the most optimal temperature range for growth, and that they currently have options, such as migrating to the cooler headwaters, that will be taken away by a dam impassible to juvenile salmonids, as there is after all no trap and haul facility capable of moving juvenile salmonds upstream.
F	WDFW-BB	35			The two most important limiting factors for salmonid productivity in the Chehalis system as identified in the 1999 LFA (lack of LWD and lack of clean spawning gravel) are largely ignored as productivity parameters in this study, and are not used as model inputs at all, even though total loss of LWD and gravel recruitment from upstream of the dam is predicted. This will significantly compromise the model results.
F	WDFW-BB	37,38		F-3	The conclusion that you reach, that essentially your model is capable of reproducing accurate Chinook escapement results, could be simply because the model uses so little meaningful data that the modeled results cannot be differentiated from escapement estimates. Certainly the data input into the model is in error in major sections as pointed out repeatedly in the previous comments, and the data input into the model also emphasizes meaningless factors while ignoring the most limiting factors. Specifically, the effects of high temperature have been overemphasized, the effects of gravel impaction have been underemphasized, the effects of LWD loss have been ignored, and spawning areas have been created where none exist. I'm sorry, this model is useless with this kind of data in it.
F	WDFW-BB	38,39		F-4	Again, the model, by using data that is grossly in error, particularly the error of assigning spawning habitat to steelhead in areas where they never spawn, is incapable of predicting much of anything, the fact that it seems to assign higher survivals than the chronic underescapement measured by WDFW indicates that the wrong data is being modeled. The problem with steelhead is not a habitat problem, steelhead habitat in the Chehalis, particularly the upper Chehalis, is by and large just fine. Yes, there are impacts from legacy logging, but there are also vast areas of the watershed that are quite favorable to winter steelhead and that have maintained healthy native populations in spite of major population crashes and recent ESA listings in all of the Puget Sound and Columbia River watersheds (and not coincidentally almost all of these watersheds have dams on them). The problem with steelhead survival in recent years is mostly a harvest/hatchery problem. There are abundant hatchery steelhead produced in the system, these hatcheries were constructed to mitigate loss of steelhead due to dams on the Wynoochee and Skookumchuck Rivers. These hatchery steelhead are mixed in the lower river with wild steelhead, and are heavily fished. Wild steelhead are protected by sport fishing regulations that prohibit retention of wild steelhead, and since released sport-caught steelhead average less than 5% mortality and can basically be caught and released 20 times before suffering any ill effects, this works quite well for the sport caught portion of the run. However, the Chehalis system is in the U and A of the Quinault Indian Nation, which has co-management rights to 50% of the harvestable hatchery fish. These are not caught selectively, they are gillnetted in the lower river, and any wild fish caught are retained as they die in the gillnet anyway. Since the fishery for hatchery fish is intense and divided evenly between sport and tribal, and since tribal fishing causes 100% mortality on wild fish, the upstream return is almost universally reduced by at least the sum of the impacts on the wild fish (50% tribal, 5% sport) and so the return to the upper river is typically depressed to 45% of escapement goal. The Washington Coast is the only place where this kind of fishery can be tolerated, as the rest of the state is in ESA recovery, and non-selective steelhead fishing of all kinds has virtually ceased. Were the loss of 91% of the steelhead due to a dam blocking 91% of the run to be added to this chronic underescapement, the Chehalis steelhead would find themselves in ESA recovery also.
F	WDFW-BB	**39,40**		**F-5**	**The same problems are repeated over and over with this model, particularly with Coho, who are assigned spawning area where they never spawn.**

F	WDFW-BB	**40,41**		**F-6**	**And here is the proof that the model is incapable. Results that "vary by as much as a factor of 100" tell me that the model cannot tell if 1 fish came back or 100 came back. Confidence limits of +/- <1% do not impart any "confidence" in the model to predict anything. This is not at all surprising given the previously discussed quality problems with the data.**
F	WDFW-BB	42 to 45		F-7 through 10	**I don't want to continually berate your models over and over here, except to repeat that the less than 1% confidence limits in the Chinook and Coho models do not inspire any confidence in the projections. The narrow confidence limit range for steelhead, by comparison, is a symptom of a factor outside of habitat, that of harvest practices previously discussed, that overwhelms the variability of the model. Modeled results for steelhead that ignore the major impact that harvest has on the population will not be capable of predicting anything, as will be seen later.**
F	WDFW-BB	45, 46, 47		F-11, F-12	Here we have results that simply fly in the face of reality. First, the comparison of Chinook abundance with or without a fish passage facility is a moot point. Chinook spawn above the dam only within the approximately 9 mile long area that would be covered by the reservoir footprint, and cannot spawn anywhere else above the dam. So any prediction that assigns a higher abundance with fish passage than without is automatically in error. 6% of the population that wants to spawn above the dam is going to die without spawning if they are sent up there, period. The minor decrease in abundance in this dam scenario is not remotely realistic, given that the spawning area remaining downstream after the dam will be suffering a dramatic decrease (50%) in gravel recruitment (actually immediately below the dam and above Rock Creek a likely 100% decrease in gravel) coupled with a 14% increase in fine sediment, which will at the minimum place the percent fines in the remaining gravel at 38% (10% fines at present, an additional 14% increase in fines in the future, and half the gravel for these fines to occupy). This is approaching the 95% fatal range for Chinook egg survival. The best you could expect, assuming that the dam will displace all Chinook spawning immediately downstream into gravel 38% impacted with fines is for 5% of the present run to survive. This places the return pretty much completely off the bottom of the chart, and I think you will find, if you consult the literature for wild spring chinook survival below any dam in the Pacific Northwest, that a 95% extirpation rate is pretty much the norm.
F	WDFW-BB	47,48		F-13	If fish passage is provided in the flood-only scenario, not all of the 91% of the steelhead using the Chehalis River for spawning above the dam will be able to get above the dam, trapping of wild steelhead is risky and stressful, they frequently drop back, and at best survival to spawning will be well less than the 95% passage success for a low head fish ladder identified in the Study. A literature search concentrating on identifying the spawning success rate of steelhead passage using trap and haul should be conducted. Certainly there is no evidence that juvenile steelhead can be transported above a dam using trap and haul, and that may be important given that steelhead that emerge from mainstem spawning will want to seek out cold and turbulent headwaters to rear in. Additionally, 5 miles of documented steelhead spawning beds will be lost to spawning within the reservoir footprint. Even with passage a reduction in survival would be predicted. Finally, 9% of the steelhead will be unable to spawn below the reservoir in the highly silted gravel that will remain. In spite of spawning habitat below the South Fork being assigned to steelhead in the model, none of them will spawn there because none ever have. Ultimately, survival will likely be below that in Figure 13. Of course, this entire situation is overshadowed by the problem with harvest in the lower river, and if any reproduction is slightly compromised the entire return, which already escapes at 45% below goal, will be in real trouble.
F	WDFW-BB	48,49		F-14	This is easy to predict without the model, as 91% of the steelhead that spawn above the dam location will die, period, the 9 percent that spawn below the dam will suffer 95% mortality from trying to spawn in 38% silt impacted gravel, and the run will wink out.

F	WDFW-BB	49,50,51		F 15, 16	Impacts will be similar to steelhead, passage will provide less than full survival of the 90% of the Coho spawning above the dam, and delay in migration will result in inability for Coho to access spawning habitat high in the watershed, as by the time they get trapped, hauled, drop back to figure out where they are, and get on with migration the rising hydrograph that they need to reach headwater spawning areas will have passed. Coho also will be denied spawning grounds within the reservoir footprint similar to Chinook and steelhead, and the 10% of the Coho that attempt to spawn in silt choked gravel below the dam will suffer 95% mortality. In the no passage scenario 90% die unspawned and 10% suffer 95% mortality below the dam. In spite of the cheery predictions of lots of habitat for Coho to use below the dam, they do not spawn below Rainbow Falls and will never use any of this hypothetical mainstem Coho habitat.
F	WDFW-BB	51 through 55		F-17 through 20	Here again we have results that simply fly in the face of reality. First, the comparison of Chinook abundance with or without a fish passage facility is a moot point. Chinook spawn above the dam only within the area that would be covered by the approximately 9 mile long reservoir footprint, and cannot spawn anywhere else above the dam. So any prediction that assigns a higher abundance with fish passage than without is automatically in error. 6% of the population that wants to spawn above the dam is going to die without spawning if they are sent up there, period. The projected increase in abundance in the dam scenario depicted in F-17 is not remotely realistic, given that the spawning area remaining downstream after the dam will be suffering a dramatic decrease (50%) in gravel recruitment (actually immediately below the dam and above Rock Creek a likely 100% decrease in gravel) coupled with a 14% increase in fine sediment, which will at the minimum place the percent fines in the remaining gravel at 38% (10% fines at present, an additional 14% increase in fines in the future, and half the gravel for these fines to occupy). This percentage of fines in the sediment is approaching the 95% fatal range for Chinook egg survival. The best you could expect, assuming that the dam will displace all Chinook spawning immediately downstream into gravel 38% impacted with fines, is for 5% of the present run to survive. This remaining 5% will be all that is left to receive the "benefits" of cold water released from the bottom of the dam, benefits that are questionable given that the high temperatures they are supposed to reduce to provide these "benefits" are dramatically inflated as previously and frequently outlined. This places the return pretty much completely off the bottom of the chart, and I think you will find, if you consult the literature for wild spring Chinook survival below any dam in the Pacific Northwest, that a 95+% extirpation rate is pretty much the norm.
F	WDFW-BB	**55 through 59**		**F-21 through 24**	**Here we have once again an example of one of the more ludicrous predictions that are possible with this flawed model. First, if fish passage is provided, only 10% of the 91% of the steelhead spawning above the dam will survive outmigration. If no passage is provided obviously none of that 91% will spawn, and certainly never in that huge amount of mainstem spawning habitat provided below the South Fork where no steelhead has ever spawned before. The 9% remaining will suffer 95% mortality from trying to spawn in 38% silt impacted gravel. So if we have passage, 85+% die, if we have no passage 95% die. This is not a huge difference, but survival is certainly not improved by providing no fish passage, and to suggest, as your model seems to do, that "nearly equal" abundance is provided in both the passage and no passage scenario simply proves that the model predicts ludicrous results. Table F-22 appears even more ludicrous, as it implies improved abundance by denying 91% of the upstream spawning steelhead fish passage! The best you can hope for is a reduction of mainstem Chehalis steelhead to 15% or less of their present abundance.**
F	WDFW-BB	59 through 63		F-25 through 28	Similar to steelhead, if 90% of the Coho that spawn above the dam suffer 90% mortality as juveniles passing over the dam, 81% of the run dies. Of course 90% dies if no passage is provided. Those 10% that attempt to spawn downstream in 38% silt impacted gravel suffer 95% mortality, and of course none will spawn in the abundant habitat "designated" for them downstream of the South Fork as none ever have, so we are faced with either 9.5% survival or 5% survival. This remainder will be all that is left to receive the "benefits" of cold water released from the bottom of the dam, benefits that are questionable given that the high temperatures they are supposed to reduce to provide these "benefits" are dramatically inflated as previously and frequently outlined. The best you can hope for is a reduction of mainstem Chehalis Coho to less than 10% of their present abundance.

F	WDFW-BB	64			Not surprisingly, I completely disagree with the conclusions on Page 64. About all you can hope for in the best scenario is 5% of the present abundance after a dam is built. I challenge you to find any wild spring Chinook run in the Pacific Northwest that has even achieved 5% of it's former abundance post dam construction.
F	WDFW-BB	65			The model for steelhead is so flawed that "Steelhead numbers are predicted to be higher in a scenario in which no fish passage is provided.", even though 91% of the present run would wink out if they could not get above the dam where they presently spawn. In spite of knowing in advance that only 9% of the steelhead spawn below the dam and no steelhead spawn below the South Fork, your model still predicts 89% survival if no passage is provided. I don't really know what to say except that a ridiculous result like this should be embarrassing, and should certainly be grounds for re-examining the entire modeling effort.
F	WDFW-BB	66			Because of errors made in estimating downstream migrant fish survival through the dam (10% at best instead of 80% as predicted), and because of errors in correctly assigning Coho to their spawning areas, the best result that could be achieved for Coho would be a 90% decrease in abundance, not the 28% decrease so optimistically predicted.
F	WDFW-BB	72 part 1			This is kind of a culmination of all of the problems with this study. First off, the river temperature data imported into the model was inflated, in that average temperatures were predicted that have never been achieved, even during the one day record temperature event of July 29, 2009, when the river reached 28 degrees C at Dryad, which was the hottest water temperature event recorded by Ecology in 10 years of daily temperature data, and which occurred during a record air temperature event of 104 degrees F in Olympia, the highest since 1948 when daily temperature recording began. The average high temperature day over this 10 year span of real-time Ecology data at Dryad is closer to 20.5 degrees. Somehow your modeling of 5 weeks of daily temperature data taken in September and October of 2010, combined with this data from Ecology taken at Dryad, turned this into a 33 degree average temperature in the Chehalis River just upstream from the Newaukum and 22 miles downstream of Dryad, even though your own Tidbit data showed that on the highest temperature day you recorded (September 19, 2010) the temperature was 21.5 degrees at both Dryad and Chehalis and two locations in between. So the "...cooler downstream temperatures which were predicted to be as much as 10 degrees C cooler in some downstream areas." are a myth. But even if any benefits to salmon abundance from releasing cool water and achieving a higher minimum flow could be found in the literature, particularly in case studies of the impacts of dams on pacific salmon, these "benefits" would be nullified in even the best scenario, as they would be overwhelmed by fish passage and spawning problems, particularly for Coho and steelhead, 90% and 91% respectively of which spawn above the dam and not "...approximately 22% of Coho and 91% of steelhead based on data from WDFW." Your selective use of a fish passage survival study conducted on a low head river run dam with a bi-modal hydrograph to postulate 80% downstream migrant survival on this high head dam with a unimodal hydrograph, when the best survival achieved in a high head dam just to the south on the Cowlitz River was 10%, and the only downstream passage facility installed in the Chehalis system on the Wynoochee provides only 3% survival, has dramatically altered the survival rates in the "with passage" scenario to inflate the numbers of surviving juveniles that would be able to reach the theoretically cooler water downstream.

F	WDFW-BB	72 part 2			The reality is that barely 10% of the Coho and steelhead will survive to get that far. And even with fish passage, no Chinook passed above the dam would be able to spawn, as their entire mainstem spawning area will be inundated by a reservoir, so their survival is now moot. In addition, since the majority of the shaded deep canyon pools in which spring chinook prefer to hold in the mainstem Chehalis will be covered up by the reservoir, they will be forced to hold downstream in glides largely denuded of riparian vegetation due to agricultural development from the dam site down to Rainbow Falls. This will not enhance their survival. The effect of gravel starvation is blithely ignored in calculating percent fines in the spawning beds downstream, beds that are not that important to the 9-10% of steelhead and Coho that use them (and use only spawning habitat upstream of the South Fork as no steelhead or Coho have ever spawned in the mainstem downstream of this point) but are vitally important to the remaining 94% of the spring Chinook that have no choice but to use them. Here we have somewhere between 100% and 50% of the gravel reduced by a combination of blockage by the dam and loss of channel forming flows and channel migration that continually would have provided new gravel if the river was not dammed. Add this to the 14% increase in silt from the loss of flushing by the loss of these same flows, and we have spawning gravel presently in the range of 10% fines increasing to 38% fines, which if used by any salmonid species would result in 95% mortality. So the bottom line is we lose 95% of the spring Chinook, and 85 to 90% of the Coho and steelhead under the best scenarios before they ever even get to the portion of the river that is supposed to be so enhanced by lowering the temperature. The last couple sentences of this page are spent discussing the model result "...not consistent with what would be expected given that 91% of steelhead spawning occurs upstream of the proposed dam site." - the very unlikely result that steelhead survival would be increased by not installing fish passage.
F	WDFW-BB	72 part 3			But instead of stating something sensible, like perhaps the inputs to the model should be revisited, statements are made that reflect a complete lack of understanding of basic fish biology, statements like "Presumably it reflects the redistribution of steelhead to spawn in the cooler downstream water available in the summer." Hello, winter steelhead do not spawn in the summer, they spawn in the winter and spring, when the water averages 9 degrees C or below, and would never spawn much later than that unless cold spring conditions persist at high elevations late into the spring. Yes, they can spawn as late as July, but this is not normal and spawning temperature is always going to be 10 degree C and under when they do. And this gem is followed by "The downstream reaches are predicted to be much cooler than temperatures experienced by steelhead migrating up through the reservoir to access upper tributary spawning grounds." Hello again, these are WINTER steelhead, they migrate in the coldest months of winter, when the reservoir is predicted to be under 5 degrees C for most of the winter migration period. This whole thing just sort of winds down into oblivion, like the salmonids using this system will do if this dam is built. Enough said.

HAL BEECHER COMMENTS					
Project and Deliverable Name:		Draft Chehalis River Fish Study			
Review Date:		Comments Due by:	Monday January 2, 2012		
(Appendix Letter or Main)	**Checker/ Reviewer**	**Page**	**Line Number**	**Table or Figure Number**	**Checker / Reviewer Comment**
ES	WDFW-HB	8-14		Table 2-3	This section should better explain that the December 2007 flood data exceeds the 100-year flood at the Doty gauge (and other gauges as determined). Finally, in Table 2-3, both the 100-year flood and the December 2007 flood are both shown.
ES	WDFW-HB	14		Table 2-3	Table 2-3 appears to have an error in the 100-year flood row for existing conditions. The 1-day average flood flow cannot exceed the peak flow!
ES	WDFW-HB	16	7-8		The dubious point is made that since the 100-year flood (~39kcfs) does not fill the proposed flood storage reservoir, the reservoir size could be reduced to optimize for flood storage. However, the real flood of December 2007 greatly exceeded (by about 50%!!) the statistically determined 100-year flood, and it was the real flood that triggered this study! Although dams have consistently been detrimental to salmonids, reducing the planning scale would be unlikely to fulfill the proposed dam's intended primary purpose: protection of Centralia-Chehalis and surrounding communities from extreme floods. (Some climate change projections for western Washington suggest a greater frequency of extremes of precipitation, so risks of flooding might be underestimated by flood frequency statistics based on the existing hydrological record. However, some of the increased prospect of severe flooding under some climate change predictions are based on rising snow levels and this will not be a consideration in the Willapa Hills where the Chehalis River originates.)
ES	WDFW-HB	16	4		typo: "t0068at"
ES	WDFW-HB	17			Anchor QEA states its opinion that the December 2007 flow was overestimated. In fairness to readers and decision-makers, it should be stated that the estimate Anchor disputes was made by the USGS, the nation's authority for hydrology (see 2.3, pp. 25 ff). In preliminary reviews of the flood hydrology for the Army Corps of Engineers, another agency with national and international credibility in flood hydrology, a consultant to the Corps has not discredited the USGS estimate. In Table 2-6 (p. 21) the December 2007 flood is not included, apparently because of this disagreement over the magnitude of the 2007 flood, but it is again a disservice to readers and decision-makers to exclude the 2007 flood, even if it is specified with upper and lower estimates.
ES	WDFW-HB	17 (through 20)	32		In 2.2.1.2 the median September flow with the multi-purpose reservoir is stated as 122 cfs. This statement should be corrected to indicate that this projection is based on assumptions about flow releases from the reservoir. However, flow releases from the reservoir in a multi-purpose reservoir would be subject to Clean Water Act section 401 Water Quality Certification, including specification of instream flow releases varying by season to protect fish and other instream values. Without detailed analysis of instream flow studies, it is not possible to state what those flows would be. The instream flow studies reported in this report might be used in part for the determination of suitable instream flows, but because of time limitations that may have influenced model sensitivity and quality, additional instream flow studies may be required before Section 401 instream flows could be determined. This could modify the right side of Figure 2-3.
ES	WDFW-HB	24	14-16		The statement that "The recurrence interval of floods … during the 1996 flood was … approximately 33 to more than 100 years at the Doty gage" should either be corrected or explained.
ES	WDFW-HB	29	24-28		As with flows, management of woody debris would likely be addressed if a multi-purpose dam with hydropower generation were licensed by the Federal Energy Regulatory Commission, so the assumption on p. 29 (lines 24-28) that "large wood and coarse sediment from the upstream watershed would be trapped in the impoundment" might require modification.
ES	WDFW-HB	32	25		On p. 32 (line 25) "climatic" should be replaced by "weather" (it is correct in the previous line).

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment
ES	WDFW-HB	44-47			By deploying water temperature probes in September 2011, the warmest conditions were missed. It would be useful to compare magnitude, frequency, and duration of air temperatures from August 1, 2011 at Centralia (or whatever reference data are being used) with a comparison to magnitude, frequency, and duration in other years to show how late summer 2011 compared to other years. Was 2011 unusually warm, cool, or typical? This is an important point in reference to Bob Burkle's observation of inordinately high modeled temperatures (e.g., >30°C – see Figure 4-5). Were air temperatures sufficiently high to account for the high modeled water temperature? As Bob Burkle pointed out, the high modeled temperature for August 15 in Figure 4-5 is highly suspect and sheds significant doubt on the temperature model. It has the potential to be misused to claim a modeled benefit to salmonids that is greater than is realistic. The greatest modeled temperature change is portrayed as 16 °C between "base case" and "hydropower case". The benefits in temperature and in salmonid habitat value are less if the base case is closer to the measured temperatures (≤26 °C). Figure 4-7 shows modeled temperatures with surface release do not exceed 30°C.
ES	WDFW-HB	53	20-21		Wording is unclear about habitat: "Instead, their results indicated that the most habitat for coho salmon occurred at very low flows, then declined as flows increased." It would be more clear to replace "habitat" with "WUA, the habitat index calculated by PHABSIM".
ES	WDFW-HB	53-54			The first paragraph in 5.3 is an important one. WUA indexes part of habitat, but it is generally at a microhabitat scale and seldom includes meso- or macrohabitat. Temporal connectivity can be critical for egg incubation beginning with spawning. WUA with unsuitable temperature or other water quality (macrohabitat) is of little value. WUA does not provide an indication of flows needed for maintaining suitable mesohabitats (pools, riffles, etc.).
ES	WDFW-HB	59		Figure 6-1	Figure 6-1 should include the pink triangle in the legend symbolizing dam location.
ES	WDFW-HB	60	20, 27-29		As mentioned by Brad Caldwell (Ecology) and Bob Burkle at the December 12 workshop, downstream migrant survival is greatly overestimated on p. 60 (line 20). This will lead to gross errors in the Shiraz model. Instead of the model showing that multi-purpose dam construction and operation will result in extirpation or near extirpation of steelhead in the Chehalis and of a significant proportion of coho and Chinook, the model with the gross overestimate of downstream migrant survival will lead to the erroneous impression that salmonid production would be minimally impacted. In lines 27-29 the statement implies that 80% downstream migrant survival has been achieved, while such a survival rate has not been achieved with decades of effort and millions of dollars in construction and modification at several Northwest dams, as Brad Caldwell and Bob Burkle explained.
ES	WDFW-HB	61-63			In 6.1.1.3 the integration of WUA from PHABSIM into Shiraz is described, but it is not clear if maximum WUA or some other value is used for each reach, since WUA depends on flow. As discussed above, WUA should be used with great caution. WUA should really only be used as an index of relative habitat value at a given site across a series of flows. If the purpose of WUA in Shiraz is to estimate carrying capacity of different reaches, WUA might be more valuable if only binary suitabilities were used (however, the type of PHABSIM model done in this study is useful for estimating flows that provide better habitat). Use of binary criteria with emphasis on the most preferred depths, velocities, and substrates as done in this study is appropriate for evaluating flows and comparing flow release schedules from the reservoir. Large areas of low suitability do not necessarily equate ecologically to small areas of high suitability, yet both could result in the same WUA but different carrying capacity.

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment
ES	WDFW-HB	62	4-18		The report discusses gradual decline of habitat over time as a result of geomorphic influences of dam construction and operation. This topic was briefly discussed at the December 12 workshop. The following publications may be relevant to this analysis: Petts, G.E. 1979. Complex response of river channel morphology subsequent to reservoir construction. Progress in Physical Geography 3: 329-362. Petts, G.E. 1980. Long-term consequences of upstream impoundment. Environmental Conservation 7 (4): 325-332. Petts, G.E. 1984. Impounded Rivers: Perspective for Ecological Management. John Wiley and Sons, Chichester. Petts, G.E. 1989. Perspectives for ecological management of regulated rivers. Pages 3-24 in: J.A. Gore and G.E. Petts (editors). Alternatives in Regulated River Management. CRC Press, Boca Raton, Florida. Petts, G., P. Armitage, and E. Castella. 1993. Physical habitat changes and macroinvertebrate response to river regulation: the River Rede, U.K. Regulated Rivers: Research and Management 8: 167-176.
ES	WDFW-HB	63, 68	10-14; 28-30	Table 6-1	The report states that "The approach taken to characterize habitat productivity in this study was to use available data sets that are documented in the scientific literature to contribute to the habitat needs of salmonids and to develop a predictive model that relies upon as few habitat parameters as necessary to effectively calibrate to previous observations of salmonid returns to the river." Citation of the relevant literature would improve credibility and elucidate uncertainties. In Table 6-1 the single habitat parameters input to affect productivity do not always make sense. For returning adults, temperature is listed as the most influential parameter, and this might be quite important for some stocks some places, but for the three stocks modeled in the Chehalis the case is unconvincing because of run timing, particularly for steelhead. On p. 68 the equations should be adjusted to exceedence flows for August-September so that survival is low at low flows (high exceedence percentages) and high at high flows (high exceedence percentages) instead of the cfs values listed on lines 28-30.
ES	WDFW-HB	70-73		Figures 6-2, 6-3, and 6-4	In 6.2.1 matching of model predictions to WDFW fish return estimates should be indicated by some statistic for how well they match, since matching is being touted as the indication of model quality. The matching in Figures 6-2 is not persuasive to me, and 6-3 and 6-4 are only somewhat better (see also discussion of Figures F-3, F-4, and F-5 below).
ES	WDFW-HB	73-77		Figures 6-5, 6-6, and 6-7	There are so many issues to be resolved in this report that conclusions in 6.2.2 are premature. The conclusions from Figures 6-5, 6-6, and 6-7 lack credibility when the most productive salmon and steelhead habitat in the Chehalis River would be blocked, yet salmon and steelhead productivity is portrayed as nearly as great as with existing conditions.
D	WDFW-HB	D-11 ff and Attachment B			I need to review calibration details, not just summary calibration statistics.
D	WDFW-HB	D-15	2-3		Statement that spawning substrate was too mobile needs further explanation.
D	WDFW-HB	D-29 and D-30	4 and first line in last paragraph	Figures D-14, D-15 to D-21	Figure numbers in text and figures do not match but appear to be off by one.
D	WDFW-HB	following A-30 and B-30			Attachment cover pages are not matched to the appropriate attachments.
E	WDFW-HB	E-8			Habitat variables for Chinook salmon habitat evaluation were selected based on data availability, but this process resulted in exclusion of some habitat variables included in the Shiraz model (e.g., temperature).
E	WDFW-HB	E-9			Description of spawning gravel computation is unclear. It appears that A and B each applies to two different concepts: first, gravel particle size, and second, area of habitat occupied by gravel. It is unclear how spawning area and rearing area are delineated or distinguished from total area.
E	WDFW-HB	E-14 ff			The report refers to the East Fork Chehalis River. Cartographers have named the branch that enters the Chehalis near Adna the East Fork Chehalis, but have also designated a branch upstream of Pe Ell the East Fork Chehalis, and this could lead to confusion. The branch upstream of Pe Ell should be designated the East Fork Upper Chehalis River.
E	WDFW-HB	E-21			I concur with the conclusion that habitat suitability for coho spawning is similar to habitat suitability for steelhead spawning.
E	WDFW-HB	E-35			The draft nature of the report is apparent in the number of items remaining to be filled in.
E	WDFW-HB	Attachment 1			Attachment 1 has the uncorrected spell-check false correction of HIS instead of HSI.

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment
F	WDFW-HB	F-8	2.2.2.1.2		Report has steelhead incubation through September. Even with July spawners, higher TUs are likely to result in emergence in August.
F	WDFW-HB	F-11		Table F-2	Table F-2 is mysterious. The text explaining it is limited. The data basis for it is extremely limited. The assumptions for populating the table do not appear to be stated and any rules (e.g., use is proportional to reach length between emergence and estuary, or modified by a summer temperature rule) are not stated (although at some point I learned that WUA at mean seasonal flow is the basis). If Table F-2 is a foundation for the remainder of the model effort, then it should be clearly explained. The lower right corner (intersection of Tributaries and Tributaries) implies tributary fish never leave tributaries until they smolt.
F	WDFW-HB	F-14		Table F-3 and 2.2.3.1.2	Average (mean) flow is not a good indicator for typical flow conditions; median is much more realistic (typically lower flow) because the distribution of flows is not normal, but skewed so that a few very high flows drive a mean up much higher than is typical of the season. Anchor should have used median flow.
F	WDFW-HB	F-14		Table F-3	Table F-3 does not adequately account for flow accretion (or it is not explained). If flow is 97 cfs in the upper watershed during spring Chinook salmon spawning, then flow will be greater than 97 cfs below Elk Creek and below the South Fork confluence. If these are flows at particular gauges, then the gauges should be identified. The spawnable area may be indexed to a flow at a particular gauge, in which case the index rate should be stated.
F	WDFW-HB	F-15	last paragraph		The guess that equates tributary rearing area to South Fork Chehalis to Newaukum River should be justified. GIS tools are available to provide some more reasonable and supportable estimate.
F	WDFW-HB	F-16 through F-17		Tables F-4 through F-6	Report uses mean flow during spring, summer, and winter rearing as a basis for calculating rearing area from WUA. Instead, median flows are a better representation of typical hydrologic conditions during a season in Tables F-4 through F-6. Use of WUA to estimate winter rearing habitat (Table F-6) should be done cautiously because WUA is based on summer habitat selection and use by rearing salmonids. Winter behavior is different and sensitivity to crowding is less during winter when metabolic needs are lower. Coho rearing habitat is reported in Tables F-4 through F-6, but WUA for juvenile coho was not generated in the instream flow/PHABSIM study (Appendix D) because WUA calculations for juvenile coho salmon are known to be misleading (Beecher et al. 2010).
F	WDFW-HB	F-18		2.2.3.2.1	As with rearing area, it is more appropriate to use median, rather than mean, flows to assess available spawning area, with the possible exception of coho salmon.
F	WDFW-HB	F-19		2.2.3.2.2 Tables F-8 through F-10	Again, rearing area should be based on median, rather than mean, flows and juvenile coho salmon rearing should not be based on WUA. Information in Tables F-8 through F-10 is difficult to track. It would be helpful to graph, for example, steelhead rearing within a reach through the three rearing seasons, perhaps with reaches starting from the top and going down to Porter, resulting in three graphs, one for each species. In the end readers will want to track changes in those patterns with different management options.
F	WDFW-HB	F-21		2.2.3.3 Table F-11	What is the rationale for the flow releases specified in this section and table? Instream flow requirements determined for 401 Water Quality Certification process, hydropower generation capacity, and flood reduction are all factors in determining actual flow release, so the tentative placeholder nature of these figures should be made clear.
F	WDFW-HB	F-24 and F-25		2.2.4	Caveats stated in this introduction are important. On the other hand, it is important to make management decisions that are based on assumptions and models that emphasize the risk in making perpetual or at least long-term commitments to habitat, such as dam construction.
F	WDFW-HB	F-25 through F-29		2.2.4.1 Table F-16	Use of temperatures from the Dryad station may be an overstatement of temperatures in the reach upstream of Pe Ell. If temperatures in the reach above the dam site are overestimated in summer, then the model will be misleading by understating the value of adult holding habitat and underestimating the fish impact of dam alternatives. This is particularly a problem in Table F-16 as spring Chinook salmon spawning overlaps the end of summer.
F	WDFW-HB	F-28		Table F-17	The temperature of 19.5 is not appropriate for steelhead spawning. Typically in western Washington steelhead spawning peaks in April and May when temperature is much lower (2-6 C, rarely 8-10 C). Incubation time is driven by temperature so that warmer incubation leads to faster development, allowing fry to emerge at suitable temperatures rather than remaining confined in redds at unsuitably high temperatures.

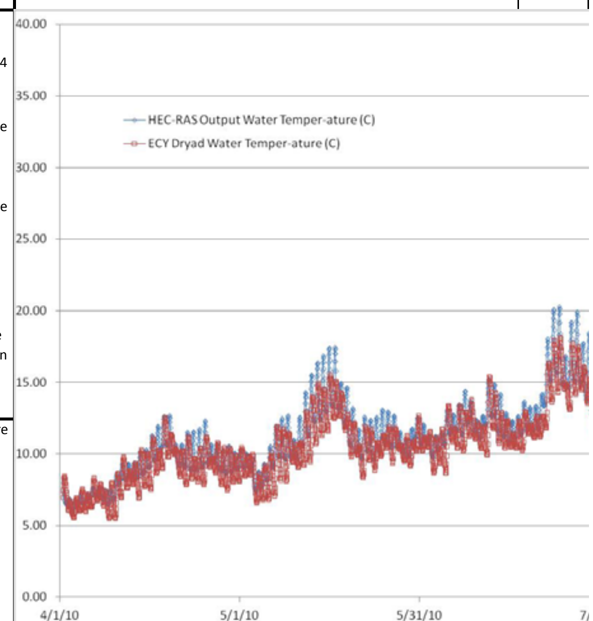
(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment
F	WDFW-HB	F-31		2.2.4.3	The statement about steelhead fry emergence timing in relationship to summer rearing is misleading. Although steelhead spawning extends from winter through June into July, the peak of wild steelhead spawning is typically late April and May. Warming water, including hyporheic flow, accelerates development, leading to shorter incubation times as the season progresses. Many steelhead fry emerge in June and early July, some earlier. A smaller percentage emerge in August, usually the progeny of the late June-early July tail of the steelhead spawning temporal distribution. In sum, steelhead fry are present throughout the summer, although only by late in the summer have all emerged. In 2.2.4.4, the seasonality is presented somewhat more accurately and it is in 2.2.4.4 that summer rearing is addressed.
F	WDFW-HB	F-33		Table F-20	Values in this table for spring (March through June) appear unrealistically high. An appendix of real temperatures at the two stations during these months should be included if these temperatures are to be used in the model.
F	WDFW-HB	F-34		2.2.4.4	The listing of rearing survival factors for rearing coho salmon is unclear, perhaps as a result of typographical errors. Are the temperature and flow criteria on p. F-34 taken together (multiplied flow x temperature)? Is there a missing temperature value? Where is the flow measured? Should the flow factor be scaled to channel size? (Yes, by reach.) Toward the bottom of p. F-34 it appears wording was copied from elsewhere as it relates to months when adults are present, even though summer rearing is being discussed.
F	WDFW-HB	F-35		Table F-21	Table F-21 refers to summer rearing as March-June!
F	WDFW-HB	F-37 through F-39		3.1	No actual statistics are provided to show whether one model run was better or worse than another in its ability to track WDFW population estimates. Figures F-3 through F-5 are inconclusive, given the range of possible options. I used rounded estimates of the values on the graphs and entered them in a spreadsheet (see below for individual figures).
F	WDFW-HB	F-38		Figure F-3	For 20 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.25 and R2 is 0.06. The year to year direction matches 53% of the years. Based on these figures the model does not do a good job of estimating adult Chinook salmon return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.
F	WDFW-HB	F-39		Figure F-4	For 13 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.004 and R2 is very small. The year to year direction matches 69% of the years. Based on these figures the model does not do a good job of estimating adult steelhead return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.
F	WDFW-HB	F-40		Figure F-5	For 10 years there are values for both the model and the WDFW estimates. Correlation between the pairs is 0.67 and R2 is 0.45. The year to year direction matches 67% of the years. Based on these figures the model does a fair job of estimating adult coho salmon return, but marine survival and harvest may be poorly represented while having a substantial impact on adult return.
F	WDFW-HB	F-45 to F-63		3.3 and 3.4 Figures F-11 and F-12	Figure F-11 shows some Chinook rebound after dam construction with passage and only flood control. The question about the quality of the model (see 3.1) remains and it is unclear whether the modeled future Chinook population is lower than the average of the WDFW estimates of recent run sizes. It is noteworthy, although not necessarily statistically significant, that the range of modeled future Chinook run sizes does not reach the retrospective modeled peaks, a possible indication of adverse impact of flood control only dam operation with passage. The projected decline is more pronounced in Figure F-12 (without fish passage). Steelhead and coho conclusions seem plausible, despite the same questions about model quality.
F	WDFW-HB	F-63 to F-67		3.5 Figures F-29 and F-30	In Figures F-29 and F-30, modeled numbers of Chinook salmon and steelhead spawners modeled with a multi-purpose dam with colder water release and passage is lower than modeled without passage! Only for coho salmon is modeled fish passage favorable to production with a multi-purpose dam with cold water release.

Paul J. Pickett, Department of Ecology	
Project and Deliverable Name:	Draft Chehalis River Fish Study
Review Date:	Comments Due by: Monday January 2, 2012

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment	Response	Initials
A	Ecology-PJP	A-7	10-Aug	Table A-3 (also Figure A-1)	The elevations in this table contradict Table 1.1 in the main report and are inconsistent with topographic maps of the site. Apparently the HEC-RAS model vertical datum was increased by 1,000 feet. Why was this done? If modeled elevations were altered for some reason, that reason should be noted, and adjusted elevations and true elevations should be clearly identified where shown in the report, and the consequences for model results described. Preferably, the elevations should be returned to true values. These altered elevations appear		
A	Ecology-PJP	A-10	22		The analysis suggests a losing reach between Pe Ell and Doty. Previous groundwater and TMDL studies should be reviewed to see if this is confirmed.		
A	Ecology-PJP	A-11	14-26		The analysis by WEST for the Corps GI hydrology study confirmed the USGS estimate. That analysis should be noted, since it supports the use of the that value.		
A	Ecology-PJP	A-22	15-Sep		This time lag is probably fine for high flows, but the reach between the Newaukum and Skookumchuck River alone can have up to 7 days travel time in low flows. Was this factored into the time lag used?		
A	Ecology-PJP	A-22	24-33		It's not clear why this method was used for the sediment analysis and not the HEC-RAS model. This needs more explanation.		
A	Ecology-PJP	A-36-39		Tables A-9-12	A key question is the effect of the on flood stage in the Chehalis-Centralia area. Could curves be developed for the dam projects showing percent exceedance of river stage levels above the Skookumchuck River? It would be a very useful piece of information.		
A	Ecology-PJP	A-41	9-Jul		The 2007 flood should be run as the historic flood, consistent with the WEST hydrology study.		
A	Ecology-PJP	A-42		Table A-19	The left-hand column on this table is labeled for return interval floods. However, from my understanding of the description of the analysis, 100-year floods in the upper watershed were combined with 20-year floods in other tributaries. What was the return frequency of the resulting flood at Mellen Street or Grand Mound? The fact that the return frequencies shown are for the Doty gage should be noted in the column header or in a footnote. The recurrence flood downstream should also be noted.		
A	Ecology-PJP	A-55	22-23		Estimating Black River flows from the Skookumchuck River is a weak approach, and other methods should be explored. The Black River is a very different watershed from the Skookumchuck. In addition there has been an active gage on the Black River since 2005. The existing data should be used where possible, and synthetic hydrographs for the historic record and design flows be developed by comparison to neighboring gages.		
A	Ecology-PJP	A-56	13-30		Model validation: specific goodness-of-fit metrics should be provided. For example, for paired data points of discharge and stage provide the Root Mean Square Error (precision) and the Relative Percent Difference (bias). These statistics should be shown for all data and for flood flows and low flows (top and bottom 20 th percentile perhaps). In addition, some examples of model accuracy from other studies (with citations) would be helpful to put this		
A	Ecology-PJP	A-64	5-Mar		Again, this sentence should be revised or deleted: "it is believed that the USGS estimated peak flow 4 for the 2007 flood is not accurate since the Doty gage was washed out during the flood, likely 5 caused by a flood wave from log jams breaking up." If you are going to include this, you should attribute it to a source – who believes this? And you should include reference to the WEST memo that supports use of the gage. But my recommendation is to cite the WEST memo and align your hydrologic analysis with theirs.		
A	Ecology-PJP	A-64	28-Jan		This discussion should also make note of the uncertainty in the flow measurements and estimates. Even the gaged flows have an error associated with them, and many of the tributaries have estimated flows for all or much of the record. In addition, the timing of flood peaks would play a large role in the ability of the model to predict downstream flows and stage. The timing, transport, and attenuation of flood peaks would be affected both by		

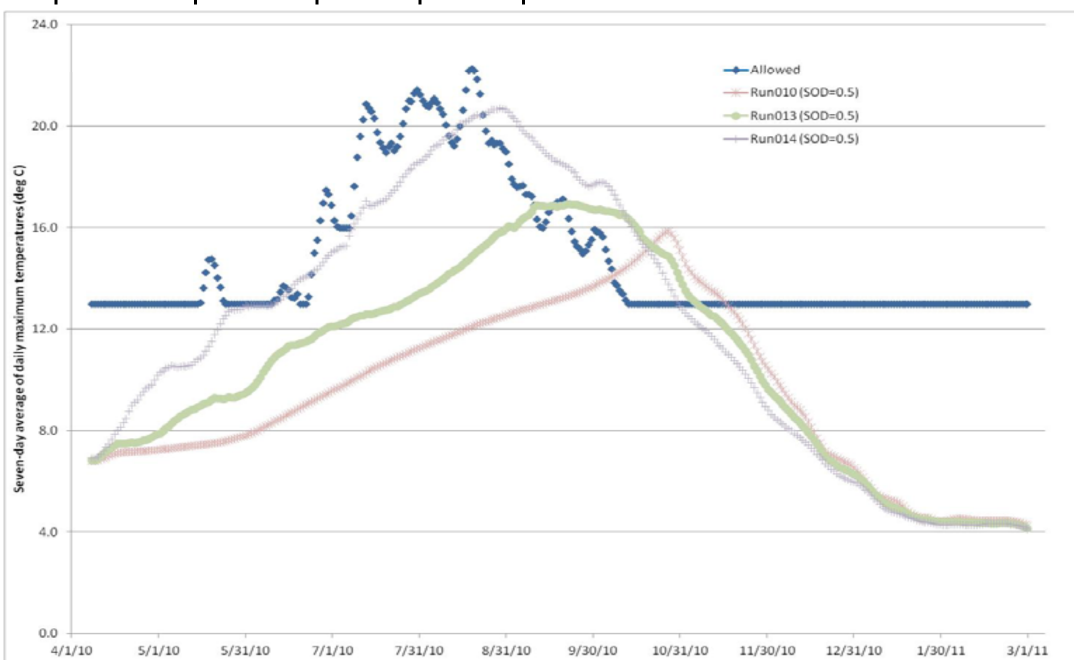
C	Ecology-PJP	C-19 - 49			CE-QUAL-W2 model: The following simplifying assumptions were applied. The effect of these assumptions is unknown: · All flows enter the modeled reservoir from upstream. No tributaries were provided, including the upstream end of Crim Creek one side branch. · Neither evaporation nor precipitation were included. All angles in bathymetry are 0 (varies in reality)		
C	Ecology-PJP	C-19 - 49			CE-QUAL-W2 model: The following errors were found in the model. The consultant was notified and these have been corrected: · Segment widths, volumes, and surface areas were about ten times too large. · Latitude and longitude were a little too far to the north · Elevations were 1,000 feet too high. The consultant provided updated input files for one of the scenarios (bottom release). They have said they will provide a reanalysis of the study based on the changed model outputs. This reanalysis will need to be provided and time allowed for comment, in order for a complete review to be possible.		
C	Ecology-PJP	C-19 - 49			CE-QUAL-W2 model: The following simplifying assumptions are like to have a significant impact on the dissolved oxygen predictions:		
C	Ecology-PJP	C-19 - 49			• Sediment Oxygen Demand (SOD) was not included. This is highly unrealistic. SOD rates of 0.5 or 1.0 g O_2 m^{-2} day^{-1} are not uncommon, and models of reservoirs sometimes use values of 1.5 or greater. The Run010 model scenario was run with SOD of 0.5 and 1.0, and the result compared to the consultant's model run with an SOD of zero. Minimum oxygen in the modeled reservoir forebay was 8.5, 7.0, and 3.8 mg/L for SOD rates of 0.0, 0.5, and 1.0, respectively. The minimum daily DO levels in the modeled reservoir outlet were 9.5, 7.4, and 4.6 mg/L for SOD rates of 0.0, 0.5, and 1.0, respectively. Therefore, a very reasonable level of SOD in the reservoir results in depressed DO levels in a bottom discharge that fail to meet the state's water quality standards.		
C	Ecology-PJP	C-19 - 49			SOD is unlikely to begin at 0.0, since the bottom of the reservoir will be covered with timber debris and forest litter. Therefore, the assumption of a SOD level of 0.0 is not reasonable and results in a model with unrealistic DO results.		
C	Ecology-PJP	C-19 - 49			• No Carbonaceous or Nitrogenous Biochemical Oxygen Demand (CBOD or NBOD/Ammonia) was applied in the model. This is not a reasonable assumption, since low levels of CBOD and NBOD are present even in relatively undisturbed forest conditions. This assumption likely produces DO levels slightly higher than would actually occur.		
C	Ecology-PJP	C-19 - 49			• No algae or nutrient system is included. Algal growth in a reservoir is likely to have a significant impact on DO dynamics in the reservoir. This occurs through photosynthesis and respiration in the water column; algal death, settling, and decomposition in the sediments; and nutrient rerelease from sediments, especially under anoxic conditions. Although the characteristics of this reservoir are uncertain, some test runs with reasonable levels of nutrient inputs, algal growth and death, and nutrient recycling would be reasonable.		
C	Ecology-PJP	C-19 - 49			CE-QUAL-W2 model: The following simplifying assumptions are likely to affect temperature predictions:		
C	Ecology-PJP	C-19 - 49			• Wind sheltering coefficients are set at 0.9, which may be too high for a reservoir in a sheltered canyon. I ran a scenario with WSC set to 0.6. The maximum temperature in the modeled reservoir forebay was 0.4 degrees warmer.		
C	Ecology-PJP	C-19 - 49			• No shading from trees is provided. With a narrow reservoir and a tall stand of trees on the shores, shading might have some effect on surface temperatures.		
C	Ecology-PJP	C-19 - 49			• The lack of algal modeling can have an effect on temperatures, since the turbidity caused by algal biomass can increase heat flux into the water.		
C	Ecology-PJP	C-50-70	Sec. 4		The use of the 2010-11 year for the temperature simulation underestimates possible temperatures in the Chehalis River. The summer of 2009 included record hot air temperatures and the highest water temperatures in Ecology's record. The summer of 2010 closer to an average year. At Ecology's Dryad gage, the maximum water temperature in 2009 was 28 °C, while the highest temperature during the summer of 2010 was 23.2 °C. Similarly, the maximum temperature in 2009 at Porter was 4.5 °C higher than the maximum temperature in 2010. Additional analysis should be done with 2009 conditions.		

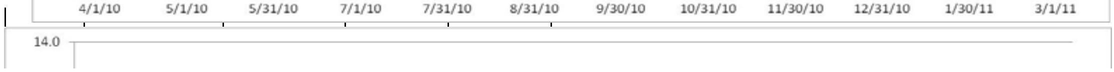
C	Ecology-PJP	C-8	Sec 2.1		Six years of additional temperature data are available from the Chehalis BMP effectiveness study. Was this data reviewed? Could these data be used?		
C	Ecology-PJP	C-8-10	Sec. 2.2.1 and 2.2.2		Were field checks or post-calibration checks made of the tidbit or Hydrolab data? What data quality information did you collect or develop for the field samples and laboratory analysis? Please provide any quantitative data quality information that you collected, or provide a note that none was collected.		
C	Ecology-PJP	C-18		Figure C-5	The axis for saturation should be labeled.		
C	Ecology-PJP	C-54		Figure C-24	Tributary temperature inputs do not look realistic. The summer of 2010 was realtively cool, and data from this period appears to be combined with higher temperatures from other years. A consistent data set for 2010 should be used to simulate conditions for the study period.		
C	Ecology-PJP	General			To model the impact of reservoirs on water temperatures for comparison to the water quality standards, Ecology recommends use of a critical year and a median year for air temperatures and flows. It is not clear what conditions 2010 represents for the Chehalis, but my review of records in other locations suggests that it was a year of unusually cool air and water temperatures and moderate summer flows. To adequately understand impacts of a proposed dam on water quality, additional modeling should be done for a hot, low flow year (2009 for example) and a median year for air temperatures and flow.		
C	Ecology-PJP	C-61&C-63		Figure C-29	The data selected for these graphs are not clear. Are these daily maximums? Daily averages? The report should provide this information. The daily maximum would be most appropriate. Also, the dates shown in these graphs don't capture the period when temperatures are the most elevated compared to background.		
C	Ecology-PJP	Section 4.3			HEC-RAS model: Model results were verified against Ecology data at the Dryad station from April 1, 2010 through September 22, 2010. The report in Figure C-27 shows a Root Mean Square Error (RMSE) of 1.0 °C. The verification analysis I conducted resulted in a RMSE of 3.4 °C from April through September and 1.9 °C for August and September.		
C	Ecology-PJP	Section 4.3			The report also shows modeled maximum temperatures at Dryad of about 25 degrees, while the output data obtained from the HEC-RAS files supplied by Anchor show maximum water temperatures of almost 34 degrees. This discrepancy should be explained.		
C	Ecology-PJP	Section 4.3			The mean error (average of pair-wise residuals) was also evaluated as a measure of bias. The mean error for April through September was 2.0 °C and for August through September was 3.6 °C. This suggests that the model is greatly over-predicting temperatures.		
C	Ecology-PJP	Section 4.3			This cannot be considered a good calibration. For example, the temperature model for the Pend Oreille River calibrated by Portland State University resulted in RMSE values generally between 0.3 and 0.5 °C and all less than 0.7 °C. More work is clearly needed to improve the calibration of the HEC-RAS model before it can be used with confidence to assess impacts on water quality and fisheries.		
C	Ecology-PJP	Section 4.3			HEC-RAS model: The HEC-RAS model appears to be a highly simplified mode for temperature analysis. Chehalis River model development, through its assumptions, has simplified it even further. Two key processes that appear to be missing is ground water exchange (losses or inflows) and shading. Ground water inflows can be significant in portions of the river, and would have much cooler temperatures than this model provides as distributed boundary conditions. There is information available from previous studies, and even from the mass balance in this study, to quantify these exchanges. Also, HEC-RAS provides no direct mechanism for providing shade. Effective shade could be calculated outside the model and input as a reduced solar radiation input. This should have been done. The absence of these two factors make the model unreliable for assessing the impacts of the proposed dam on the temperatures of the river.		

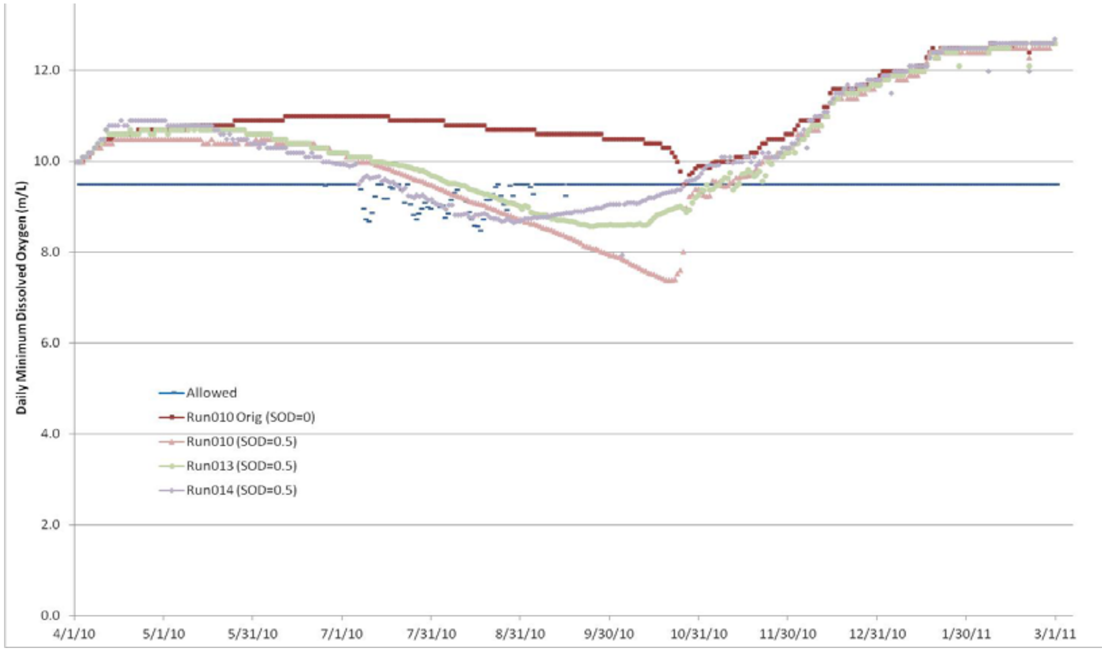


C	Ecology-PJP	Section 4.3			HEC-RAS model: The Chehalis River model has many of the same shortcomings as the reservoir model. Only reaeration is included - no sediment oxygen demand, biochemical oxygen demand, or nutrient dynamics. In addition, this model is inadequate to predict dissolved oxygen in the reach between the Skokumchuck and Newaukum Rivers due to stratification in that reach. Therefore the dissolved oxygen results cannot be considered a realistic approximation of the impact of the proposed dam on conditions in the Chehalis River.		
A	Ecology-PJP	General			The Anchor fish study report should provide a more comprehensive analysis of compliance of the project with water quality standards. It should, if possible, summarize the results described below or otherwise make note of what the model results suggest for compliance of a new reservoir with Clean Water Act requirements for the protection of fishery uses.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Model results from the CE-QUAL-W2 model were compared to the State's water quality standards. This is not an official assessment of compliance with the standards, but should be considered a preliminary review.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Water quality standards are based on the protection of uses. For most of the reservoir site, and for the mainstem downstream of the reservoir as far as the Ceres Road Bridge (just upstream of the South Fork confluence), the use protected is "Core Summer Salmon Habitat". The criteria for protecting this use is 16 °C as a 7-day average of daily maximum temperatures, and 9.5 mg/L dissolved oxygen as a daily minimum.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			In addition, most of the mainstem above and below the proposed dam also is protected by Supplemental Spawning and Incubation temperature criteria of 13 °C from September 15 through July 1 of each year. This criteria supercedes the higher criteria during this time frame. Several of the tributaries that would be inundated by the reservoir are also covered by the Supplemental Spawning and Incubation temperature criteria of 13 °C, but from October 1 through May 15 of each year.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Another use that is protected by the standards and would be affected by the reservoir is Char Spawning and Rearing (e.g. Bull Trout). This use has been designed for Thrash Creek. Up to about one-half mile of Thrash Creek would be inundated during reservoir high water. The DO criteria for this use is the same – 9.5 mg/L. However the temperature criteria for this use is 12 °C as the 7-day average of daily maximums.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Three other conditions from the criteria need to be applied:		
A	Ecology-PJP	General			• When a water body's temperature is warmer than criteria due to natural conditions, human actions may not cumulatively increase the temperature by greater than 0.3 °C.		
A	Ecology-PJP	General			• Incremental temperature increases must not, at any time, exceed 28/(T+7), where "T" represents the background temperature.		
A	Ecology-PJP	General			• When a water body's dissolved oxygen is lower than criteria due to natural conditions, human actions may not cumulatively decrease the DO by greater than 0.2 mg/L.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			To compare model results to the criteria, these conditions were programmed into a spreadsheet. Background or natural temperatures were derived from the temperature data collected during this study above Pe Ell, and where that data were not available, Dept. of Ecology data from Dryad were used. For dissolved oxygen, background levels were assumed to be saturation concentrations calculated from temperature data.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Four reservoir scenarios were compared to standards:		
A	Ecology-PJP	General			1. The revised model provided by Anchor QEA for a bottom discharge with Sediment Oxygen Demand set to 0.0 g O_2 m^{-2} day^{-1}.		
A	Ecology-PJP	General			2. The bottom discharge model with SOD set to 0.5 g O_2 m^{-2} day^{-1}. This is a low value that could be expected from the decay of organic material on the reservoir bottom.		
A	Ecology-PJP	General			3. The thermocline discharge model with SOD set to 0.5 g O_2 m^{-2} day^{-1}.		
A	Ecology-PJP	General			4. The surface discharge model with SOD set to 0.5 g O_2 m^{-2} day^{-1}.		
A	Ecology-PJP	General					

A	Ecology-PJP	General			Comparison of these scenarios to the standards resulted in the following:		
A	Ecology-PJP	General			1. The revised model with SOD of zero resulted in 40 days of noncompliance with the temperature standards, and 1 day of noncompliance to DO criteria. The worst day of noncompliance with temperature criteria was 2.9 °C above allowable levels, and the one day of noncompliance with DO criteria was 0.01 mg/L below allowable levels.		
A	Ecology-PJP	General			2. The bottom discharge model with SOD of 0.5 resulted in 40 days of noncompliance with the temperature standards (the same as #1), and 85 days of noncompliance to DO criteria. The worst day of noncompliance with DO criteria was 2.1 mg/L below allowable levels.		
A	Ecology-PJP	General			3. The thermocline discharge model with SOD of 0.5 resulted in 53 days of noncompliance with the temperature standards, and 79 days of noncompliance to DO criteria. The worst days of noncompliance were 3.4 °C above allowable temperature levels, and 0.9 mg/L below allowable DO levels.		
A	Ecology-PJP	General			4. The surface discharge model with SOD of 0.5 resulted in 82 days of noncompliance with the temperature standards, and 78 days of noncompliance to DO criteria. The worst days of noncompliance were 3.5 °C above allowable temperature levels, and 1.6 mg/L below allowable DO levels.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			Since the discharge is not in compliance with standards, then the reservoir itself would not be in compliance with standards. No information is available for background or natural temperatures in Thrash Creek, so compliance with Char criteria can't be assessed.		
A	Ecology-PJP	General					
A	Ecology-PJP	General			The compliance of a new reservoir with state water quality standards will have to be analyzed in much greater detail than this brief review allows. The discharge below the reservoir would need to meet existing standards. For the reservoir itself, the standards provide a process to evaluate and address the changes in uses in the reservoir. It is unlikely that a reservoir will remain a viable habitat for Salmon or Char Spawning.		






Daily Minimum Dissolved Oxygen (m/L)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
4/1/10
5/1/10
5/31/10
7/1/10
7/31/10
8/31/10
9/30/10
10/31/10
11/30/10
12/31/10
1/30/11
3/1/11
Allowed
Run010 Orig (SOD=0)
Run010 (SOD=0.5)
Run013 (SOD=0.5)
Run014 (SOD=0.5)

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(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment	Response	Initials
ES	Ecology-BC	ES-1	30		You say flood levels predicted to decrease by 1.4 to 1.8 feet for 1 in 100 year flood. Please add a comment on how the 1 in 100 flood compares to the 2007 and 2009 floods.		
ES	Ecology-BC	ES-3	29 and 30		You say minimum releases from November to March and April to November. Please add what days of the month those minimum release would be for.		
ES	Ecology-BC	ES-4	5		You say on page ES-3 line 30 the minimum release in most years will be 140 cfs in the month of September but on page ES-4 you say the median flow for September will be 122 cfs at the Doty gage. Please explain the loss of 18 cfs since you said there were no diversions between the dam release and the gage.		
ES	Ecology-BC	ES-3	18	F-1	You say a flood storage dam without fish passage will cause a 37 % decrease in steelhead spawner abundance. I disagree. Table F-1 page F-9 in Appendix F correctly states that 91% of steelhead spawning occurs upstream of the dam site. This reach upstream of the dam also has the cooler water and more pristine fish habitat for juvenile salmonids. Removing 90% of the spawning habitat and many miles of the best juvenile rearing habitat will likely cause more than a 90% loss of steelhead spawner abundance. Please change the Shiraz model to reflect this decrease in steelhead with a dam with no fish passage.		
ES	Ecology-BC	ES-5	17	F-1	You say for Chinook salmon that with a hydroelectric dam with no fish passage that there will be a 1% loss of spawner abundance. Table F-1 page F-9 shows 6% of Chinook spawning is upstream of the dam and the best juvenile habitat is upstream of the dam. I believe the loss of Chinook, particularly spring Chinook will be far greater than 1% because spring Chinook prefer to spawn the farther upstream than other Chinook stocks.		
ES	Ecology-BC	ES-5	21 and 22		You say steelhead spawner abundance will decrease by 17% with a hydroelectric dam with fish passage and will decrease by 9% with fish passage. I disagree. Table F-1 page F-9 in Appendix F correctly states that 91% of steelhead spawning occurs upstream of the dam site. This reach upstream of the dam also has the cooler water and more pristine fish habitat for juvenile salmonids. Removing 90% of the spawning habitat and many miles of the best juvenile rearing habitat will likely cause more than a 90% loss of steelhead spawner abundance. Please change the Shiraz model to reflect this decrease in steelhead with a dam without fish passage.and believe the decreases will be over 90%.		
ES	Ecology-BC	ES-5			You need to include comparisons with other Washington dams with their effects on salmonid populations. Generally, dams have had very negative effects on salmonid populations and mitigation typically has failed. Please state how the best comparative dam is the Cowlitz Dam where after a decade of effort and tens of millions of dollars Tacoma last year could only successfully pass around 10 to 30% of coho, steelhead, and chinook smolts downstream past the dam. Tacoma has plans to spend on the order of 50 million dollars to try and improve the survival just over the next few years. Another example is the Wynoochee Dam where I understand survival of steelhead smolts past the dam is around 5%.		
	Ecology-BC	Page 60 Fish Population Modeling 6.1.1.2	20		You assume with dam fish passage that 80% of juveniles survived. This is an incorrect assumption. It is based not on similar dams, but on the Columbia River dams which spill hundreds of thousands of cfs of flow around the dam for fish passage and barge the juveniles. This is not a fair comparison. Please state that for a fair comparison you should use the Cowlitz and Wynoochee Dams and assume a fish passage survival rate of 5 to 30% for the first decade. This may improve with adaptive management and decades of studies at a cost of likely in the high tens of millions of dollars after the dam is in place.		

F	Ecology-BC	Page F-14 appendix F		Table F-3	Your RHABSIM numbers indicate quantities of habitat where no spawning exists. These WUA habitat number should reflect the spawning distributions in Table F-1. For instance, where the exisiting spawning distributions are zero then the corresponding 8 cells in Table F-3 should be zero. A certain percentage of spawning salmonids will explore and spawn in a different reach other than where they were born to make sure that all available spawning habitat is being utilized. Your RHABSIM model found WUA habitat of correct depths and velocities and substrate downriver but if there are no spawners there now it tells you that spawning will not be successful in that downstream reach. There are many factors affecting survival of eggs and fry that were not measured and modeled. We do not know what possible gravel spawning areas will be scoured out by high flows or whether the water temperature will result in successful egg hatching and fry survival or whether the fry are in a reach where they will be forced out by high flow velocities to downriver reaches where they will later die due to high water temperatures. You need to have your habitat model predict spawning habitat in the reaches where fish spawn presently to avoid gross errors of having salmon spawn where their progeny will not survive.		

Project and Deliverable Name:	Draft Chehalis River Fish Study	
Review Date:	Comments Due by: Monday January 2, 2012	

(Appendix Letter or Main)	Checker/ Reviewer	Page	Line Number	Table or Figure Number	Checker / Reviewer Comment	Response	Initials
ES	JP	ES-4	10,12		Report touts cool water inputs. Is this reach of the river on the 303D list for temperature?		
ES	JP	ES-5	last Para		Fish abundance impacts are severe. While no studied stocks are listed under the ESA, they are part of Treaty Fisheries for the Chehalis and Quinault Tribes. As such, tribes and regulatory agencies will likely place a particularly high level scrutiny on the proposal.		
A	JP	a-10	Para 1		Only 1 cross-section was extrapolated for the entire model for the upstream reaches of the study area, and the same Manning's "n" values were used throughout. A model this crude will not capture important channel changes and resultant effects on flows. The resultant model is inherently inaccurate and thus of very limited value in drawing conclusions that reflect actual future post-project conditions. Suggest that an interpretation of this important limitation in the model input in this reach be reiterated in the conclusion section.		
A	JP	A-11	para2		You state that there are indications that the high flows at the Doty gauge could have resulted from a surge of water and debris caused by break up of large log jams, and that it's Anchor's QEA's opinion that results based on USGS peak flow determination at the site are "conservatively high". Since this statement affects the reader's interpretation of the study results, and Anchor's opinion is contradicted by the official position of the responsible agency in this case, suggest that the statement needs to be supported by more definitive evidence than that offered, or omitted.		
A	JP	A-40,A-41	last line		Report states that while a 100 -year recurrence interval was used for the Chehalis, the Newaukum and Skookumchuck rivers were run using only a 20-year flow as the concurrent discharge. This paints an overly optimistic picture of actual flood conditions. It is not uncommon for several tributaries in the Chehalis to experience major (> 20-year recurrence) flooding concurrently with each other. In fact, your report estimate that the 1996 flood on the tributaries for the 1996 flood to be as large as a 50-year event (See pg. a-43 Lines 13 and 14). Your own report indicates that you should use larger flows on the tributaries to simulate worst-case conditions.		
A	JP	A-41	31		Reductions of 1.4-1.5 feet at the confluence with the Newaukum and Skookumchuck rivers are unlikely to be adequate to protect I-5 or the populated areas near these locations. Please add a note that additional measures beyond that provided by the proposal will be needed to protect I-5 and the cities.		

A	JP	A-64	Para 2 and Para 3		In paragraph 2 you state that the channel likely has changed due to the various floods that have occurred since the now outdated cross sections were originally surveyed in prior to 2007, 2001, and the 1980's respectively. Conversely, you attempt to explain the problem away, stating in Para 3 that similar results would be expected so long as the channel has not changed significantly. Given the number and severity of the flood events that have occurred on the Chehalis since the 1980s the only logical conclusion is that the channel has changed significantly. If this is indeed the case, then the model results do not reflect current conditions. This consideration adds significant uncertainty to the modeling results, and is another feature of the modeling approach used in the study that needs to be highlighted in the conclusions.		
B	JP	B3	last Para		Sediment samples were gathered from gravel bars but not from pools, glides, or riffles. Different geomorphic features sort stream gravels differently largely depending on gradient and velocity. Gathering samples from a more diverse array of geomorphic features found in the river would result in a more accurate characterization of bed load and how it is transported and distributed through the system.		
B	JP			Fig B-6	Figure shows profound increases in bed load/transport capacity disequilibrium in the reaches upstream of the South Fork confluence. The effects of this on fish habitat and stream channel stability due to aggradation in reaches 2 and 3 seem understated in the report text.		
B	JP	B42	22-25		I agree with your conclusion that a comprehensive transport model of the river would be needed if this project were to proceed further with planning and design. However, before proceeding on a more detail modeling effort, suggest that a review of the apparent impacts and benefits be conducted first to assess the basic project feasibility, and confirm that further modeling is worthwhile,		
B	JP	overall			The analysis/discussion of the impacts of LWD loss due to the project is lacking and understated. LWD plays a pivotal role in habitat formation and geomorphic processes. It also plays a key role in inducing hyporheic functions, which in turn has effects on water temperature and DO levels. Hyproheic functions also have been definitively linked to the formation of spawning habitat for salmonids. Suggest adding a reference to the significance of hyproheic functions and the potential effects to the project.		
D	JP	D10			Why did you not use the ADCP data gathered for the Instream Flow Study to develop new cross-sections for your HEC RAS model? This would have greatly increased the accuracy of your model.		

CONFEDERATED TRIBES of the CHEHALIS RESERVATION

Natural Resources Department

Memo

To: Anchor QEA/Flood Authority
From: Mark White, Director
Date: 12/29/2011

Laura,

Here are some of our first rough comments on the Fish Study. I wanted to get them to you before our meeting with Anchor QEA, so they had some time to address them when they meet with the Tribal Chairman in January. We will continue to review the report and if anything else pops up I will get our comments to you ASAP. If you or Anchor have any questions please don't hesitate to contact me.

OVERVIEW COMMENTS ON THE ANCHOR QEA REPORT

The following are overview comments on the compiled report. More detailed comments by appendix that substantiate these comments, follow these overall comments.

General Comments

- There needs to be a synthesis of the compiled information. The separate appendices are not synthesized into what the overall information means. For example, there are small descriptions of the proposed Projects in each section but not a comprehensive description anywhere. Many of the components are not brought into the Shiraz model, which seems to be the appendix that is supposed to bring the information together and tell the story (we assume).

- The fish study focuses on three salmonid species, spring Chinook and coho salmon and winter steelhead that are supposed to represent a diversity of anadromous life history strategies and habitat requirements. We would disagree that that it represents a diversity of even anadromous fish, let alone the substantial diversity of other fish that are important in the basin. These three species are not representative in terms of representing stakeholder values or potential impacts from the two potential projects. There is little information on the distribution and abundance of these fish species (especially steelhead, which has over 90% of the production occurring upstream of the study area) and fall Chinook and summer steelhead and other species are not considered that do not rear all year long in the system were not considered.

- There are problems with the basic methodology used in the other models that feed into the Shiraz model. The overall study is set of models feeding into another model where much of the basic information used in the models is lacking or not justified. The problem with most of this study is that it is all based on modeling and habitat representations. There is little or nothing that I have seen to date that tries to incorporate reality of where fish are and how they use the habitat. Models with incomplete or inaccurate assumptions are used to build the Shiraz model, which predicts changes in fish production. Models are used to build models to produce results, with little or (in some cases) no information or basic correlation with fish distribution, abundance, life history information or harvest information.

- All models and other data (except geomorphology) are focused on the main channel only (fish species and life stages, hydrology, IFIM, and Shiraz). They are also focused on temperature and flow in the main channel (it is even stated that these are the most important limiting factors for fish), which introduces bias. There is no evidence that these are the main limiting factors. This is the only location where the multipurpose dam can provide benefits to any large degree. There is little or no information or analysis on the effects to peripheral habitats.

- There is a significant lack of practical data or correlation to current fish production facts to support modeling and results. Distribution and abundance of fish are not correlated with the hydrology, geomorphology, water quality, IFIM or even the Shiraz model. For example, If over 90% of the steelhead population currently spawn above the proposed dam locations, how can you determine that they will simply move below the dam (or pass easily over the dam) to spawn and how can you predict their numbers will be stable or even increase?

- In Appendix A, the report provides considerable information on flood reduction benefits. It seems that it is focused on only one side of the equation; the benefits. There needs to be information on negative flood reduction effects such as impact on groundwater recharge and storage etc. .

- We agree with the Appendix B assessment. We cannot determine the changes that could result from the placement of dams, elimination of high flows, larger sized sediment load, and etc. The questions that remain are critical. High maintenance flows and sediment supply obviously maintain all channels, including migration of the main channel and peripheral habitats such as abandoned or side channels. What are the consequences to habitat if these are not maintained? Will the channel aggradation in some locations due to the considerable decrease in bedload transport capacity make the main channel shallower, less diverse (e.g. fewer pools) and increase temperatures? Will the decrease in channel migration, reduction in peak flow events and channel aggradation severely degrade the maintenance of off channel features? The off channel features (side channels, etc.) are critical for maintaining summer rearing, high water refuge and rearing, and in some species, spawning habitat.

- We also agree that changes to LWD input and transport will occur under either the flood control or multi-purpose alternatives. The lack of LWD from the upper Chehalis River basin and reduction in transport and input of large wood through geomorphic reaches 2, 3, and 4 due to reduced peak flows would likely result in reduced levels of LWD in the river. Since LWD levels are low under current conditions, this would result in a further reduction in habitat diversity. Critical issues that remain unanswered include: What does a reduction in habitat diversity mean to fish populations? It appears that little to none of this is used in the Shiraz model to predict overall degradation of habitat, including less food production, less cover from predators (e.g. pools and overhead cover) and less high water refuge.

- Appendix C estimates of temperature with and without a multi-purpose facility were provided for fish population modeling. Specifically, daily maximum temperature predictions in summer (spawner to egg survival) and daily average temperature predictions in fall through spring (egg to fry survival) were provided. In addition, historical temperature and water quality information was used to establish periods of temperature suitability in the Chehalis River from 2001 to 2010, the period over which data were used to develop escapement correlations for use in fish population modeling. It does not appear that the temperature and DO changes were correlated with existing distribution and abundance of fish spawning and incubation. It does not provide information on criteria used to determine correlations. Are criteria specific to the Chehalis River fish used? The current populations seem to do fine under current conditions.

- The Introduction to Appendix D states that the primary purpose of an instream flow study is to provide a technical basis for biologists, resource managers, and other stakeholders in the decision-making process to evaluate flow alternatives in relation to important fish habitats and other flow-related resources. Although you mention it can be used in assessing the feasibility of the project, we thought the primary purpose was to examine the potential effects of the proposed projects on fish in the Chehalis River system. The study Objectives state the specific objective of the instream flow study is to assess potential impacts of potential flow augmentation from reservoir operations on rearing and spawning of salmonids in the mainstem Chehalis River. This specific objective introduces bias to the entire study.

- Also there is little or no information on how these flows and the resulting WUA compares with natural flows - and therefore fish production. The major missing pieces are effects on peripheral habitats, changes in sediment and LWD supply, especially increased in fine sediment and decreases in larger sediment such as gravel or even boulders that are said to be important in rearing.

- This fish population analysis in Appendix E applies the information gained in other aspects of the fish study to an analysis of how salmon production in the river would be predicted to change with the construction and operation of a dam. It seems to be totally focused on the mainstem area, which will have the only benefits from the dams (or specifically the multipurpose project).

- The Analysis Frame in Appendix E states that the Shiraz is a spatially explicit life-cycle modeling platform that simulates the effects of environmental change on salmon populations and utilizes a set of user-defined relationships among habitat characteristics, fish survival, and carrying capacity to evaluate population performance across space and time. This seems like a basic flaw in the concept of the model since most of the species and lifestages used do not have complete or reliable spatially explicit information, relationships between habitats are not defined and there is nothing about real population estimates (only escapement estimates).

- The Shiraz model is also based on developed of specific habitat and salmonid population data, as well as the "functional relationships" that characterize the relationship between habitat conditions and salmonid productivity. This was not done. Too little specific habitat and salmon utilization data is used to run an accurate model and the species, habitats, etc. , and those used are bias towards the increase in flows and decrease in temperature provided during the summer by the multiuse project. Other problems include:

    - The passage rates of survival are unrealistic,
    - Data from other stream reaches used to extrapolate to above the dam are inappropriate

- Important habitat that will be degraded are not in the analysis
- Loss of habitat in the reservoir area and above are under estimated,
- The potential for extirpation of one or more species in early stages of dam operation are under estimated
- Etc.

COMMENTS ON COMPILED REPORT APPENDICIES

Appendix A

General Comment - There is significant discussion about reduction of flood flows and volumes downstream of the dam after the dams are constructed (e.g. the multi-purpose reservoir will cut peak flows by ½ in October). Please provide discussion of frequency analysis of flooding outside of the main channel associated with different alternatives (i.e. area 1 will be submerged x days at the 100-year flows; y days at the 25-year flows; etc.).

General Comment - The results state that migration patterns and rates in geomorphic reaches 2 to 4 are likely to change under both potential projects; particularly in upper reaches where changes to peak flows are most pronounced. In unconfined areas of reaches 2 to 4 where there has been channel migration in the past, future rates would be expected to decrease due to the decrease in peak flows that cause bank erosion and channel migration. However, there may be channel aggradation in some locations due to the considerable decrease in bedload transport capacity predicted by modeling. If there is aggradation in unconfined areas, channel migration rates could stay the same or even increase as the channel adjusts to the new flow and sediment regime. It is not possible to determine the exact changes to channel migration based on available data and resources. Please provide explanation.

General Comment - Changes in bedload transport capacity and bedload input during the modeled floods under either the flood control or multi-purpose alternatives is much lower than under existing conditions in geomorphic reaches 2 through 5 (about 30 miles). Much of the predicted decreases in bedload transport capacity approach near 100 percent resulting in a decrease in annual transport (tons) of near 50% in many of the upstream reaches. Combined the above with a decrease in flushing of fine sediment from spawning beds, what does this mean in terms of habitat and production of invertebrates and fish. There is no correlation to habitat quality, fish use, fish abundance or fish production that is carried through to the Shiraz model. Please Explain.

Page A-4 - Calculations were conducted assuming that “the ratio of precipitation in two basins is equal to of the ratio of the runoff in two basins”. That statement also assumes that soils in both basins are similar or comparable, so that calculated infiltration is comparable. Did you compare soils in these basins before performing calculations and what were differences in soil characteristics affecting infiltration?

Page A-10 - It is understood that Manning roughness values were not available because no surveyed Chehalis river section existed. However, did you at least compare the Manning roughness values estimated for the floodplain via Google Earth or other similar means before just using the Manning roughness from the closest available surveyed sections? How do these compare, or will the model have to be re-calibrated due to this uncertainty?

General Comment - Anchor QEA provides very subjective judgment throughout Appendix A that 2007 flood was over-estimated by other agencies. Can you be more specific in this statement – what is the reasoning behind this suspicion, can you provide scientific support for this statement?

Appendix B

Table B-5 – Please define categories of “Confinement” for non-geomorphologist readers.

General Comment - Provide a figure showing USGS stations and their locations relative to the project area.

Attachment B-1 - is missing.

Attachment B-2 – Did you use a spreadsheet or similar to derive graphs in this Attachment? The main text refers to a “model” being used. Please clarify.

Attachment B-2 – most of the figures – Is Cumulative Sediment Transport Capacity (M_S) labeled on a vertical axis same as QC_S, labeled in the legend on the same figures. In general, Anchor QEA may decide to present each one of these graphs in two parts, as they appear “too crowded”.

Appendix C
Please provide the list of acronyms and abbreviations used in this appendix, similar to Appendix B.

C-1 – States that this water quality analysis focuses on temperature and dissolved oxygen (DO), two of the most important water quality parameters affecting instream habitat conditions for salmonids. We would consider this introducing bias into the fish study. These are the two habitat parameters that the proposed projects could potentially improve. Rivers such as the Chehalis have many more and just as important limiting factors such as high water refuge during the winter. Please explain.

C-2 -3 – States that the multi-purpose facility alternative, more than 100 feet of water storage is planned during spring and summer. This larger body of impounded water will be exposed to a prolonged period of solar heating and could result in thermally stratified conditions in the reservoir. Depending on the elevation from which water is released from the reservoir to augment the summer flow, these releases can mitigate or exacerbate downstream DO and temperature. The primary objective of this water quality evaluation is to provide an assessment of temperature changes in the Chehalis River to support the evaluation of changes to fish habitat and populations (through Shiraz modeling) due to the construction and operation of the proposed flood retention facility. Include more information of the effects of exposure to prolonged solar heating as it does more than just stratify the reservoir - it acts as a heat sink so the overall temperature of the water in the Chehalis River downstream has a net temperature increase and potential DO decrease. Please explain.

Page C-10: Temperature probe at Porter (Figure C-2) did not function most of the time. Please explain.
C-17 – States that Based on this analysis, it can be reasoned that reaeration, and possibly photosynthesis, is sufficient to maintain DO levels throughout the river at or near saturation during late fall and winter. Thus, DO concentration in the Chehalis River appears to be primarily a function of temperature and flow during fall and winter. Historically, DO concentrations in the river during summer, particularly in the vicinity of the city of Chehalis, have shown departures below Class A water quality standard of 8 mg/l. These low DO levels have been attributed to point sources near the city of Chehalis (Jennings and Pickett 2000). Please provide results or extrapolation that relates the DO concentrations you have observed to the situation in the river at low flow and those used in the Shiraz model. It seems that you found that DO is fine throughout the year, assuming summer photosynthesis continues as would be expected. If the city of Chehalis inputs were corrected, would the DO problem not be an issue?

Figure C-6: Please add river and/or tributary names to this figure, so that the reader knows which segment is associated with which reach.

Page C-56: Clarify the HEC-RAS temperature model calibration. It was calibrated for the existing conditions, correct? This becomes clear only later in this Appendix, but it is just confusing here, as it comes right after discussion of reservoir alternatives.

Figure C-30: You show an almost 9 mg/l increase in DO concentrations if the water is taken from the bottom of the reservoir (we assume as location of withdrawn is not labeled). This would be the first reservoir that we have seen that would not have DO depleted water 250 feet in depth in a reservoir, and as far as we can tell, it does not include any BOD in a body of water that will collect organic material and fine sediment. This does not appear realistic and introduces extreme doubt on the accuracy of the modeling.

Table C-4 - Early in the document, you state that flow and temperature are the main determining factors fish production. We do not agree with that statement which relates to the main input to the Shiraz model - the fact that temperature is the main determining factor of egg survival. There are a whole host of other variable that would affect egg survival - especially gravel quality and fine sediment content that will in fact increase and decrease egg survival, not to mention the other life history stages of the entire fish assemblage in the river. Please explain.

General Comment - Need to label the axis for most of the graphs and have an explanation in the title as to what it is trying to relate – scenario, month, location etc. What we take from the data and results is that the temp and DO downstream are basically unchanged for all three scenarios in most cases. Add what fish habitat is related to the results.

General Comment - Please relate the results to the issues and the Shiraz model use. DO concentrations in the Chehalis River are reported to be primarily a function of temperature and flow during fall and winter. How does this relate to any problem (if there are any) time periods such as low flow? It seems that you found that DO is fine throughout the year, assuming summer photosynthesis continues as would be expected. Although, historic DO concentrations in the river during summer, particularly in the vicinity of the city of Chehalis, have shown departures below Class A water quality standard of 8 mg/l; apparently related to point source contributions. If the city of Chehalis inputs/point sources were corrected, would the DO departures from the standard be an issue?

Appendix D Draft PHABSIM – Instream Flow Study

D-1 and D2 – The Introduction states that the primary purpose of an instream flow study is to provide a technical basis for biologists, resource managers, and other stakeholders in the decision-making process to evaluate flow alternatives in relation to important fish habitats and other flow-related resources. Although you mention it can be used in assessing the feasibility of the project, we thought the primary purpose was to examine the potential effects of the proposed projects on fish in the Chehalis River system. The study Objectives state the specific objective of the instream flow study is to assess potential impacts of potential flow augmentation from reservoir operations on rearing and spawning of salmonids in the mainstem Chehalis River. This specific objective introduces bias to the entire study. The only place that could potentially improve from the projects is the mainstem. What about peripheral habitat that are so critical in the Chehalis River? What about the species that will be impacted that other stakeholders are concerned about? Basically the fish species and location of the study, that are focused on the only aspect that the dam could "potentially" improve (flow and temperature), introduce bias towards presence of a dam.

D-1 – States stakeholder concurrence on study scope, design elements, and overall decision-making are commonly instituted under the framework of the IFIM as one of the first steps of the methodology (Bovee et al. 1998). This was not done – We believe you talked to Ecology and WDFW. What about the other stakeholders such as the tribe that has as much fish management responsibility as the state and knows as much as anyone in terms of fish biology, distribution, abundance and especially habitat preferences. Other interested parties would include NOAA Fisheries, US Fish and Wildlife Service, watershed groups, etc.

D-12 – In the Target Aquatic Species section you have three sentences explaining what species were chosen and why. Please provide substantiation for these species being the target species and include the consultation record from stakeholder discussions. Explain what are the distribution and abundance of these fish species (especially steelhead, which has over 90% of the production occurring upstream of the study area) and make sure you describe why they are chosen as representative. Explain why fall Chinook and summer steelhead and other species that do not rear all year long in the system were not considered.

General Comment - Explain why peripheral habitats are not included and why they would not be important when examining what could be the most negatively affected habitat by the dam and that off-channel rearing and high flow refuge would be critical. This section is completely inadequate and critical to the evaluation of effects form the two dam proposals. It also demonstrates the lack of stakeholder involvement from the Tribe who could have assisted in choosing appropriate species to model where negative effects would be realized rather than species that would likely benefit from mainstem flow augmentation in the summer. Also provide an explanation of why coho rearing was excluded because of lack of life history and habitat use information (probably as much information on coho rearing as the other species and lifestages examined). What are the implications of this species life stage excluded since it is the only species and lifestage that uses the peripheral habitats out of the mainstem. There is too little specific habitat and salmon utilization data to run an accurate model and the species chosen are bias towards the increase in flows provided during the summer by the multiuse project. Please explain implication of that.

D-14 – Habitat mapping – There appears to be little attempt to represent future conditions if the dams were to be build. As projected in the geomorphology and channel migration study, the area below the dams with the highest percentage of riffles and with gravel substrate will be the most affected. This area will also likely aggregate, loose gravel, and likely become armored with fines in substrate. What does this change do to your future spawning and rearing projections and how does other habitat degradation such as decreased food production affect your results (and more important the results projected by the Shiraz model).

D-28 – etc. Habitat Modeling - See previous comments. Do we know where rearing and spawning takes place? It appears that above 50 cfs, all juvenile rearing habitat remains about the same. What are the flows when Chinook, steelhead and coho spawn under natural conditions? Where are the high velocity refuge areas and why are they not examined. This is for the mainstem only - in the PNW juveniles find velocity refuge in peripheral habitats and in tributaries. This does not say anything about juvenile survivability etc. and when other fish species spawn under natural conditions; is it in the 100 to 500 cfs range? If so, would this not argue for natural flows that have maintenance flows for gravel recruitment and cleaning and delivery of LWD; please explain.

D-38 – Discussion – States that results of the instream flow study must be put in context with other variables that affect fish use and distribution such as water quality, temperature, and other limiting factors that may be present. The tendency to look at the maximum or "peak" of a habitat index curve greatly oversimplifies the results. We could not agree more. Because of the complexity of the Chehalis River, in particular, the habitat variables external to flow are absolutely critical and likely outweigh any particular flow. Also there is little or no information on how these flows and the resulting WUA compares with natural flows - and therefore fish production. The major missing pieces are effects on peripheral habitats, changes in sediment and LWD supply, especially increased in fine sediment and decreases in larger sediment such as gravel or even boulders that are said to be important in rearing.

D-39 – Discussion – States that different fish species and life stages exist simultaneously in the river and each has a different flow requirement. Other factors such as egg incubation, smolt out-migration, and upstream fish passage may also need to be considered. A balance should be reached between the requirements of each fish species and life stage. No single flow can provide optimum habitat for all species and life stages at a given moment in time. The process of determining instream flows often involves a negotiation process, taking into account numerous factors. Instream flows need to be discussed in the context of the long range water and fishery management objectives desired by the local watershed planning groups, state, and federal natural resource agencies, and affected tribes.
Again, we agree. So this analysis has not been done, which is the basic purpose of the fish study - again there are other species that need to be considered - other than those that are in the mainstem and would benefit from flow augmentation in the summer. Again, this purpose of this study is not to negotiate flow regimes, it should have been an analysis of what the difference in condition between natural, and the two proposed projects means to fish production. The basic components of the study should have been discussed with other stakeholders - like the Tribe, which has 1/2 of the management responsibility for fisheries and likely different ideas on what fish species would represent a robust study on the effects of the dams.

Habitat Suitability Criteria attachment: Olympia peninsula streams are completely different from the Chehalis and certainly the Dewatto River is not comparable, which is extremely small and short. Since the Chehalis is the second largest river in the State of Washington - after the Colombia, why were the real large river criteria excluded? This is for the mainstem only. In the PNW juveniles find velocity refuge in peripheral habitats and in tributaries.

Appendix E – Draft Upper Chehalis River Watershed – Fish Habitat Evaluation

E-2 – The Fish Distribution and Life History is interesting and very important – We are not sure why there is nothing like this for the river below the dams for the IFIM, etc? In the IFIM study – coho rearing was not examined (because of lack of data) like it is here. Is that because there will be a negative impact on them if the dams are constructed. This is a good example of the lack of basic life history, distribution, abundance and habitat use data that is not presented in the fish report – in its entirety.

E-4 – Provides WDFW has established index reaches in the upper Chehalis River where annual spawning. It is interesting to note that for Chinook and steelhead combined, of the eight index reaches listed – six are within the footprint of the reservoir and two are upstream. These are normally choses because they represent consistent and big escapement numbers (critically important areas for salmon production). What does this mean from a salmon production standpoint if they are nearly all inundated by the reservoirs? An excellent example of how real fish use could be integrated into the analysis but is not.

E-4 - Selection of Study reaches - The problem with this study and the IFIM study is that it is all based on modeling and presumed habitat representations and there is little or nothing included attempts to incorporate reality of where fish are and how they use the habitat. These fish select habitat use beyond the parameters examined here so how accurate is the study? Please explain how this affects results in the independent appendices and most important the results of the Shiraz model.

E-12 – Rogers Creek having no value in evaluating habitat - If they are using it - why does it not have value. I would think the high flow channels in particular have value.

E-21 – Explain how representative this habitat survey is since it occurred right after a major flood. Consider that in the next few years the habitat could be completely different once a more permanent channel and vegetation are allowed to establish.

Appendix F – Fish Population Model Chehalis River Fish Study

F-1 – States that the fish study focuses on three salmonid species, spring Chinook and coho salmon and winter steelhead, representing a diversity of anadromous life history strategies and habitat requirements. We would disagree that that it represents a diversity of even anadromous fish, let alone the substantial diversity of other fish that are important in the basin. Se comment on the IFIM and upper river studies. These three species are not representative is it in terms of representing stakeholder values or potential impacts from the two potential projects.

F-1 - This fish population analysis applies the information gained in other aspects of the fish study to an analysis of how salmon production in the river would be predicted to change with the construction and operation of a dam. Again, we do not agree with this statement, especially in terms of how well this represents the dams would affects salmon production. It seems to be totally focused on the mainstem area, which will have the only benefits from the dams (or specifically the multipurpose project). What about other species of salmonids that do not use the mainstem and the other species, in general? Please explain how the species you chose are good representation of fish that use peripherial habitats (the most affected by the projects), important sensitive, culturally, subsistence, commercial species, etc. that will be affected. This is a very small look at a larger fish assemblage that supports one of the last remaining large rive aquatic ecosystems in the state that is still in good shape.

General Comment - Why were other models that have been used in looking at water storage project not used such as the EDT model that has been used to predict impacts and prioritize mitigation on several dams on the west coast. For example, it appears the Shiraz model does not take into consideration riparian or floodplain areas and how that may change and affect fish. This model does not take into consideration the riparian areas when compared to the EDT model.

General Comment: The model does not appropriately incorporate important physical and biological parameters that are critical to any production model. Explain how sediment recruitment and the effect of the dam and this used in model and included in assumptions. For example, the Skokomish River has been "perched" because of aggradation and has greatly impacted the floodplain, flooding and fish habitat. It is extremely important to incorporate the complex limiting factors into this simple model and explain all assumptions and how the model does or does not reflect reality. It seems you are assuming temperature and flow during the summer are the only substantial limiting factors, please explain. There are many other factors that enter into the equation and if you are focused on temperature and high flows, it will certainly introduce bias as those are the only two basic factors that a dam could potentially address. A change in one physical habitat parameter may help one species but hurt another. A good example is Chinook salmon that will use habitats up and down the watershed depending on conditions such as temperature. There is little to no information incorporated into the Shiraz model on how the watershed above the dam site may be used in times of higher temperature, especially with the existence of some very unusual and specifically adapted populations of Chinook salmon in the basin. Please provide an explanation of the missing physical and biological components and how they may or may not affect results.

F-2 – The Analysis Frame work states that the Shiraz is a spatially explicit life-cycle modeling platform that simulates the effects of environmental change on salmon populations (Battin et al. 2007). Shiraz utilizes a set of user-defined relationships among habitat characteristics, fish survival, and carrying capacity to evaluate population performance across space and time (Scheuerell et al. 2006). This is very important since most of the species and lifestages used do not have complete or reliable spatially explicit information, relationships between habitats are not defined and there is nothing about real population estimates (only escapement estimates). Please explain how this affects the basic premise of the model and how it may contribute to a basic flaw in the entire analysis.

F-2 – D – States that the model is developed by defining specific habitat and salmonid population data, as well as the "functional relationships" that characterize the relationship between habitat conditions and salmonid productivity. This was not done. Provide examples here of how you did this. Please include the fact that coho rearing was excluded because of lack of life history and habitat use information, although was the only species/lifestage that uses the peripheral habitats out of the mainstem. Address the fact that too little specific habitat and salmon utilization data to run an accurate model and the species chosen are bias towards the increase in flows provided during the summer by the multiuse project.

F-2 - Calibration of the model entails comparing empirical observations of fish abundance over multiple years. Ideally the numbers available for calibration will have been extrapolated to represent an estimate for the entire study area. Please provide evidence and details tht this was done. Characterize the amount of empirical observation of fish abundance (not just escapement numbers) that was used and how this affects the calibration of the model.

F-3 – Separate models for the alternatives - Not sure why scenarios without fish passage were run, other than to show some negative effects. We all know fish passage would have to be included in a basin with perhaps the healthiest salmon populations in the nation. It would also need to have a multi-intake tower to regulate temp and DO. Again not sure what the other scenarios do to reflect reality other than promote the only scenarios that could be built. Please comment.

F-4 – Study area - Good information but please explain why you used small rivers and stream for criteria in model inputs such as the IFIM modeling. Need to describe the importance of the snow - not rain - events like rain on snow are huge factors in making this river extremely unique. The fact that the fish populations have evolved to utilize habitat associated with extreme flood events is likely a big reason that they are still doing OK. By degrading and eliminating the peripheral habitats, the fish populations could be critically affected. This is not an Olympia Peninsula or Hood Canal type river; it is unique and the fish have adapted to the unique conditions. The fish populations are still doing relatively well using the habitats as they are available - they are used to high summer temps, they are well adapted to use high water refuge in winter.

F-4 - Please explain why you assumed that the only area directly affected by the proposed dams is the mainstem Chehalis River from RM 33 to the headwaters of the West Fork. This area is the only area that is directly affected by taking away higher flows – may potentially benefit from increased flows in summer. The floodplain areas downstream will also have direct impacts, especially during high flows.

F-10 – States that Data on juvenile salmonid rearing distributions along the mainstem study area were not available. WDFW staff stated that few if any juvenile salmonids rear in the lower river during the summer months when temperatures are high. How can we model rearing if there is not information available? What about fall Chinook and summer steelhead. What about those species that do not rear all year long? Please explain.

F-10 - You indicate that a "tributaries" reach was included in the model as available habitat for rearing with lower temperatures than the mainstem river. Please explain what the influence of including this reach is. How have you incorporated the other peripheral habitats that will be affected if either of the dams is built? Tributaries will not likely be affected as much as the side channels and other floodplain habitats, accept above the dam and at the mouth below the dam. Again - high water refuge is critical habitat and likely one of the main limiting factors in the Chehalis basin give the propensity for extreme high flows. Coho in particular use flood plains, even little ditches and swells during the winter. If these are not maintained by high flows, this critical habitat will be seriously degraded and eliminated - what will that do to coho production? Please provide an explanation and estimate of why these habitats were not examined and the effect on the results.

F-12 - It was assumed in this section assumed that 95% of the adults migrating upstream and 80% of the juveniles migrating downstream survived. The adult survival rate is equivalent to survival rates reported in Cramer and Beamesderfer (2006) based on observations in the Columbia River watershed. This is not realistic - what about the juveniles migrating upstream to use upper watershed? It was assumed that 95% of the adults migrating upstream and 80% of the juveniles migrating downstream survived. The adult survival rate is equivalent to survival rates reported in Cramer and Beamesderfer (2006) based on observations in the Columbia River watershed. You use small streams for developing habitat criteria, which provides higher quality habitat during summer low flows that are augmented and Columbia River criteria for passage. This is not realistic. For example, Whynoochee Dam in the Chehalis Basin has about 95% mortality in passage of fish. In addition, the water quality modeling that was done estimated temperatures of 22-23 degrees on the surface of the reservoir. These are probably lethal temperatures to many cold water fish and will produce large populations of warm water predators. Please justify your 95% and 80% (even with the additional 10% added on) survivability of survival rates considering the above issues and provide more data on similar dams to support these. Provide statistics and realistic citations for the original and 10% add on.

F-12 – States that coupled with the scenario that does not provide fish passage past the dam, the “with passage” survival rates provide the upper and lower range of impacts if a dam is constructed. In this way, if lower survival rates were assumed, then the output would be between the “with passage” and “no passage” scenarios conducted in this analysis. This should provide a realistic estimate - not without being the lower and with the upper. We all know it will require passage so please try to provide a realistic mortality rate for all passage related issues. Include juvenile passage upstream during warm water time periods since this could also be a critical limiting factor.

F-12 – Habitat Capacity Model Inputs. See comments on IFIM modeling that explains species are only representative of mainstem use, inappropriate habitat criteria, etc. Again modeling assumptions that are not quite right piled on top of more modeling assumptions that do not seem real accurate.

F-13 – States that the findings of this inventory are provided as Appendix E, but was not available in time for use in the draft models. Instead, the upper watershed habitat was estimated by extrapolating habitat in the PHABSIM analysis reach just downstream of the proposed dam site. This is not appropriate and introduces enormous bias. Please explain.

Table F-3 – This is a good example of where reality strays from modeling. Steelhead do not spawn in any numbers below the dam site. Explain why you even include them in those parts of the model. Need to incorporate distribution and abundance reality when doing this sort of analysis. Explain how these numbers affect the Shiraz output, with little information incorporated with regards to distribution, abundance and life history/habitat use.

F-15 - Obviously the rearing habitat gets better as you go up in the watershed. Please explain why it is appropriate to extrapolate in this manner. Rearing habitat in the Tributaries reach was assigned the same amount as the South Fork Chehalis to Newaukum River reach. The calculated rearing areas contain the appropriate water flows, cover, and substrate for rearing. This is also not appropriate - tributaries are likely critical in both winter for providing high water refuge and summer for providing warm water refuge. It would be more similar to upper watershed. Please explain.

Table F-4 – It seems very little rearing occurred in the lower watershed. Please refer to comment on the spawning table that preceded this.

F-17 - Please provide substantiation of assumptions used in model for sediment and LWD issues.

F-17 - To account for anticipated detrimental impacts to habitat in the inundation area, the estimated habitat in the Upper Watershed to Proposed Dam Site was assumed to equal the amount of habitat in the 2.3 mile sub-reach between the proposed dam site and Pe Ell. Please substantiate. It appears it is not realistic - this habitat will likely be devoid of riparian habitat and geomorphology will completely change - how can you say an area that is periodically inundated is similar to an existing and well-functioning reach of river.

Please reference reservoirs and provide results from reservoirs that are filled and drained on a periodic basis?

Table F-8 – Explain the exclusion of habitats – other than the mainstem where high flows maintain and allow access to peripheral habitats that are likely used extensively by rearing salmonids. Including only the mainstem introduces substantial bias.

F-19 - The section states that the Multi-Purpose dam scenarios will alter winter and spring flows after larger upper watershed flow events. Please explain how these relate to maintenance flows in the watershed and how this was incorporated into the Shiraz model.

F-21 – States that to account for anticipated detrimental impacts to habitat in the full capacity inundation area, the estimated habitat in the Upper Watershed to Proposed Dam Site was assumed to equal the amount of habitat in the 2.3 mile sub-reach between the proposed dam site and Pe Ell. This habitat should be eliminated from any sort of habitat value. It is a reservoir and the species you are looking at are riverine species. Even if you used the habitat criteria in the IFIM model, the suitability would basically be zero - then you add the bass and sediment and it has a substantial negative effect on populations above the dam. Please explain the logic behind this.

F-25 – States Adult pre-spawn survival in all 3 species was characterized based on water temperatures. Explain the reasoning behind the pre-adult spawning variable. Justify the focus on temperature in relation to the fact that it is one of the few variables the dam projects can control. These fish are likely adapted to the existing temp regime and find temperature refuge in other parts of the watershed, including tributaries and peripheral habitats. Even on the east side of Washington where temperature is a bigger problem for salmon, they find cold water refuge in many forms. Please explain.

F-26 – States that changes to the upper watershed reach were estimated based on the changes in water temperature predicted for the Proposed Dam Site to Elk Creek reach if surface waters were released. This approach was taken to account for the warmer surface waters of the reservoir that the fish would need to swim through to reach spawning grounds in upper tributaries. Please justify. Address the appropriateness considering temperature and passage comments above.

F-31 – Explain how fine sediments are incorporated into the model and effect on results.

F-35 – Overwintering Rearing Survival - This is completely inadequate and is just as important as a limiting factor as temperature and flow during the summer. Off-channel habitat is critical to overwintering and is the main reason that including only the mainstem to represent habitat is not appropriate. Please explain or incorporate.

F-37 – Explain how escapement numbers predict production or populations. Explain why issues like harvest numbers do not need to be considered. For example, spring Chinook spawning data, an index area is used. It is examined regularly and repeatedly during the spawning weeks, and then a one time survey is conducted outside the index area to determine if the index area has remained in use consistently with past years. The index areas are used to get a representative estimate of potential production, not actual production, and it is not focused on how fish may use the upper watershed for example. Sampling is affected by budgets, logistics and weather.

F-38 - If harvest is not included, how does the model get to actual production? Ocean survival is important but harvest would seem to be just as important in determining how many reach the index areas. How does this relate to the majority of spawning and rearing habitat for steelhead being inundated or potentially inaccessible compare to production estimates? Explain how this affects results.

F-42 – Please define what is meant by the term salmon spawners. Are we talking about escapement numbers - not spawners or return numbers? Harvest is a critical component?

F-45- Explain the practicality of how can you put in a dam, degrade a huge part of their habitat, create a passage barrier and have an increase in abundance?

F-48 - Considering the low numbers of returning steelhead and Chinook and the fact that they use much of the area that will be degraded or much more difficult to access, explain the potential that one of the projects could be the tipping point to send this population to the T&E listing, especially with the prediction of greatest effects early on in the project.

F-50 – Please explain why you think the coho population is stable. We do not see anything that would indicate a more stable population given the low a numbers. Explain why the population would not crash

F-63 – States that it is also important to recognize that the minimum numbers of returning spawners described above are more informative in characterizing a species vulnerability to extirpation (i.e., absent from the mainstem). This is important and good you included this statement. Explain the potential for either dam and potential for extirpation, especially in the first few years when the fish are not adapted to the huge changes in their habitat.

Figure F-29 - This seem to indicate there is a potential in each scenario to exterminate one or all populations of naturally spawning fish with the project. Please explain.

Figure F-30 - This is very telling in terms of the value of the modeling. Explain, given current steelhead distribution and use of habitat above the dam with not passage, how you can predict more fish.

F-72 – This section states that coho salmon are predicted to be the most impacted by a dam that does not include fish passage, despite the fact that a much higher percentage of steelhead currently spawns above the proposed dam site (approximately 22% of coho and 91% of steelhead based on data from WDFW. The finding of higher steelhead abundance predicted if no passage is provided past a multipurpose facility that releases water from the bottom of the reservoir is not consistent with want would be expected given that 91% of steelhead spawning occurs upstream of the proposed dam site. This finding warrants further consideration. Presumably it reflects the redistribution of steelhead to spawn in the cooler downstream water available in the summer. The downstream reaches are predicted to be much cooler than temperatures experienced by steelhead migrating up through the reservoir to access upper tributary spawning grounds. This does not seem to make any sense what so ever. How can you put in a dam bellow where 91% of the fish spawn and rear and not have huge impacts. This is another indication the model is lacking critical components and potential bias introduced by the model. It seems to be focused on the only potential benefit that the multipurpose dam can provide. It does not take into consideration any of the current distribution of fish and habitat use or other real data.

F-73 – States that consideration of how low minimum spawner abundance was predicted to decrease to is an important part of the evaluation of the potential impacts of a dam scenario to the fish. The lower the minimum numbers, the more vulnerable the population will be to prolonged time periods of low numbers or even extirpation. As described above in the sensitivity analysis section, unfavorable habitat conditions beyond the range used in the calibrated base models, will occur over the course of time and when they do, the number of fish surviving should be expected to decrease. If unfavorable conditions occur when the salmonid population is already at a low level, then there is the risk of having 1 or more years with few spawners. Further, the lower the minimum numbers of salmon, then the longer it would take for any kind of rebound to higher numbers. This is an excellent point and could become reality – thanks for the honest opinion.

General comment - The Chehalis River is very unique, although not a lot is known about the fish use, distribution and abundance. Explain how outside data can be used to model the Chehalis River fish populations and missing but unique data have been adjusted and incorporated into the model. For example, it has a self-sustaining population of spring Chinook and no glacier fed streams on it. WDFW smolt trapping window is only conducted during the spring months, and that there may be a fall and/or winter smolt component. There does not seem to be enough sufficient information to determine the actual habitat use because of logistical problems. Chinook could be using the upper watershed and outmigrate late but because of the inability to sample with higher water in the fall and no sampling in early winter, there is no reliable information on this time period, not that they do not outmigrate at that time. Outmigrating Chinook captured in the traps are 0 age fry from May through June at the trap located on river mile 51 (Oakville trap). Very few smolts captured are yearling fish in the Chehalis River. In fact, no yearling smolts were collected in 2011. What are the numbers of Chinook that emerge from areas below the dam and migrate upstream to cooler water potentially above the proposed dam site?

January 2, 2011

Merlin MacReynold
City Manager
City of Chehalis
350 N. Market Blvd., Room 101
Chehalis, WA 98532

Mr. MacReynold:

I appreciate the opportunity to provide the following comments on the Chehalis River Fish Study, dated November, 2011. I am a professional fisheries biologist with extensive experience in working with dams and their effects on fish since 1994. I have reviewed the entire report, but my comments relate primarily to the analyses presented in Appendix F: Fish Population Study. I have provided a summary of concerns related to the document, as well as some background information on my qualifications for your review. Detailed comments on each section of the report then follow. In summary:

There is lack of basic information on fish and their habitat in the mainstem Chehalis River, which is the portion of the river most affected by the proposed multi-purpose dam. More information is needed to provide a more complete picture of the effects of a dam on the Chehalis River Basin fish resources.

- It appears the authors had limited time lacked sufficient information to complete a thorough impact analysis. We recommend that additional information be collected, or developed, to establish a more representative baseline condition and that the analysis then be repeated.

The multi-purpose dam described in the report does not represent the configuration or operation of a dam that would most likely be built at the proposed dam site. A conceptual dam design and operation regime should be further developed before repeating the analysis.

- The dam analyzed in the report should include modern fish passage facilities that are operated to provide proper protection to upstream and downstream migrating fish.
- The conceptual dam should reflect typical design and operation characteristics intended to meet water quality goals, specifically for temperature. A selective-withdrawal structure would typically be included in the dam design, to allow release of water providing the maximum benefit to species of concern.

Water temperatures used to analyze the proposed dam do not represent natural or test conditions. Existing baseline and expected temperature regimes should be revised and the analysis repeated.

- Water temperatures used to represent baseline conditions in the Chehalis River appear to be too warm and do not represent actual temperatures likely to be expected.
- Water temperatures used to represent test conditions below a multi-purpose dam do not incorporate a selective-withdrawal structure, which would allow the operator to release water of optimized temperature.

We recommend these items be corrected and the analysis repeated to better represent the effects of a dam on fish in the Chehalis River Basin. Thank you for the opportunity to comment on this important public policy issue. If you have any questions or need further information please do not hesitate to contact me at (360) 576-4830.

Sincerely,

B. Shane Scott
S. Scott and Associates LLC

Comments on Chehalis River Fish Study

Shane Scott
Principal - S. Scott & Associates LLC
January 2, 2012

Background

I am a professional fisheries biologist and owner of S. Scott & Associates LLC in Vancouver, WA. I have extensive experience working with public and private organizations to provide both technical and policy guidance on mitigation of impacts on fish and wildlife from the development and operation of dams and related facilities. From 1990 to 1994, I worked for a private consulting firm, where I conducted assessments of marine and aquatic environments, wetland delineations, stream habitat assessments, and water and sediment assessments to support permitting and project development. I also worked with teams of engineers to design hatcheries for cols, cool and warmwater fish species all over North America. From 1994 to 2001 I worked as a fisheries biologist for Tacoma Power, managing fisheries mitigation projects on the Cushman, Wynoochee and Nisqually hydroelectric projects.

From 2001 to 2003, I was special assistant to the Director of the Washington Department of Fish and Wildlife, where I represented the agency on the implementation of fisheries mitigation in the Federal Columbia River Power System. From 2003 to present, I have provided technical and policy guidance on fish and wildlife issues for the Public Power Council, an association of public utilities in ID, MT, OR and WA. From 2005 to present, I have been the technical and policy advisor on fish and wildlife issues for the Northwest RiverPartners, an alliance of farming interests, utilities, ports and other river-oriented businesses in the Columbia River Basin.

Since 2006, I have been the owner and principal of S. Scott and Associates LLC where, in addition to my work with utilities and river-oriented industries, I have worked on fish passage projects in North and South America, Asia and Europe. I continue to provide technical and policy guidance on dams and related facilities. Lastly, I also grew up in Lewis and Thurston counties so am very familiar with the Chehalis River Basin.

My primary responsibilities through my professional career have been to represent Clients on interdisciplinary teams of engineers, biologists and hydrologists to develop river operations and dam configurations that protect and improve juvenile and adult fish passage and survival at dams and related structures. As part of this effort, I work with federal, state and tribal fish and wildlife resource management agencies to plan, research and implement fish passage projects for Pacific salmon, steelhead and other species at both high head and run-of-river dams. I also advise Clients on the effects of various policies and regulations on the operation of dam and related facilities.

Summary of Comments on Chehalis Fish Study

There is a lack of basic information on water quality, especially temperature, fish habitat quantity and quality, fish population structure and fish life history distribution in the Chehalis River Basin that limits the authors' ability to provide a more complete picture of any effects of a dam on local fish populations. We understand that the authors had to make a wide variety of assumptions on several biotic and abiotic factors while conducting this analysis. However, we feel that the analysis could be improved if some of the assumptions were replaced or modified. We recommend that additional information be collected or developed and the effects of a dam on fish populations be subsequently reanalyzed.

We also recommend an analysis of fall chinook be included in this report. This species is an important management species and there is likely more information on the spawning distribution and habitat use by fall chinook than any other in the basin. In addition, this species would likely spawn and rear in the mainstem Chehalis River below the proposed dam site and therefore be most affected by operation of a dam on the upper mainstem.

The configuration and operation of the multi-purpose dam described in the report should be modified to more closely reflect those of a typical hydroelectric dam in the Pacific Northwest. Special attention should be paid to how water is released from a multi-purpose dam. It is most likely that water would be released through a selective-withdrawal outlet to more closely meet optimum water temperatures. The authors should also further develop a dam configuration and operation that reflects current hydroelectric generation and flood control practices, water quality maintenance operations (especially for temperature), upstream and downstream fish passage facility design and operation, and should also incorporate more recent fish passage survival estimates into the analysis. The analysis in Appendix F should then be repeated.

Another concern we have with the study was the assumed baseline water temperatures used throughout the analysis in Appendix F. It appears the temperatures selected for spawning and rearing are near the maximums observed in the basin, and are estimated to remain constant through each lifestage. This does not accurately reflect existing seasonal fluctuations. We recommend developing a temperature regime that more closely mimics existing conditions in the basin for these analyses. The authors should also include some analysis of large summertime fish losses that have been observed in the basin.

We question the decision to not model the effects of a dam on juvenile coho rearing habitat due to lack of validated habitat preference relative to fish production. We understand that the authors were told that this information was not available. However, this lack significantly reduces the value of the analysis. Increased instream flows and reduced water temperatures in the summer would most likely benefit juvenile coho rearing habitat quality and quantity in the mainstem Chehalis River. Other species would also likely benefit.

We understand why the three selected species were included for analysis in Appendix F. However, we recommend the authors consider including an analysis of fall chinook in the fish population study for two reasons. First, they are a primary management species in the basin, so much more is likely known about their habitats and distribution. Secondly, mainstem spawning and rearing habitats would more likely be affected by a dam in the Chehalis River Basin.

Lastly, the authors should include an estimate of the effects of the various mitigation actions for fish and wildlife that will be required of a multi-purpose dam. The Federal Energy Regulatory Commission (FERC) licensing process will require a variety of mitigation measures to offset the impacts of a hydroelectric dam. These actions would include both upstream and downstream fish passage, temperature control operations to meet water quality standards, and habitat improvements that would benefit the fish and wildlife populations in the Chehalis River Basin. There are existing FERC-licensed dams in Western Washington, including two in the Chehalis Basin, from which example dam configurations, operations, and fish and wildlife mitigation programs can be evaluated and incorporated into this analysis.

Comments on Specific Sections of the Chehalis River Fish Study

Appendix F: Fish Population Model

2.2.2.2 Spatial Distribution of Spawning

The authors indicate that the spawning of chinook and coho salmon and steelhead are surveyed annually. Does the spawning distribution represent in Table F-1 represent the life histories analyzed in this appendix (i.e., spring chinook, winter steelhead and coho) or the whole population for each species?

Table F-1 should include a separate reach that represents the amount of spawning habitat utilized by each species above the proposed reservoir (RM 118 to RM 108.3). The proposed dam appears to inundate all available spawning habitats. Identifying the amount of spawning habitat actually inundated by the dam would help to better quantify impact to spawning habitat and would assist in the development of fish passage strategies.

Authors selected steelhead, spring chinook and coho salmon for analysis. We recommend the authors consider including an analysis of fall chinook in the fish population study for two reasons. First, they are a primary management species in the basin so likely much more is known about their habitats and distribution. Secondly, mainstem spawning and rearing habitats would likely be more affected by dam in the Chehalis River Basin.

Lastly, the authors should include information about the spawning distribution of these species and life histories throughout the entire Chehalis River Basin. This would give a better estimate of the actual effects of a dam on the Upper Chehalis River to the anadromous fish populations in the entire river basin.

2.2.2.3 Spatial Distribution for Rearing

The authors report that little data on juvenile salmonid rearing distribution is available. Also, they report that the WDFW noted that juvenile fish are likely not found in the mainstem during the summer. The lack of information on juvenile fish presence limits the completeness of the analysis. Fish presence information collected during the various field surveys in support of this analysis should be included to help verify fish presence and distribution. Also, fish species presence and distribution information from other sources, such as snorkel surveys, should be included in the report. This information would help further what we know about the current distribution of species and their spawning habitat in the basin.

Cooler summertime temperatures would likely provide a variety of benefits that are not mentioned in this analysis. For example, increased summer instream flows would likely increase fish access to off channel habitats preferred by some species, especially juvenile coho salmon. Also, lower summer time water temperatures would likely reduce consumption by piscivorous predators feeding on outmigrating juvenile fish.

2.2.2.4 Fish Population Data Modifications in Analysis with Construction and Operation of a Dam

The authors assume 20% mortality for juvenile fish migrating to, and through, a proposed reservoir. We recommend further research of the available literature on this issue. In the free flowing reach of the Snake River, from the Snake River Trap to the Lower Granite Dam (a reach of approximately 30 RM), the average mortality rate for juvenile steelhead from 1993 through 2011 was 4.7% (NOAA-F 2011). We recommend the authors evaluate more recent juvenile fish passage survival research.

2.2.3.1.1 Spawning Area

The SHRIAZ model used outputs from the PHABSIM model to estimate how many individuals survive to subsequent life stages. We understand this is a limited study, but see opportunities for increasing the accuracy of the analyses provided. We propose that the PHABSIM model may over-estimate the amount of spawning habitat available in the Chehalis River Basin. Shirvell (2007) reports that this model over-predicted available chinook salmon spawning habitat in the Nechahako River in Alaska by 210% to 660%. That author recommends increasing the number of transects measured at each reference site and incorporating bottom topography and velocity gradients into the model to improve spawning area estimates (Shirvell 2007).

Payne et. al. (2004) reviewed over 600 instream flow studies and notes that 18 to 20 transects per study segment will provide the highest accuracy for the PHABSIM model. We suggest that the number of transects studied be increased to provide a more robust analysis.

2.2.3.2 Flood Storage Only Dam Habitat Capacity Inputs

The authors chose to reduce the amount of habitat by 0.5% per year, so that by the end of the 50-year analysis period the available habitat below the dam is approximately 75% of the amount estimated as currently existing. Please provide the basis for this estimate.

The authors also estimate that 90% of the available spawning habitat above the dam site would be lost due to construction and operation of a dam. They note that this will be verified in future drafts. This verification is necessary to better quantify loss in future analyses.

2.2.3.2.1 Spawning Area (Flood Control Dam)

The average river flows presented for the segment from the “Upper Watershed to the Proposed Dam Site” differ between the flood control only and multi-purpose dam alternatives. Average summer flow given for this segment for the flood storage dam is 57 cfs (Figure F-9) but the summer flows for the multi-purpose dam are noted as 140 cfs (Figure F-14). Please clarify how flows above the dam site are expected to differ.

2.2.3.3.2 Rearing Area (Multi-Purpose Dam)

Reservoirs provide rearing habitat for juvenile salmonids. The authors should estimate rearing habitat provided in a reservoir maintained for a multi-purpose dam.

2.2.4 Habitat Productivity Model Inputs

We recommend the authors work with design and operation experts to more thoroughly conceptualize the configuration and operation of a multi-purpose dam. Any dam successfully permitted would most likely be built to meet current fish conservation and water quality standards. The dam would also be designed to release water that meets State and local water quality standards. Upstream and downstream fish passage would generally be provided as a condition of approval. This analysis should be modified to better represent a more realistic multi-purpose dam scenario.

Lastly, the authors could improve and modify this section by describing the effects of the various dam operations on the periodic catastrophic summertime fish losses currently occurring in the Chehalis River Basin.

2.2.4.1 Adult Pre-Spawn Survival

For the baseline analysis the authors chose to use, "the maximum water temperature observed in the months of the year that the adult of each species are understood to be in the river…" The authors do state that temperatures used in the analysis may be too high to support successful spawning for most of these species. However, Tables 16 through 18 use an average temperature for the existing baseline condition. Also, these temperatures are assumed to persist throughout the spawning season, when cooler temperatures would be expected as the year progresses.

The authors also proposed that adult fish would be exposed to high water temperatures above the dam because adult fish would be released into the reservoir where they would have to swim through warm water to continue their spawning migration. Adult fish collected at a trap and haul facility below the dam would most likely be released in free flowing river above the reservoir, therefore avoiding warm water conditions in the reservoir. Further developing fish passage facility configuration and operation would help inform potential effects to fish passing the dam.

2.2.4.4 Summer Rearing Survival

For the baseline analysis the authors chose to use the maximum water temperature observed in June and July for all species and the whole time period. However, Table 21 uses an average temperature for the existing baseline condition. The temperature used should be first clarified. Then a temperature regime to better represent the baseline conditions should be used.

Literature Cited:

NOAA-F 2011. Memorandum to Bruce Suzumoto from John Ferguson. Preliminary survival estimates for passage during the spring migration of juvenile salmonids through Snake and Columbia River reservoirs and dams, 2011

Payne, T.R., Steven, S.D. and D.B. Parkinson 2004. The number of transects required to compute a robust PHABSIM habitat index. Hydroecol. Appl. (2004) Tome 14 Vol. 1, pp. 27-53

Shirvell, C. S. 2007. Ability of PHABSIM to predict chinook salmon spawning habitat. Regulated Rivers: Research and Management, 3: 277-289.

Review Comments: Draft report - Chehalis River Fish Study (December 2011)
Wild Game Fish Conservation International
December 27, 2011

The Chehalis River Basin Flood Authority, as directed and funded by the 2010 Washington State Legislature, commissioned the Chehalis River Fish Study. The purpose of this study was to determine the impact of a 'water retention structure' (a dam, in another words) on anadromous salmon in the Chehalis River

After reviewing the report and its appendices, Wild Game Fish Conservation International (WGFCI) remains extremely concerned that supporters of building a dam in the headwaters of the Chehalis River basin will dismiss this report with its negative conclusions. There seems to be no understanding that from here on any studies on this topic will likely result in even more negative conclusions.

From our perspective there are a number of issues with this study. Among them are:

- There was insufficient time to collect the necessary data, approximately a year. Water temperature data was collected for only two months;

- Only three of the anadromous species; spring run Chinook salmon, winter run Steelhead trout, and Coho salmon were included in the study. This resulted in several species such as summer run and fall run Chinook salmon, summer run steelhead trout, Cutthroat Trout (both resident and anadromous), Sturgeon (both green and white), Rainbow trout, Bull trout, Chum salmon, Eulachon and Pacific Lamprey being excluded from the study. This means, again, that the impacts due to a water retention facility on fish in the Chehalis River basin are underestimated;

- The failure to include the 2007 and 2009 floods in the modeling of water flows, temperature, and impact on fish. These two floods are the reasons for the creation of the Flood Authority and this study;

- The assumption that Coho salmon and Steelhead trout would change where they spawn from the headwaters and upstream tributaries downstream to an area in the main stem where they have never spawned. In effect, this meant that conclusions about the impacts of a dam on fish were understated;

- The modeling makes clear that a dam will not protect I-5, the Chehalis-Centralia Airport or the cities of Chehalis and Centralia.

There is more, but the point is painfully clear.

The conclusions reached by the report authors are easily understood. Every scenario modeled predicted declines in the three species if a dam were to be built. This is regardless of the type of dam (hydroelectric or flood control) or whether fish passage is included in the construction of the dam or whether water is released from the top of the reservoir or the bottom.

The Flood Authority is reviewing possible mitigation and enhancement projects in the basin. The stated purpose is to lessen the impact of a dam on fish and to enhance or improve current conditions. So far there has been no discussion on how other mitigation efforts, necessary because of a dam, have fared regarding the impact on fish. A question we have asked is for the Flood Authority to give us one example of a dam being built where the outcome for anadromous species was the status quo or better. So far, no answer and we do not think there will be one.

We continue to ask about other factors that are nowhere considered in this study. These include irrigation withdrawals and its impact on aquatic plants and on animals such as deer or elk that live in the basin, forestry practices and floodplain development.

Given the Chehalis River Fish Study's predicted negative impacts to anadromous salmon due to a proposed water retention facility in the headwaters of the Chehalis River, Wild Game Fish Conservation International respectfully recommends:

- Discontinue all further efforts and expenses associated with the proposed construction of a water retention facility in the headwaters of the Chehalis River;

- Immediate adoption and implementation of these actions:
  - Immediate and permanent moratorium on steep slope logging
  - Immediate and permanent moratorium on floodplain development
  - Independent peer reviews of Flood Authority-commissioned studies and associated reports (review by UW or WSU);

- Work collaboratively to prevent flood related damage throughout the Chehalis River basin

Given the potential and irreversible impacts of the proposed Chehalis River dam to Chehalis River basin fish, we requested that Dr. Robert Vadas, Jr, a renowned fisheries biologist with the Washington Department of Fish and Wildlife review the draft report associated with the Chehalis River Fish Study (December 2011).

The following are comments from a colleague and friend of WGFCI who has a Ph.D. in fish biology.

- It is possible to have headwater-oriented salmonids spawn below dams, if coldwater (hypolimnetic) releases are made from dams, as has been required to maintain headwater-oriented (i.e., winter, spring, and late-fall) runs of Chinook in the Sacramento River, CA. But even with that scenario, these populations haven't recovered, so dam-release management has been a stopgap solution (rather than a panacea). Moreover, loss of Chinook runs into the upper Sacramento River drainage has led to the loss of bull trout, given loss of adequate foods. Hence, the very coldwater-adapted bull trout became extirpated from California with such dam-building;

- Fall Chinook and winter steelhead are better at spawning in mainstem habitats than spring Chinook, coho, summer steelhead, and cutthroat. All 6 of these runs occur in the upper Chehalis River drainage.

See:

Caldwell, B., J. Pacheco, H. Beecher, T. Hegy, and R. Vadas. 2004. Chehalis River Basin, WRIAs 22 and 23: Fish Habitat Analysis using the Instream Flow Incremental Methodology. Washington Department of Ecology and Washington Department of Fish and Wildlife, Open File Technical Report 04(11-006): 99 pp. (http://www.ecy.wa.gov/biblio/0411006.html

- Winter steelhead should also be relevant to summer/fall Chinook, whereas that for spring Chinook and coho should also be relevant to summer steelhead and cutthroat (for mainstem vs. tributary-spawning guilds, respectively). Other mainstem spawners include sturgeons and eulachon, but likey not upstream into the Pe Ell area. Other salmonids, notably other salmon species and bull trout, are believed to be rare in the Chehalis River basin;

- Clearly, the hydropower option should change Chehalis River flows more significantly than the storage-only option, likely with more-significant impacts on downstream salmonids and other fishes, given the importance of normative (semi-natural) flow management for native fish and wildlife.

See:

AQ, Watershed GeoDynamics and Normandeau Associates, Inc. 2011. Flood storage facility fish analysis: Chehalis River Fish Study (draft). Prepared for the Chehalis River Basin Flood Authority.

Arthington, A.H., S.E. Bunn, N.L. Poff, and R.J. Naiman. 2006. The challenge of providing environmental flow rules to sustain river ecosystems. Ecological Applications 16: 1311-1318 (http://rydberg.biology.colostate.edu/~poff/Public/poffpubs/A

rthington2006(EcologicalApplications).pdf).

Geller, L.D., ed. 2003.
Guide to instream flow setting in Washington State. Washington Department of Ecology, Water Resources Program Publication 03(11-007): 81 pp. (http://www.ecy.wa.gov/biblio/0311007.html).

Poff, N.L., et al. 1997.
The natural flow paradigm: a paradigm for river conservation and restoration. BioScience 47: 769-784 (http://www-personal.umich.edu/~dallan/pdfs/Poff_1997.pdf).

Strange, E.M., K.D. Fausch, and A.P. Covich. 1999.
Sustaining ecosystem services in human-dominated watersheds: biohydrology and ecosystem processes in the South Platt River basin. Environmental Management 24: 39-54 (http://www.springerlink.com/content/ufheul6ma97rkkf1).

Vadas, R.L. Jr., and D.L. Weigmann. 1993.
The concept of instream flow and its relevance to drought management in the James River basin. Virginia Water Resources Research Center Bulletin 178: 78 pp. (http://www.vwrrc.vt.edu/pdfs/bulletins/bulletin182.pdf).

- This would be the expected worst impacts for downstream-oriented spawners like sturgeons and eulachon;

- Although these thermal data are for a limited window of time, they don't support Lewis County's claim that the upper mainstem has a heating problem. Indeed, the main channel (MC) was colder there than for the Satsop River during mid-early September of 2001. Moreover, MC values for both rivers then were within the optimal range for most salmonids.

Respectfully submitted,

Bruce Treichler
James E. Wilcox

January 3, 2012

Chehalis River Flood Authority
2025 NE Kresky Avenue
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RE: Comments on Chehalis River Fish Study, Anchor Report, November 2011

Public Utility District No. 1 of Lewis County (District) thanks Anchor QEA for its expert analysis, coordination, and presentation of the findings of the study of fisheries and habitat of the Chehalis River and water retention for flood mitigation, summer flow enhancement and hydropower generation. The District appreciates the opportunity to comment on the study and believes that with some limited modifications to certain assumptions the analysis can be revised to incorporate and model the best design and operation scenarios for fishery and habitat.

A couple of fundamental questions about the water retention dam design were raised during the presentations by Anchor on the preliminary report relating to temperature and oxygen level of dam releases, minimum flow, and amount of summer flow enhancement. In Phase I, IIA, and IIB assumptions were made that included a variable elevation intake structure for water feed to the hydroplant or for outflow (without hydro), flow enhancement during summer months, and for minimum flow releases. All of these assumptions were preliminary pending refinement and definition of best design for fisheries and habitat study and recommendation. The fish studies and agencies need to provide direction relating to all three of these assumptions as the projects primary purpose is flood mitigation and fishery protection and summer flow enhancement. The PUD has indicated from the beginning that hydroelectric benefit would be secondary to the priorities of flood mitigation and flow enhancement.

1. <u>Temperature and Oxygen Level of Releases</u>**:** The project can be designed to draw water from any elevation in the reservoir to be most beneficial to fisheries and habitat for temperature and oxygen level and for the specific time of year for anadromous fish life stages.

2. <u>Minimum Outflow: The project can be operated with minimum flow releases as defined by the fish studies and agencies to be most beneficial to fisheries and habitat for all months of the year within the limits of the precipitation and annual flow capacities above the site.</u>

3. Flow Enhancement: The project can be designed and operated with summer flow enhancement as defined by the fish studies and agencies to be most beneficial to fishery and habitat for each species and life history within the constraints of the project storage capacity, precipitation and flow above the site, reservoir storage for flood control and storage for summer flows.

Below are comments related to specific sections of the report.

- Pg. ES – 2 Stated it assumed the flood storage and multi-purpose reservoir alternatives would trap large wood and course sediments in the reservoir. The amount of wood and sediment trapped would actually be dependent on Project design with some design options allowing the majority of the wood and sediments to pass. Approximately 95% of the large wood that comes into the Cowlitz Falls Reservoir is passed downstream into Riffe Lake. The low level sluices are also capable of passing much of the sediment during high flow events. Some Project features or goals should be agreed to prior to modeling large wood and sediment transport.

- Pg. ES – 5 States, "The counter-intuitive predictions of higher Chinook and steelhead spawner abundance if fish passage is not provided will require additional consideration of model inputs, but the percent differences are rather small and within uncertainty of the model." This statement is puzzling in part because Table F-1 indicates that 91% of the steelhead spawn in the reach from the proposed Dam site upstream. It might make sense for Spring Chinook as it appears 94% of them spawn downstream of the Dam site but it seems unlikely steelhead spawner abundance could be higher without upstream passage.

- The ES makes several statements regarding the fish population models predicting declines to all three salmonid species in all scenarios but it never states that it is comparing the results to a no Project alternative. Most readers probably assume this but it should be stated. Also, there may be some future options with no Project that should be considered; i.e. warmer river conditions should be considered. How warm the Chehalis River has become and might become will affect all salmonid life stages, as was observed during the July 2009 fish kill (spring Chinook adults and most likely many anandromous juveniles).

- A-1 Introduction - Add a map and river mile index identifying pertinent locations, bridges, gauges, etc.

- Pg. A- 64 - Modeling Limitations - Do we need a better understanding how these limitations and assumptions impact the results or is it insignificant. Is there some oversight group that addresses the limitations described here.

- Pg. B – 42 - Study Limitations - Would defer to experts to determine if more "accurate information" is necessary.

- Section C Water Quality and Fish Study
  ”The Washington State fresh water standard stipulates that in surface waters with designated use as salmonids spawning, rearing and migration habitat, the 7-day average of the daily maximum temperature should not exceed 17.5 degrees Celsius…” (WAC 173-201A-200).

  The water quality section states that WDOE deployed continuous temperature monitors at two long term monitoring locations in the Chehalis River during the summers of 2001 through 2010: one at Dryad and the other at Porter. The report goes on to say, the existing data was not of a sufficient resolution to support the calibration of the downstream water quality model and that Onset TidBits were deployed at eight locations. It appears the study went to great lengths to ensure the accuracy of the temperature collection methods but was limited to a very short window of opportunity to collect temperature data (September 2010 – March 2011). In addition to the short data collection season, the 2010 temperature data set was collected following a La Nina year. The WDOE Dryad gauge indicates the max 7-day mean in 2010 was the coolest of the 2001 – 2010 summers.

  Is it possible to generate a graph that compares WDOE 2001 – 2010 summer temperature data (or the max 7-day mean temperatures) at Dryad and Porter over the ranges of temperatures generated by the predictive models for the same two sites (something like Figure F-3, Chinook model comparing model predictions and WDFW spawner estimates). Seeing this graphically would be helpful.

  - The Dryad gauge max 7-day mean temperatures ranged from 20.6 to 26 degrees Celsius from 2001 to 2010 and the max 7-day mean, averaged 22.9 degrees C during the ten years.

  - The Porter gauge max 7-day mean temperatures ranged from 22.1 to 26 degrees Celsius from 2001 to 2010 and the max 7-day mean, averaged 23.2 degrees C during the ten years.

  - The max 7-day temperatures must really stress adult spring Chinook and some late winter steelhead adults prior to spawning as the above temperatures approach lethal levels. The 2009 spring Chinook kill was triggered by temperatures at or less than 26 degrees C.

- C – 71 Sensitivity Analysis - Were the “simplified assumptions” agreed to with some form of an oversight committee or agency and how much can the various assumptions impact the results of the study?

- D – 12 & 13 Target Aquatic Species – “At this time WDFW does not recommend modeling Coho juvenile rearing due to lack of validated habitat preference relative to fish production.” Although we do not know how the reservoir (if any) would be operated in the future, it could provide some significant benefit to juvenile coho numbers. If there is a reservoir, it would be operated in some manner that would benefit juvenile rearing fish.

- F – 9 - The area from the dam site upstream is referred to in several sections of the report as one reach but in reality should be evaluated as two distinctly different habitat types: 1) reservoir reach and 2) free flowing reach above Project. The area above where the reservoir terminates most likely consists of significant spawning and rearing habitats for some of the three anadromous species. Table F-1 could lead readers to think 91% of the entire Chehalis River steelhead spawning grounds will be inundated.

- F – 10 - The rpt states that juvenile rearing data was not available but that "WDFW staff stated that "few if any juvenile salmonids rear in the lower river during the summer months when temperatures are high." The rpt goes on to say the model was set to allow juveniles to redistribute to other reaches if conditions were better elsewhere. Most likely there are some years where no refugia from high temperatures exists where these fish can redistribute to (except above PeEll); i.e. similar to 2009 when areas upstream of Pe Ell downstream of Chehalis and including the South Fork and Newaukum rivers all experienced lethal water temperatures. The model needs to have criteria that includes juvenile salmonids being killed by high temperatures in some years to be accurate.

  If Global warming occurs it will only make the problem worse.

- Pg. F – 37 & 38 (Figure F-3) The Chinook salmon model comparing model predictions to WDFW Estimates of mainstem Chehalis River spawners "properly predicted whether changes in Chinook spawner abundance in a given year would be higher or lower than the preceding year" was correct more often than not in the last decade. Is there a reason this became more accurate in the last decade?

  - Does Figure F-3 represent the mainstem Chehalis River spring Chinook spawners or is it a small index reach near the Dam site? The figures should indicate the upper and lower ends of the reaches.
  - If it is only an index reach would it make sense to model the entire spawning range for each species or at least downstream to Porter to accurately compare alternatives?

cc: Paul Schlenger, Anchor
Lara Fowler
Bob Geddes
Dave Muller
Mike Kohn
Greg Hueckel
David Plotz

Questions from 12/12/11 Fish Study Data Transfer Workshop

1. Why wasn't more current data used for the hydraulic modeling (2007, 2009 vs. 1996)?
2. What are the risk factors in the worst-case scenario?
3. What are the releases based on in Table A-9?
4. Flow exceedance curves – Variance due to hydro operations?
5. Why don't you graph percentage of time the multipurpose facility would have an affect on In-stream Flow.
6. Identify the days of the months (and not months) for the median flow with respect to the minimum release.
7. Page A-20 dates – record at Doty goes further back than 1989. Why not use data older than 1989?
8. Executive Summary P.5 – Citation of juvenile survival (80%). Reality 10% Coho, 30% Chinook from the Cowlitz). Include examples from Washington State (Dunn 1975, Dept. of Fisheries Tech. Report)
9. Temperature Fig C24 – Historic DOE data, Fig C26 – Model. Why are the model temperatures so much higher?
   Discussion: Model is based on 2 months of data. Model relied on temperature from a few stations.

   Can you modify data in the model?

   Discussion: Estimates are for comparative reasons. 19.5-20 deg. C are too high. Check the temperatures and steelhead survival curves.

   Paul to work with WDFW, WDOE.

10. Paul is working on what is driving results from the model.
11. What shade information is used for the temperature model?

    Discussion: Downstream – none, Reservoir – hillside shading estimates

12. Did you use groundwater inputs? Can you add Chehalis Basin groundwater data? Can you use annual average air temperature?
13. Is irrigation a factor in the basin? Are flows accountable to the irrigation?
14. What are the variables used in calculating BOD?
15. Sediment transport – What criteria/information was used to select geomorphic reaches? Table B-5: How was confinement defined? Measured?
16. Why is a fining of sediments seen (and not coursing?) How long will it take to see a reversal?
17. F-31 – Increase in % fines? Paragraph of explanation. In table, reach closest to the dam show otherwise.
    Discussion: Paul is working. Based on data collected from gravel bars. Paul will research several sources.
18. Disconnect between water quality. Make note of this limitation in model.
19. Table F-3 – What is the steeelhead spawning area doing below the proposed dam, when the majority of spawning occurs above the proposed dam? Table depicts habitat that is available. Paul will check numbers.
20. Why is DO not a variable for habitat?

21. (PHABSIM) Value of habitat is moderated by temperature. Useable area by temperature index (discounting factor). Hal will work with Paul. More applicable to rearing than spawning.
22. Acknowledge the use (or non-use) of statistical analysis. Paul will look into how to apply statistics to model predictions.
23. Could you use smolt-out migrant data? Discussion: Only had coho data. For consistency, did not use.
24. Study impacts for three species. Why not other species? Coastal cutthroat as an example (potential for listing).
    Discussion: Selection based on discussions with local experts. Limited data for coastal cutthroat. Also, results from study can be used to apply to other species based on the species habitat requirements.
25. Concern that SHIRAZ model doesn't consider loss of LWD.
26. Loss of spawning gravel and increase in fines. How does model predict increase in spawning?
    Discussion: % degradation built into model to try to account for this loss. Hal referred to a study done by Geoffry Petts – extensive work on habitat impacts from dams.
27. Where is the HEP work that was conducted by Anchor in the headwaters?
    Discussion: being prepared for the final report.