Nez Perce

TRIBAL EXECUTIVE COMMITTEE
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November 13, 2018

**Sent via email to: comments-northern-nezperce-moose-creek @fs.fed.us**
**Also submitted online at https://www.fs.usda.gov/project/?project=38021**

Ms. Zoanne Anderson, NEPA Planner
Nez Perce-Clearwater National Forests
903 3rd Street
Kamiah, ID 83536

***Re:*** ***Nez Perce Tribe's Comments on Clear Creek Integrated Restoration Project Draft Supplemental Environmental Impact Statement***

Dear Ms. Anderson:

Thank you for the opportunity to provide comments on the Clear Creek Integrated Restoration Project ("Project") Draft Supplemental Environmental Impact Statement ("DSEIS"). The Nez Perce Tribe ("Tribe") has held staff-to-staff coordination meetings with the Nez Perce-Clearwater National Forests ("Forest") since 2012 regarding this Project. The proposed Project has evolved since the Tribe's objection April 10, 2015, and subsequent litigation in 2016. These comments reflect the current policy reviews and technical concerns of the Tribe.

The Forest proposes, through Alternative C, modified, to manage forest vegetation to restore natural disturbance patterns, improve long-term resistance and resilience at the landscape level, reduce fuels, improve watershed conditions, improve elk habitat effectiveness, improve habitat for early seral species, and maintain habitat structure, function, and diversity. Timber outputs from Alternative C, modified would be used to offset treatment costs, support the economic structure of local communities, and provide for regional and national needs.

Under Alternative C, modified, Alternative C in the 2015 Clear Creek Integrated Restoration Final Environmental Impact Statement ("FEIS") has been modified to include 3,577 acres of regeneration harvest, site preparation, and reforestation (579 fewer acres than the original Alternative C), 288 acres of improvement harvest (43 fewer acres than the original Alternative C), 3,937 acres of commercial thinning (283 fewer acres than the original Alternative C), 8.7 miles of temporary road construction on existing templates, and 27.6 miles of new temporary road construction.

The Tribe appreciates the modifications the Forest has made to Alternative C, but does not believe that Alternative C, modified adequately protects watershed conditions and wildlife habitat security. The Tribe, therefore, urges the Responsible Official to apply the modifications it made to Alternative C to the more protective Alternative D. This would further reduce the Project's impacts on the degraded watershed and wildlife habitat conditions present in the Clear Creek watershed.

As the Forest is aware, this Project is located entirely within the Tribe's aboriginal territory and is subject to the rights the Tribe reserved, and the United States secured, in its Treaty of 1855.[1] The Project is also located within the Tribe's area of exclusive use and occupancy, as adjudicated by the Indian Claims Commission,[2] and encompasses areas of cultural and spiritual significance to the Tribe.

As the Tribe has made clear through its ongoing engagement in, and litigation regarding, this Project, the Tribe considers the protection of its Treaty-reserved rights and resources in the Clear Creek watershed to be a paramount obligation of the Forest when implementing this Project. The Forest has a trust responsibility to ensure that its actions, including implementation of this Project, are fully consistent with the Tribe's Treaty, executive orders, departmental regulations, and other federal laws implicating the United States' unique relationship with the Tribe.

Thank you again for the opportunity to comment on the Project. Tribal staff is happy to discuss these comments with Forest staff. You are welcome to contact Amanda Rogerson, Nez Perce Tribe Staff Attorney, at (208) 843-7355 or amandar@nezperce.org, to schedule a staff-to-staff meeting or with any questions or concerns.

Sincerely,

Shannon F. Wheeler
Chairman

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[1] Treaty with the Nez Perces, June 11, 1855, 12 Stat. 957.

[2] *Nez Perce Tribe v. United States*, Docket #175, 18 Ind. Cl. Comm. 1.

## NEZ PERCE TRIBE'S COMMENTS ON CLEAR CREEK INTEGRATED RESTORATION DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
**November 13, 2018**

## I. GENERAL COMMENTS

### a. The Nez Perce Tribe's Interest in the Clear Creek Integrated Restoration Project

Treaty tribes, such as the Nez Perce, have been recognized as managers of their treaty-reserved resources.[3] As manager, the Tribe has devoted substantial time, effort, and resources to the recovery and co-management of Treaty-reserved resources within its treaty territory.

As fiduciary, the United States and all its agencies owe a trust duty to federally recognized tribes to protect their treaty-reserved resources.[4] This trust relationship has been described as "one of the primary cornerstones of Indian law,"[5] and has been compared to the relationship existing under the common law of trusts, with the United States as trustee, the tribes as beneficiaries, and the property and natural resources managed by the United States as the trust corpus.[6]

All executive agencies of the United States are subject to the federal trust responsibility to recognize and uphold treaty-reserved rights. Executive agencies must also protect the habitats and resources on which those rights rest, since the right to take fish and other resources reserved by the Tribe presumes the continued existence of the biological conditions necessary to support the Treaty-reserved resources.[7]

Forest Service Manual ("FSM") 1563.8b specifically states that the Forest Service "shall administer lands subject to off-reservation treaty rights in a manner that protects Indian tribes' rights and interests in the resources reserved under treaty." FSM 1563.03 further directs the Forest Service, among other responsibilities, to "[i]mplement Forest Service programs and activities consistent with and respecting Indian treaty and other reserved rights and fulfilling the Federal Government's legally mandated trust responsibilities with Indian Tribes."

### b. Reference to Designated Routes and Areas for Motor Vehicle Use ("DRAMVU")

The DSEIS references the Designated Routes and Areas for Motor Vehicle Use ("DRAMVU") as though the record of decision for DRAMVU has been signed and finalized, which is not the case.[8] The Forest needs to clarify whether it has used analysis for, and impending decisions in, DRAMVU in its development of Alternative C, modified. If the unissued analysis and decisions

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[3] *United States v. Washington*, 384 F. Supp. 312, 339-40, 403 (W.D. Wash. 1974).

[4] *See United States v. Cherokee Nation of Oklahoma*, 480 U.S. 700, 707 (1987); *United States v. Mitchell*, 463 U.S. 206, 225 (1983); *Seminole Nation v. United States*, 316 U.S. 286, 296-97 (1942).

[5] Felix Cohen, Handbook of Federal Indian Law 221 (1982).

[6] *See, e.g., Mitchell*, 463 U.S. at 225.

[7] *See Kittitas Reclamation District v. Sunnyside Valley Irrigation District*, 763 F.2d 1032 (9th Cir. 1985), *cert. denied, Sunnyside Valley Irrigation District v. United States*, 474 U.S. 1032 (1985).

[8] Clear Creek Integrated Restoration DSEIS at p. 30, 136, 145, 146, 151, 194.

in DRAMVU have been used by the Forest in this Project's analysis, the Forest must make all relevant DRAMVU documents and materials available for public inspection, in accordance with 40 C.F.R. § 1502.21:

> Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference.[9]

## II. WILDLIFE COMMENTS

Despite years of close technical collaboration, the Tribe remains deeply concerned that the Forest has failed to take several important steps to ensure this Project is designed in a manner protective of elk, a vital Treaty-reserved resource. While the DSEIS contains important updates to the Elk Habitat Effectiveness ("EHE") and Elk Vulnerability ("EV") analyses, and the Tribe appreciates the Forest's effort to fully utilize the guidance provided in Servheen et al. 1997 ("Servheen"), the continued lack of a robust, science-based analysis of the Project and discretionary commitments by the Forest to retain security cover along motorized routes is troubling to the Tribe. The Forest needs to take a hard look at the environmental consequences of proposed actions. Taking a hard look includes an even-handed and thorough evaluation of best available science regardless of Forest Plan direction.

The Tribe has worked with the Forest to ensure that the Project's design appropriately protects elk in concert with its purpose and need. Specifically, the Tribe has consistently requested that:

- Project analyses incorporate, at a minimum, the analytical framework described in Servheen et al. 1997, including EHE and EV models;
- Project analyses incorporate the best available scientific information regarding motorized disturbance, forage conditions, livestock grazing, and other factors;
- Monitoring data relevant to the Project area, specific to both elk and other wildlife species, be identified and incorporated within Project analyses; and
- Project design criteria incorporate the results of the aforementioned analyses to minimize deleterious impacts to elk.

As communicated previously to Forest staff, the Tribe remains concerned that road densities within the Game Management Unit have been undercounted in the EV calculation. However, given the inherent limitations of the EV model itself, the Tribe is satisfied with the results from this and the EHE analyses and believe the overall analysis has been substantially improved in this area.

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[9] 40 C.F.R. § 1502.21.

The DSEIS summarizes a number of monitoring reports and research developed by partner organizations and researchers. This information supplements existing analyses contained in the FEIS and provides important context for the proposed actions. The Tribe appreciates the Forest's effort to gather and synthesize this information across several Sensitive and Management Indicator Species. Unfortunately, the Forest has long relied on Idaho Department of Fish and Game, non-governmental organizations, and other partners to monitor wildlife populations as required by the Forest Plan. The scale at which these entities gather such data appears to severely limit the utility of that information in the evaluation of project-level impacts, even at the relatively large spatial scale of the Project. As a result, the FEIS and DSEIS rely on dated survey efforts, often at inappropriately coarse or distant spatial scales, for many species of concern, including elk. A more robust and effective monitoring framework is needed at the Forest Plan level to ensure NEPA analyses such as this are sufficiently detailed.

The DSEIS now references a number of recent scientific studies on elk, yet little of the information or recommendations contained therein are used to evaluate the Project itself. Descriptions of how motorized routes impact elk generally provide little value when this information is not used to interpret existing conditions and evaluate proposed treatments within the Project area. For example, Appendix F Section 3 contains numerous maps showing buffers of various sizes surrounding open roads. How was this information used in the analysis? The Project Biologist has concluded that a one-year-old, peer-reviewed research study[10] developed on the Lolo, Bitterroot, Beaverhead-Deerlodge, and Custer-Gallatin National Forests is not relevant to the Project area, while a 27-year-old, unreviewed symposium article[11] developed on the Lolo, Bitterroot, and Beaverhead-Deerlodge National Forests is relevant. What criteria were used to reach this and other determinations regarding literature to incorporate? How will the proposed silvicultural treatments impact elk in different areas depending on habitat type, which the Tribe expects given the broad range of ecological conditions present in the Project area? The Forest has been dismissive of recent elk studies recommending greater resource protection while embracing older studies recommending less resource protection, which has led to the perception that the Forest's analyses provide an incomplete view of the Project's impacts. When the Forest chooses to dismiss new scientific information that highlights resource concerns, it needs to provide site-specific data that demonstrates those concerns are not relevant to the Project area. The Tribe has repeatedly requested a robust, science-based evaluation of this Project over the past several years and is disappointed it is not yet complete.

As noted in the DSEIS, Tribal Wildlife staff met with Forest staff on May 11, 2018, to review the Project's potential impacts to elk on a unit-by-unit basis. During that meeting, Tribal staff identified a number of prescription units where motorized disturbance may be particularly high and recommended changes to the Project's design, for example through the retention of screening cover adjacent to open roads and changes in silvicultural prescriptions. However, Tribal staff also made clear that such recommendations were preliminary and should not preclude a robust, science-based analysis of disturbance risk and Project design modifications. Unfortunately, that science-based analysis does not appear in the DSEIS. In addition, the Forest has chosen to incorporate the Tribe's preliminary recommendations through discretionary actions

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[10] Ranglack et al. 2017.

[11] Hillis et al. 1991.

during Project implementation, without analysis and with little opportunity for review.[12] Furthermore, the list of units identified in the DSEIS omits reference to units 155, 160, 328, and 329, which were highlighted by Tribal staff at the unit-by-unit meeting, but does include units 205, 214, and 336, which were not discussed at the unit-by-unit meeting.

## III. WATERSHED COMMENTS

The Clear Creek watershed is still recovering from effects of past road building and timber harvest. The Tribe, therefore, has concerns about sediment delivery to streams that could decrease fisheries habitat, affect the downstream Kooskia Hatchery, and negatively impact watershed conditions. Roads and harvest would be the biggest contributors of sediment from this Project.

The most harvest occurs under Alternative C, followed by Alternative B, and then D.[13] Alternative D has the least amount of total regeneration harvest (2,178 acres in Alternative D versus 3,577 in modified Alternative C) and the least number of temporary road miles (8.8 miles in Alternative D versus 27.6 miles in Alternative B and modified Alternative C) making it a logical recommendation from a natural resource protection angle. As an example, Hoodoo Creek specifically would have 22% regeneration harvest of its prescription watershed in Alternative C, which equates to a 10% increase in average water yield.[14] The Tribe urges the Responsible Official to apply the modifications it made to Alternative C to the more protective Alternative D and select Alternative D, modified. This would further reduce the Project's impacts on the degraded watershed and wildlife habitat conditions present in the Clear Creek watershed.

Discrepancies abound in the DSEIS making changes and improvements difficult to track. For example, Table 35[15] in the DSEIS has total road recondition and reconstruction miles that exceed the road miles elsewhere in the document and in the various road erosion modeling completed for Clear Creek. Additionally, these totals do not appear to be supported by the Watershed Improvement Tracking ("WIT") database or other resources provided to the Tribe. Please update tables with consistent and accurate accounting of improvements and send the Tribe an updated database of these improvements.

The Tribe understands that this proposed timber Project could be broken up into seven different timber sales and harvested over a seven-year period from 2019-2023.[16] The analysis appears to be based on assumptions that all activities would occur in one year. Given that regrowth takes time and temporary roads could remain on the landscape for years before obliteration, what additional effects on sediment and temperature could be expected? Please attempt to incorporate these delayed effects into the analysis.

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[12] Clear Creek Integrated Restoration DSEIS at p. 28.

[13] Clear Creek Integrated Restoration DSEIS at p. 97.

[14] Clear Creek Integrated Restoration DSEIS at p.101, Table 21.

[15] Clear Creek Integrated Restoration DSEIS at p. 268.

[16] Clear Creek Integrated Restoration DSEIS at p. 108, Figure 19.

**a. Sediment Delivery**

The Project's sediment production is shown in the following table with NEZSED modeled results.[17] Browns Springs and Clear Creek prescription watersheds exceed Forest Plan sediment yield guidelines for Alternative C. These model results are useful for comparing alternatives and demonstrate why the Tribe prefers Alternative D. The big 10% difference in Hoodoo Creek sediment yield between alternatives is important because that hydrologic unit code ("HUC") 12 watershed has the highest riparian habitat conservation area ("RHCA") road density, high watershed road density, and highest percent increase in Equivalent Clearcut Area ("ECA") proposed.

| Prescription Watershed | 1987 Plan Sediment Yield Guideline (% over Base) | Percent Sediment Yield Increased Over Base in Alt. C | Percent Sediment Yield Increased Over Base in Alt. D |
|---|---|---|---|
| Browns Springs Cr. | 45 | 50 | 47 |
| Solo Creek | 45 | 45 | 41 |
| Clear Creek | 30 | 31 | 28 |
| Hoodoo Creek | 60 | 53 | 43 |
| Middle Fork Clear Cr | 30 | 28 | 24 |

Results from NEZSED indicate sediment yield increases at the Forest boundary of 24% (Alternative C) as a result of Project activities. The Forest Plan objective is 30%.[18] Alternative C would cause an "increase over base" of 13%.[19]

The Tribe requests that the Forest rerun the NEZSED model for both Alternative C and D, with modifications shown in Table 3. The DSEIS water yield and sediment yield analyses are based on the original acreages as proposed in the FEIS (2015) and do not include the reduced harvest acres proposed in Alternative C, modified in the 2018 SDEIS. It is assumed that with fewer harvest acres, the effects would be less than that described in the SDEIS analysis.[20]

**(1) Sediment from Harvest Units**

The Tribe recommended dropping 53 entire units (3/7/2018),[21] a subset of which the Forest is proposing to drop in Alternative C, modified. The Tribe would like to see a more detailed

[17] Clear Creek Integrated Restoration DSEIS at p. 33.

[18] Clear Creek Integrated Restoration DSEIS at p. 226.

[19] 2017 Elliot and Miller. WEPP report at p. 9.

[20] Clear Creek Integrated Restoration DSEIS at p. 98.

[21] The Tribe constructed a risk matrix which included GeoWEPP, WEPP Road, FISHSED, watershed condition upward trend information, landslide prone, road density (of all known roads, system and non-system), and ECA. The "red flag" thresholds are as follows:

1. GeoWEPP harvest units whose modeled sediment delivery rate per acre is greater than the average of the calculated units (0.5229 tons per acre per year).
2. WEPP Road sediment outputs by segments above 0.1 ton/segment/year.
3. ECA predicted post-harvest ECA greater than 14%.
4. Upward trend watershed condition.
5. Logging units with polygon shapes that intersect any of the landslide prone polygons.

accounting of which acres within units the Forest is proposing to drop and why some high risk units/acres pointed out by both Forest and Tribal staff appear to be unchanged. Please provide the Tribe with updated GIS information and maps for Alternative C and for Alternative D, with the modifications the Forest is proposing and with the Forest's rationale for leaving units/acres that the Tribe recommended dropping in the Project.

Additionally, Table 3 has units missing from the previous DSEIS, and other units have been added.[22] Since these units were not considered during the unit-by-unit analysis, the Tribe has no idea what risk these units pose. Please account for added and dropped units in a table and propose how added units can be evaluated similar to the previous unit-by-unit process.

The Forest states that it may also drop additional acres after field verification; this means that the final action is not provided in the DSEIS. "To be determined" is unacceptable because it prevents the Forest, Tribe, and public from analyzing and understanding the action and its environmental consequences. The Tribe cannot comment on actions that the Forest has not disclosed. Please provide the actual acres that will be included in the Project and share the GIS layer of the new harvest unit boundaries for Alternative C and D,with all the Forest's proposed modifications.

**(2) Sediment from Roads**

Short-term effects of sediment delivery from temporary roads is unacceptable to the Tribe. Approximately 36 miles of temporary roads would be constructed to access harvest units for Alternatives B and C, 8.7 miles of which occur on existing templates. Alternative D proposes 17.5 miles of temporary roads, including 8.7 miles located on existing templates. Temporary roads generate the most erosion when they are first constructed.[23]

The Forest should conduct road surveys (such as GRAIP) in order to perform a robust analysis of roads within the Project area. The Forest needs to analyze all the system and non-system roads in the Project area and determine the minimum road system required.

The NEZSED model estimated 68.3 tons/year of erosion from existing roads. Fifty-two percent of that amount comes from these five roads in the Project area: 286 (northern perimeter), 650 (Hoodoo), 1106 (Hoodoo), 1855 (S. Fk. Clear Creek), and 1114 (Pine Knob/Browns Springs) account for 58 miles of road in the Project area and are some of the most traveled roads.[24] What are the additional road segments identified for treatment that are likely causing sedimentation?[25] Given the remaining 48% of the 68.3 tons/year of sediment is spread across a much more dispersed set of roads, how is the Forest proposing to address these chronic delivery problems?

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6. Road density greater than 3 mi/mi$^2$ or road density greater than 3 miles of road/mi$^2$ within each logging unit. The road miles are a collage layer compiled by the Tribe of all currently known roads.
7. FISHSED predicts a rating below Forest Plan Objective.

[22] *Id.*

[23] Clear Creek Integrated Restoration DSEIS at p. 112.

[24] Clear Creek Integrated Restoration DSEIS at p. 14 & 15, Table 2.

[25] Clear Creek Integrated Restoration DSEIS at p. 46.

The WEPP Road model results may not be of great value if the input is only from haul routes. Table 5 and 6 in the 2018 Road Erosion report[26] by Elliot et al. shows that the average annual amount of sediment entering the stream system was 809 tons from a total of 166 miles of road.[27] Figure 3 in that report show the difference being the sediment leaving the road and entering the stream with red lines indicating the buffer is eroding. Figure 4 in that report show the difference being the sediment leaving the road and sediment intersecting concentrated flow with red lines indicating the buffer may be eroding. Table 2 reports an overall road density of 2.7 mi/mi$^2$. Total sediment leaving the road surface is 4.59 tons/mile and the total sediment delivered to the stream is 306 tons. This equates to a road sediment delivery of 8 tons per mile$^2$ per watershed area.[28] Given that NEZSED and WEPP report different quantities of sediment, the WEPP model should be re-run using the road layer utilized in the April 2018 NEZSED run, including all 256 miles of roads. Based on the analysis completed to date, how do decommissioning and road improvements compare to predicted sediment outputs?

Table 35 and the NEZSED model indicate high road mileage in the Project area at 263 and 256 miles respectively.[29] The Forest's Net Maps WEPP Road has 189 miles. None of the Forest's calculated road miles appear to include the 29 miles of road in the Hoodoo Prescription watershed that the Tribe asked the Forest to add back in April.

Sediment is likely one of the contributing limiting factors for fish production in the Hoodoo Creek prescription watershed. Cobble embeddedness was measured at 71% in 2016.[30] Instream sediment in the Hoodoo prescription watershed is likely associated with roads.[31]

**(3) Road Decommissioning**

More non-system road decommissioning is suggested to improve watershed condition especially in the Pine Knob, Browns Spring, and Hoodoo creeks prescription watersheds. These watershed's road densities are all over 3 mi/mi$^2$, denoting low habitat condition[32] and could be improved. The Tribe has recommended decommissioning more non-system roads and skid trails within the harvest units with high road densities and a high risk of delivering sediment.

**b. Upward Trend**

The Tribe appreciates the effort put into updating the Upward Trend section. The Tribe also appreciates the great lengths the Forest went to for making the rationale behind the Upward Trend as transparent as possible. However, due to the number discrepancies between different sections within the DSEIS, different road miles used in various models as part of the analysis, and inability to track improvements in the documents provided, it difficult to understand the final

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[26] 2018 Elliot et al. Road Erosion Report.

[27] 2017 Elliot and Miller. WEPP report at p. 8 & 10.

[28] 2018 Elliot et al. Results of Erosion Analysis of the Clear Creek Road Network Table 2 at p. 5.

[29] Clear Creek Integrated Restoration DSEIS at p. 220.

[30] Clear Creek Integrated Restoration DSEIS at p. 48.

[31] Clear Creek Integrated Restoration DSEIS at p. 49.

[32] NOAA 1998.

conclusions. The Tribe also continues to believe that an upward trend must be show in watershed condition data.

The DSEIS discusses long term trends in sediment and includes figures 2 and 3 from Pete King and Dead Man Creeks.[33] The declining fines in these two watersheds are encouraging, but it's difficult from the description provided to understand exactly how these relate to Hoodoo Creek or other Prescription Watersheds. How do road densities compare between these example watersheds and Hoodoo? Does the Forest have similar data for Clear Creek for comparison? How does the history of road decommissioning in Pete King Creek compare to Hoodoo? In summary, how have juvenile steelhead densities responded to these improvements in fine sediment of the example watersheds?

Discrepancies abound in tables from the Upward Trend of the DSEIS making changes and improvements difficult to track. For example, Table 35[34] in the DSEIS has total road recondition and reconstruction miles that exceed the road miles elsewhere in the document and in the various road erosion modeling completed for Clear Creek. Additionally, these totals do not appear to be supported by the Watershed Improvement Tracking database or other resources provided to the Tribe. Another example, specifically for the the Hoodoo Prescription watershed activities lists,[35] a total of 33.4 miles of road reconstruction and recondition and 22 culverts to be removed. These totals do not appear to be supported by the WIT database or other resources provided to the Tribe. Please update tables with consistent and accurate accounting of improvements and send the Tribe an updated database of these improvements. The discrepancies also appear to extend to other Prescription watersheds and would likely result in reduction in short-term and long-term improvement. Please update these tables with improvements supported by the WIT or include a table of future projects. If the discrepancies result in a net loss of improvement, please update the Upward Trend to account for the decreased improvement.

Figure 24 of the DSEIS[36] has been updated since the previous draft and now shows reduced long-term sediment at the Forest Boundary for Alternative C. Does Figure 24 reflect the modifications made to Alternative C? The Tribe is excited about the possibility of this outcome, but would like to better understand the Project changes that led to it. Additionally, please explain why only Alternative C appears to be updated, and why Alternative B and D have such different results despite having fewer harvest acres.

Additionally, the road conditioning or reconstruction do not appear to directly correspond with the Rocky Mountain Research Station 2018 WEPP Road results.[37] This means that high sediment-yielding roads still exist in the Project area and some are haul roads; therefore, the Tribe doubts about the accuracy of the upward trend analysis conclusions.

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33 Clear Creek Integrated Restoration DSEIS at p. 51.

34 Clear Creek Integrated Restoration DSEIS at p. 268.

35 *Id.*

36 Clear Creek Integrated Restoration DSEIS at p. 120, Figure 24.

37 2018 Elliot et al. Results of Erosion Analysis of the Clear Creek Road Network at p. 5, Table 2.

Clear Creek, Middle Fork Clear Creek, Hoodoo, and South Fork Clear Creek prescription watersheds did not currently meet their watershed objective.[38] Two HUC 12 (upper Clear Creek and Lower Clear Creek) out of three subwatersheds would change from a good to moderate watershed condition. How does this equate to an improving trend?

The upward trend tables in Appendix J do not appear to be supported by the data in the WIT database or the culvert files. Table 35 of the DSEIS indicates that the miles of road decommissioning, road recondition, and road reconstruction are not accounted for in the WIT. Also the road reconstruction and recondition equal 263 miles, which is more road miles than in the Clear Creek Project area watershed (186 miles). This results in an overestimation of the upward trend indicators and ratings. Data should be verified and updated in the FSEIS so that upward trend can be re-calculated with values that match each other when cross referenced.

Appendix J shows the trending analysis process of quantifying the improving watershed habitat condition has been reworked since the 2016 FEIS effort. The Project area has a high density of roads at 3.03 $mi/mi^2$ despite a large roadless area in the South Fork Clear Creek drainage. Many of the 207 miles of roads are closed.

Hoodoo and Clear Creek have the highest cobble embeddedness ("CE") based on the 2016 measurements, NEZSED predicted a 7% increase in CE and decreases in summer/winter juvenile steelhead fish rearing capacity of 7% and 14%, respectively.[39] Unfortunately, embeddedness conditions are still considered unfavorable for salmon and trout and appear to be recovering slowly or not at all[40] despite road improvements and undisturbed ground left next to streams.

Table 35[41] makes it unclear which Aquatic Organism Passage and culverts have been replaced or not and when. These restoration activities, albeit from other NEPA projects, are not being tracked, and thus not necessarily accounted for. This brings into question the implementation of other projects.

The Tribe appreciates the recent road decommissioning, culvert, and cross drain replacements in the Hoodoo Creek Prescription watershed, but does not think they are adequate to warrant an upward trend when 2016 CE was measured at 71%. Road-related slides on road 650 are still occurring putting sediment into streams and portions of 6 ditches are still draining into live water. How does these erosion events factor into an improving watershed condition trend?

Given the FISHSED results discussed in Table 9[42] indicate increases from Existing Condition of over 10% for Browns Springs, Solo, and Hoodoo Prescription Watersheds. How is the Forest able to justify an Upward Trend? The Forest should update the NEZSED and subsequent FISHSED model with sediment totals produced from WEPP Road.

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[38] See Memo from the Tribe dated March 2018.

[39] Clear Creek Integrated Restoration DSEIS at p. 59.

[40] Clear Creek Integrated Restoration DSEIS at p. 43.

[41] Clear Creek Integrated Restoration DSEIS at p. 220.

[42] Clear Creek Integrated Restoration DSEIS at p. 55, Table 9.

**c. Water Quality**

ECA and changes in sediment yield values are the primary indicators for effects on water quality. Modeled ECAs in the Hoodoo Creek prescription watershed would increase to 26% under Alternative C, a moderate condition class rating based on the localized 1998 NOAA matrix.[43] This is unacceptable as it exceeds the desired threshold of 20%.

Modeled sediment yield in Clear Creek at the Forest boundary would be 23%, 24%, and 21% for Alternatives B, C, and D, respectively, which is below the Forest Plan objective of 30%.[44] It was not calculated for modified Alternative C.

As estimated with the NEZSED model version 2016, five of the eight prescription watersheds would remain below the sediment yield guidelines, under all alternatives. Sediment yield percent over base exceeded the Forest Plan Appendix A guidelines for all action alternatives for the Browns Spring Creek prescription watershed and Alternative C for the Clear Creek and Solo Creek prescription watersheds. The highest increase in sediment yield was found in Alternative C, followed by Alternative B, then D.[45]

Compliance with Nez Perce National Forest Plan R1/R4 sediment yield and R1 water yield guidelines is through the effects analysis in the DSEIS. Compliance with Nez Perce National Forest Plan fish and water quality objectives is through the project design criteria and Best Management Practices.[46]

**d. Fisheries**

Excessive sediment is devastating to fisheries, specifically ESA-listed Snake River Steelhead. As discussed during the multiple meetings with the Forest, roads are one of the most significant sources of sediment. The Forest has updated the NEZSED model and re-run it to include additional roads. These updates are much appreciated and improved the reliability of the results. Upon reviewing the updated NEZSED runs dated April 20, 2018, it appears a total of 256 miles were included. This total number of miles differs from the miles discussed elsewhere in the document and in other sediment models (i.e. WEPP Road by Elliot et al 2018 (166 miles) and NETMAPS WEPP Road (189 miles)). None of these miles appear to include the 29 miles of non-system road provided by the Tribe. Given the the higher sediment delivery estimates as estimated by Elliot et al. 2018 on 166 miles, it would be good to know how much this total would increase with the additional 90 miles. Additionally, given the higher sediment delivery estimates produced in the WEPP Road model, how these would the increased sediment affect fisheries habitat as predicted in the FISHSED model? The Forest should re-run the WEPP Road model to include the 256 miles included in the April 20, 2018, NEZSED. These updated sediment totals could be supplemented in the model to produce an updated percent over base.

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[43] 1998 NOAA Matrix of Pathway.

[44] Clear Creek Integrated Restoration DSEIS at p. 57.

[45] Clear Creek Integrated Restoration DSEIS at p. 11.

[46] Clear Creek Integrated Restoration DSEIS at p. 85, Table 17.

FISHSED results discussed in Table 9[47] indicate increases from Existing Condition of over 10% for Browns Springs, Solo, and Hoodoo Prescription Watersheds. The Forest should update the NEZSED and subsequent FISHSED model with sediment totals produced from WEPP Road as indicated above.

Cobble embeddedness and winter rearing capacity in Clear Creek exceeds the level of 10% where changes in habitat quality could occur[48] under Alternatives B, C, and C Modified.[49] Brown Springs, Solo, and Hoodoo Creeks prescription watershed exceed a 10% change for winter rearing under all alternatives.[50]

### e. Stream Temperature

As mentioned in our prior DEIS comments (5/31/2013) and FEIS objection (4/10/2015), surface water temperature and flow in Clear Creek are vitally important to the native and hatchery fish. The Tribe understands warmer stream water temperatures are a challenge to further management activities.

The DSEIS indicates the temperature of Clear Creek at Forest Boundary reached 20 degrees Celsius. Region 10 Environmental Protection Agency ("EPA") Guidelines[51] recommend 7-day average daily maximum temperatures below 18 degrees Celsius. Additionally, increasing temperatures at the Forest boundary are contributing to even higher temperatures at the mouth of Clear Creek. If lower Clear Creek has temperatures that become a thermal barrier to migrating salmonids, how will this affect the long-term viability of the population? Are any portions of mainstem Clear, South Fork Clear, Pine Knob, or Brown Springs Creeks considered core juvenile rearing or adult holding water? Please make that determination and address EPA temperature guidelines.

The DSEIS indicates temperatures should remain within optimum range for steelhead and salmon, despite the lack of recent temperature data for South Fork Clear and Kay Creeks. The DSEIS cites the NorWeST Climate Shield model developed by Rocky Mountain Research Station and states temperatures will remain in optimum ranges out to 2080. What temperature data was utilized for Kay and South Fork Clear Creeks? Has the temperature data in Table 7 of the DSEIS been provided to Rocky Mountain Research Station for inclusion in the Climate Shield Model? Does the Climate Shield model include changes associated with the Project?

The DSEIS does not appear to analyze Cumulative Effects of temperature which include changes in ECA and harvest in smaller streams which have reduced RHCA buffers. While the Tribe agrees the retention of PACFISH buffers will help maintain stream temperatures, the DSEIS does not seem to adequately assess best available science in regards to impacts on temperature as it relates to hydrologic processes within smaller headwater streams.

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[47] Clear Creek Integrated Restoration DSEIS at p. 55-56, Table 9.

[48] Stowell et al. 1983.

[49] Clear Creek Integrated Restoration DSEIS at p. 226.

[50] Clear Creek Integrated Restoration DSEIS page 55, Table 9.

[51] EPA 2003 at p. 25.

### f. Equivalent Clearcut Area ("ECA")

ECA analysis is a tool used to correlate the relationship between water yield and the vegetative condition or the extent of forest canopy openings from fire, harvest, and roads. Harvest, temporary road construction, prescribed fire, and road-related activities have the potential to increase erosion production and sediment delivery into streams.[52] Alternative D has the least amount of regeneration and new temporary road construction, and, therefore, the least potential for erosion and sediment delivery into Clear Creek's degrade watershed.

When the 5-13% increases are added to the existing ECAs at the HUC 12 subwatershed level, they produce ECA estimates that predict what watershed conditions would be like after the Project. These ECA estimates range from 9% to 15% for Alternative B, 10% to 15% for Alternative C, and 8% to 14% for Alternative D.[53] The highest increases in ECA occur under Alternative C, followed by Alternative B, and then D. Two HUC 12 (upper Clear Creek and Lower Clear Creek) out of three subwatersheds would change from a good to moderate watershed condition.[54] The Tribe does not want to see this degradation in two-thirds of the watershed.

Final ECAs for the Forest Plan prescription watersheds range from 3% to 20% for Alternative B, 3% to 26% for Alternative C, and from 2% to 19% for Alternative D. The highest increases in ECA occur under Alternative C, followed by Alternative B, and then D.[55] Estimated final ECAs were highest in the Hoodoo (26%), Browns Springs (19%), and Solo Creek (19%) watersheds. Also concerning is the amount of regeneration harvest and landslide prone areas in the 1-3 order streams.

There are some first and second order stream drainages within the Project area that have 50% or more proposed regeneration harvest treatment within their drainages. These regeneration treatment areas include portions of Units 103 and 109 (Clear Creek drainage); 128, 229, and 234 (West Fork Clear Creek drainage); 139, 141, and 226 (South Fork Clear Creek drainage) and 145 (Kay Creek drainage).[56]

All alternatives remain in the good to moderate Matrix categories (<20%) with the exception of Hoodoo Creek under Alternative C (26%)[57] based on the NOAA matrix (1998). This exceeds the desired threshold of 20% where deleterious effects are warned. However, the DSEIS states no channel alterations as a result of increased water yield are expected.

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[52] Clear Creek Integrated Restoration DSEIS at p. 86.

[53] Clear Creek Integrated Restoration DSEIS at p. 99.

[54] Clear Creek Integrated Restoration DSEIS at p. 100.

[55] *Id.*

[56] Clear Creek Integrated Restoration DSEIS at p. 104.

[57] Clear Creek Integrated Restoration DSEIS at p. 226.

### g. Monitoring

The Tribe appreciates and agrees with the PACFISH RHCA buffer widths, numerous cross drain installations, temperature monitoring and the planned Geomorphic Road Analysis and Inventory Package ("GRAIP") surveys. Where the GRAIP surveys would be done? It would be more beneficial to do these surveys before the Project is implemented so as to mitigate the high sediment producing road segments before sale activity begins. What measures would be taken if sediment reaches live water because best management practices are not sufficient?

The DSEIS indicates stream temperature monitoring would only occur at Forest Boundary. Given temperature monitoring data for South Fork Clear and Kay creeks hasn't occurred in 17 and 19 years respectively, as stated in Table 7,[58] the Tribe suggests additional monitoring would be important to understand the current and future trends.

### h. Kooskia Hatchery

The Tribe remains concerned about sediment from the Project impacting the Kooskia National Fish Hatchery. The Tribe installed a real-time, continuous water quality monitor at the Kooskia Hatchery three years ago, which has been collecting data for temperature, turbidity, and other parameters. The Tribe was hopeful that it would be able to compare this data to a monitor at the Forest boundary in order to determine how much of the sediment coming off the Forest is entering the Hatchery. The Forest has an agreement in place for the United States Geological Survey to install a water gauge and collect comparable water quality data at the Forest boundary, but the Forest has yet to pick a site where the gauge can be installed. What is the Forest's timeline for picking a site and installing a gauge?

## IV. CONCLUSION

The Clear Creek 2015 FEIS and the 2018 DSEIS analyses determined that with predefined design features and mitigation measures, there would be no impacts to water quality, including temperature, sediment, and water yield, and therefore, no adverse impacts to water entering the hatchery or the hatchery's function.[59] However, Project activities are expected to have a negative effect on aquatic condition in the short-term (0–6 years following Project activities), based on sediment yields as modeled in NEZSED. Because of the potential for short-term sediment delivery, the Tribe recommends Alternative D along with modifications to units and roads as described in Alternative C, modified.

The expected short-term consequences of the Project on aquatic condition in the Clear Creek watershed is principally related to the surface erosion process and sediment conditions. The other short-term negative consequences of the Project on aquatic conditions were related to the hydrologic processes of runoff and infiltration from temporary road construction and harvest.

The Tribe appreciates the Forest's effort to fully utilize the guidance provided in Servheen et al. 1997 to evaluate the Project's impact on elk. While the DSEIS contains important updates to the

[58] Clear Creek Integrated Restoration DSEIS at p. 41, Table 7.

[59] Clear Creek Integrated Restoration DSEIS at p. 62.

EHE and EV analyses, the continued lack of a robust, science-based analysis of the Project and discretionary commitments by the Forest to retain security cover along motorized routes remains a fundamental concern of the Tribe.

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# Results of Erosion Analysis of the Clear Creek Road Network

## Nez Perce-Clearwater National Forest

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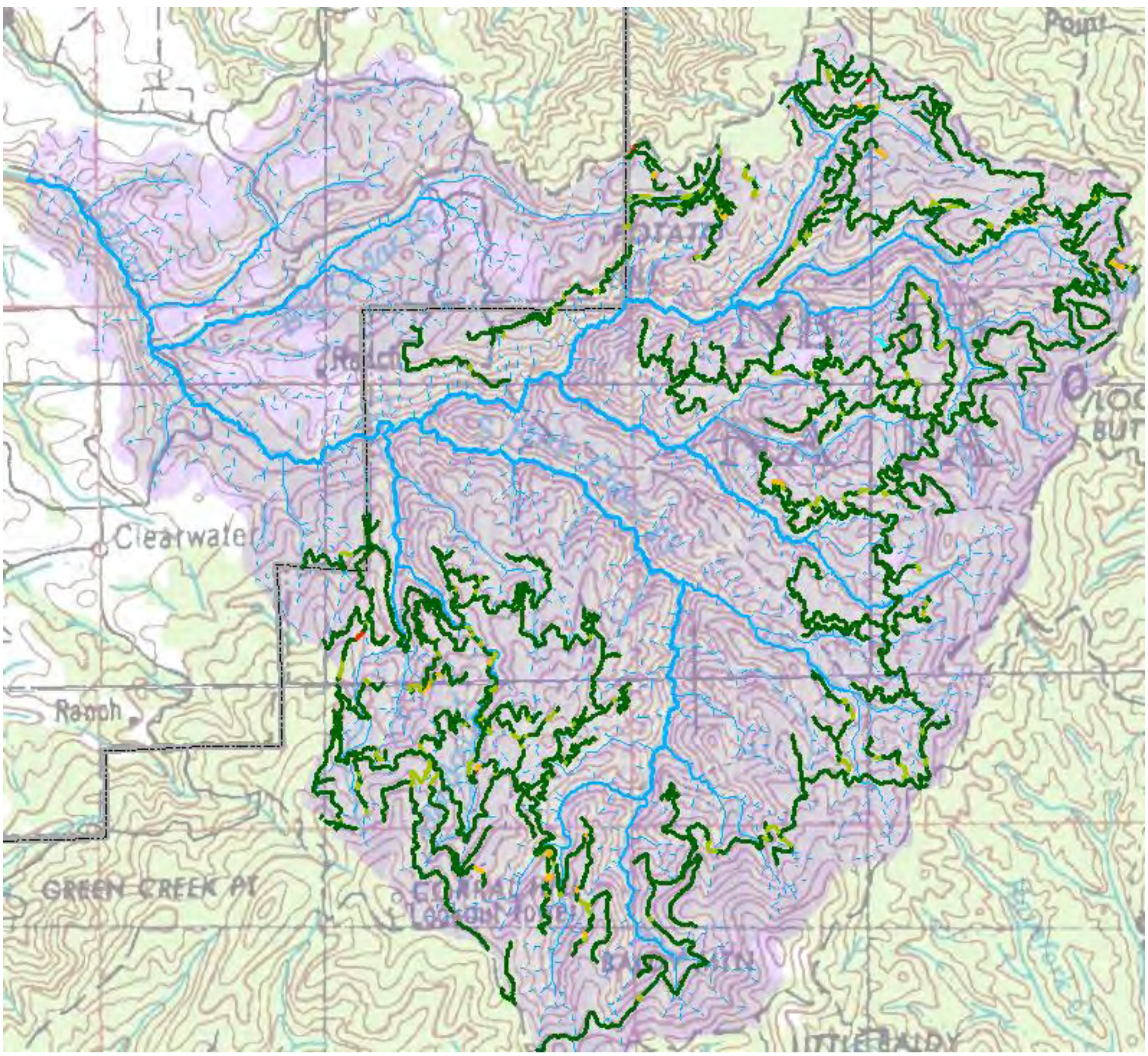
October 24, 2018



## Background

The Nez Perce-Clearwater National Forest (NPC) is planning a major restoration project to improve forest health and decrease the risk of wildfire in the 178 $km^2$ (68 $mi^2$) Clear Creek Watershed, southeast of Kooskia, ID (Moose Creek Ranger District, 2015). Elliot and Miller (2017) provided a detailed analysis estimating likely erosion from the proposed treatment areas, but at that time, did not have the tools to satisfactorily estimate sediment from the road network. Roads play a critical role in allowing access to the forest for the proposed treatments. However, the road network is the main source of sediment in most forested watersheds in the absence of wildfire (Elliot, 2013; Grace, 2017). Earlier estimates of likely road sediment generation were made with the NezSed cumulative effects model, which was not able to consider erosion from individual road segments. When Dr. Cao joined the research team, we were able to develop the methodology described below to complete a road network erosion analysis. This report is an example of applying this new methodology and evaluating its utility to support watershed analysis.

The Water Erosion Prediction Project (WEPP) was used to predict sediment delivery from each road segment. The modeling approach is based on the template used in the WEPP:Road interface that estimates erosion on the road surface and sometimes the fillslope, and then sediment delivery from runoff that is routed from the road surface, over the fillslope, and through a forested buffer before reaching live water (Figure 1[1]; Elliot, 2004). The WEPP model is a complex physically-based computer program that models the processes that cause erosion, like runoff, sediment detachment, sediment transport and sediment delivery. It is run on a daily time step, and estimates the sediment delivery for each runoff event for a period of years ranging from a single storm to 999 years of daily climate. The WEPP:Road online interface is designed to allow users to easily describe the topography and road management for the elements shown in Figure 1. Management options include road traffic level (none, low or high), road surface design (insloped to bare or vegetated ditch, and outsloped with our without ruts) and road surface treatment (native, graveled or paved). Because most managers need to know the

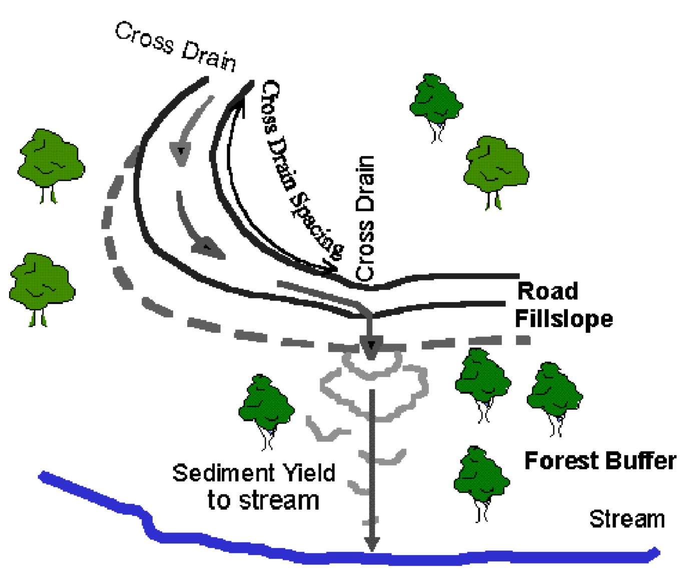



Figure 1. Template assumed for the WEPP:Road interface with sediment generated by the road surface routed over a fillslope and through a forest

[1] https://forest.moscowfsl.wsu.edu/fswepp/docs/wepproaddoc.html

Table 1. Crosswalk between the NPC road category and the segment attributes for WEPP:Road.

| | WEPP:Road Attributes | | | |
|---|---|---|---|---|
| NPC Road Category | Design | Surface | Traffic Level | Width (ft) |
| Asphalt and passenger cars | Inslope, Veg Ditch | Paved | High | 18 |
| High clearance vehicles | Rutted | Native | Low | 10 |
| Improved native material | Rutted | Native | Low | 12 |
| Crushed aggregate or gravel | Inslope, Veg Ditch | Gravel | High | 16 |
| Native material | Rutted | Native | Low | 12 |

delivery from hundreds or even thousands of road segments, a batch interface (WEPP:Road Batch[2]) was developed to receive topographic input values from spreadsheets or databases and estimate the sediment delivery from hundreds of road segments at a time.

Soil erodibility properties are highly variable with coefficients of variability (measured erodibility standard deviation divided by the erodibility mean) typically around 30 percent (Elliot et al., 1989). This means that at best, there is a 90 percent likelihood that an erosion value estimated by any model is within plus or minus 50 percent of the true value. No model can be any more accurate than the variability of the input data allows.

## Methods

A GIS layer containing the road network in the watershed was provided by the NPC. The NPC road network data had five categories of road use (Table 1). Each category was linked to road attributes required by the WEPP:Road interface. A cross walk spread sheet was developed with logistic functions to assign the WEPP:Road attributes to each NPC road segment category. For each NPC road category, we assigned a “design”, “surface”, “traffic level” and road width as required by the WEPP:Road Batch Interface ((Table 1; Elliot, 2004; Brooks et al., 2006).

With GIS, we followed the topographic analysis methodology developed in Cao and Elliot (2018) to subdivide the NPC road network into hydrologic segments, identify cross drain outlet locations and determine the overland flow path from the road outlet to the nearest likely cell with concentrated flow. The Cao and Elliot method then determined hydrologic segment lengths and gradients, and the length

[2] https://forest.moscowfsl.wsu.edu/cgi-bin/fswepp/wr/wepproadbat.pl

and steepness of each respective buffer. We assumed a maximum distance between cross drains to be 100 m (305 ft).

In ArcMap 10.3, a 10-m DEM was used to generate the hydrologic segment topographic details that were merged with WEPP:Road attributes in a spreadsheet, with one row for each hydrologic segment. From the merged data, columns in the spreadsheet were added to exactly match the WEPP:Road Batch input table. From this spreadsheet table approximately 800 road segment rows were then copied and pasted into the WEPP:Road Batch online interface. We assumed a silt loam soil category and used weather statistics from the nearby Fenn Ranger Station, located 13 km northeast of the watershed to generate a stochastic weather file. Because of timeout limitations with the internet browser when running large numbers of road segments, the model was simulated for only 15 years of stochastic climate for each road segment (instead of a recommended 50-100 years).

The output tables from each of the WEPP:Road Batch runs were copied and pasted back into the spreadsheet where the results could be summarized, and linked back to the original GIS containing the road network. In GIS, the stream order and road erosion, sediment delivery, and buffer deposition rates were classified to aid in visualizing where the segments with the greatest risk of erosion and sediment delivery were located. Additional summary calculations were carried out in the spreadsheet.

## Results

There were 3276 individual road segments identified in the GIS analysis (Table 2), totaling nearly 300 km (186 miles) in length. The total estimated amount of sediment leaving the roads was 774 Mg (852 tons) and the estimated amount delivered to the stream system was 278 Mg (306 tons). 80 % of this sediment was delivered from only 50% of the road network. At least 1 kg of sediment was delivered from 93 % of the road segments.

From the results in Table 2, the estimated road surface erosion rate in the units used in the NezSed Model, is 1573 tons mile$^{-2}$, compared to the NezSed values of 18,000 tons mile$^{-2}$ for "exist" roads and 5,000 tons mile$^{-2}$ for minor, new, major, moderate, temporary and "decomy1" roads. The NezSed values are reduced within the model to incorporate sediment delivery and time since construction or reconstruction.

Figure 2 shows the amount of sediment leaving the road surface for each of the 3276 road segments. A larger number (denoted by the color red) suggests that this segment has a high estimated erosion rate, likely due to a long segment or a steep segment.

Figure 3 shows the amount of sediment reaching the stream (Figure 1). Note that the erosion category range is reduced with the highest delivery rates about a third of what they were for road segments.

Figure 4 shows the difference between the amount of sediment leaving the road and the amount delivered to the stream. A large positive value indicates that the buffer is a location of deposition. A negative value suggests that the buffer may be eroding.

Map packages for Figures 2, 3, and 4 are available on the Pinyon Drive[3] (Appendix), as is the spreadsheet with all of the NPC category and WEPP:Road Batch input and output data for each segment. The

[3] https://usfs.box.com/s/go9hy4r4uprn1ncngqdmojkrydb80qo7 ; Contact suemiller@fs.fed.us for access.

Table 2. Summary of road network erosion analysis for the NPC Clear Creek Watershed.

| | Metric | English |
|---|---|---|
| Average Annual Precipitation | 960 mm | 37.7 in. |
| Average Annual Runoff from rainfall | 5.46 mm | 0.21 in. |
| Average Annual Runoff from snow melt or rain on snow | 5.25 mm | 0.21 in. |
| Total Runoff | 10.71 mm | 0.42 in. |
| Total length of road | 299 km | 186 miles |
| Number of road segments | 3276 | |
| Average segment length | 91.3 m | 299 ft |
| Average segment gradient | 4.63% | |
| Average width of road segments | 4.69 m | 15.38 ft |
| Average buffer length | 64.1 m | 210 ft |
| Average buffer steepness | 30.4% | |
| Total sediment leaving the road surface | 774 Mg | 852 tons |
| Total sediment delivered to the stream | 278 Mg | 306 tons |
| Calculated Sediment Delivery Ratio | 0.36 | |
| Average road erosion rate per Km and Mile | 2.59 Mg/km | 4.59 tons/mi. |
| Average sediment delivery rate per Km (mile) | 0.93 Mg/km | 1.65 tons/mi. |
| Average surface erosion rate | 5.52 Mg/ha | 2.46 t/acre |
| | 552 Mg/km$^2$ | 1573 t/mi$^2$ |
| Road density | 1.66 km/km | 2.7 mi/mi |
| Road sediment delivery per watershed area | 2.8 Mg/km$^2$ | 8 tons/mi$^2$ |

spreadsheet can be linked to the ArcMap files in two ways. If the user notes a road segment on the spreadsheet and wants to find it on the map, make a note of the “ORIG_FID” in column AO on the spreadsheet. Open the desired ArcMap file (Road_Erosion, Road_Buffer_Erosion, or Road_RD-Buffer-Diff), right click on the CC_roads-WEPP_Rd_Runsxxx line in the Table of Contents, and open the attribute table. Search the attribute table for the desired ORIG_FID value and select its line. The segment will then be highlighted on the map. The user may find it helpful to highlight several lines around the desired one to better find the general area on the map before highlighting a single line only.

To find the results for a given road segment on the map, select the Identify button and click the desired segment. On the table of information about the segment that is presented, note the ORIG-FID, and find the line on the spread sheet for that segment in column AO. There are other ArcMap methods that can also be used to link the spreadsheet to the map for users who are familiar with ArcMap.

When interpreting the spread sheet results for road segment lengths, be careful to use the original input lengths from the NPC. The output lengths from WEPP road have been truncated during processing, and will result in an underestimation of road segment lengths.

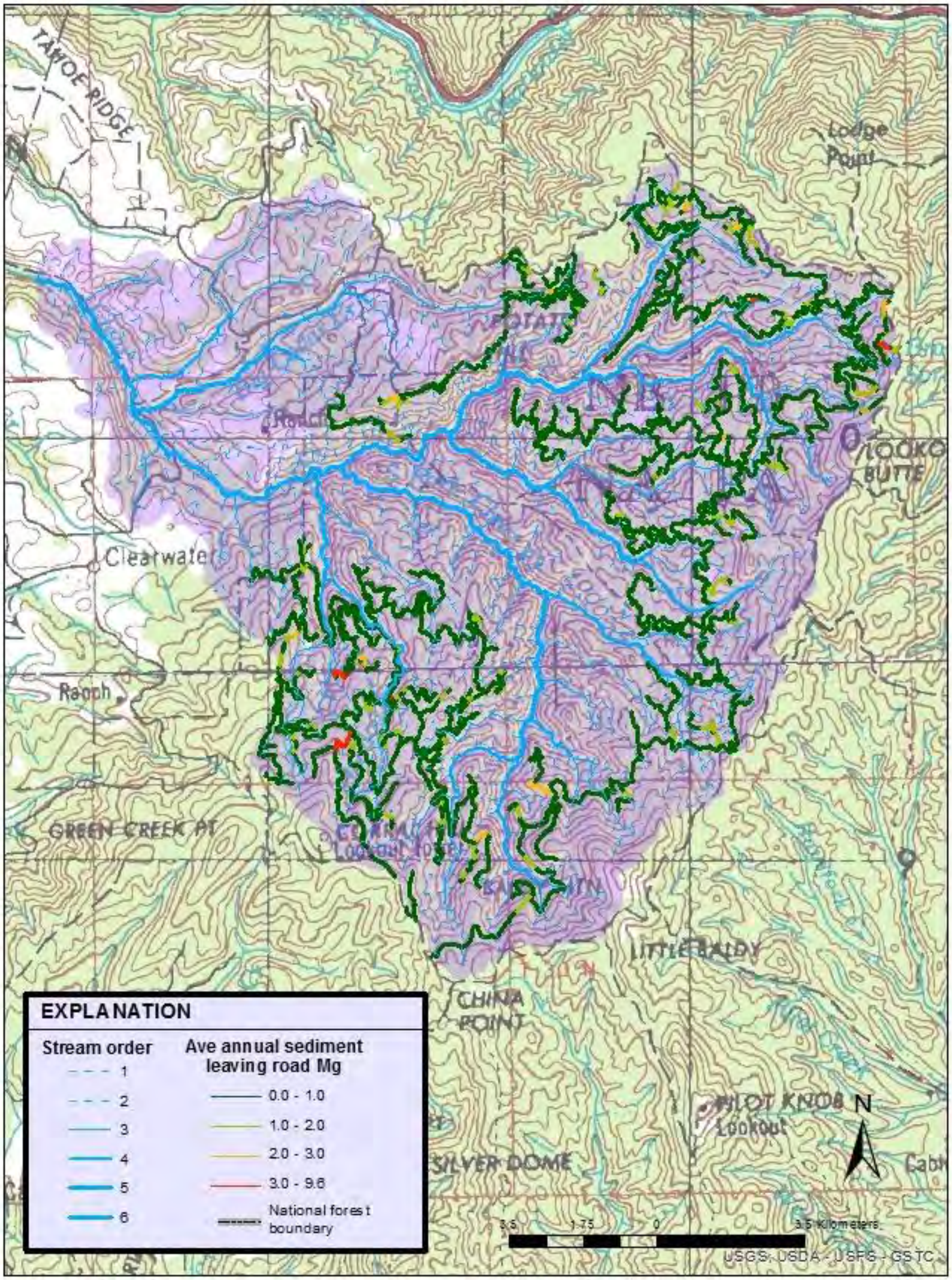



Figure 2. Estimated road surface erosion in the Clear Creek Watershed, Nez Perce-Clearwater National Forest.

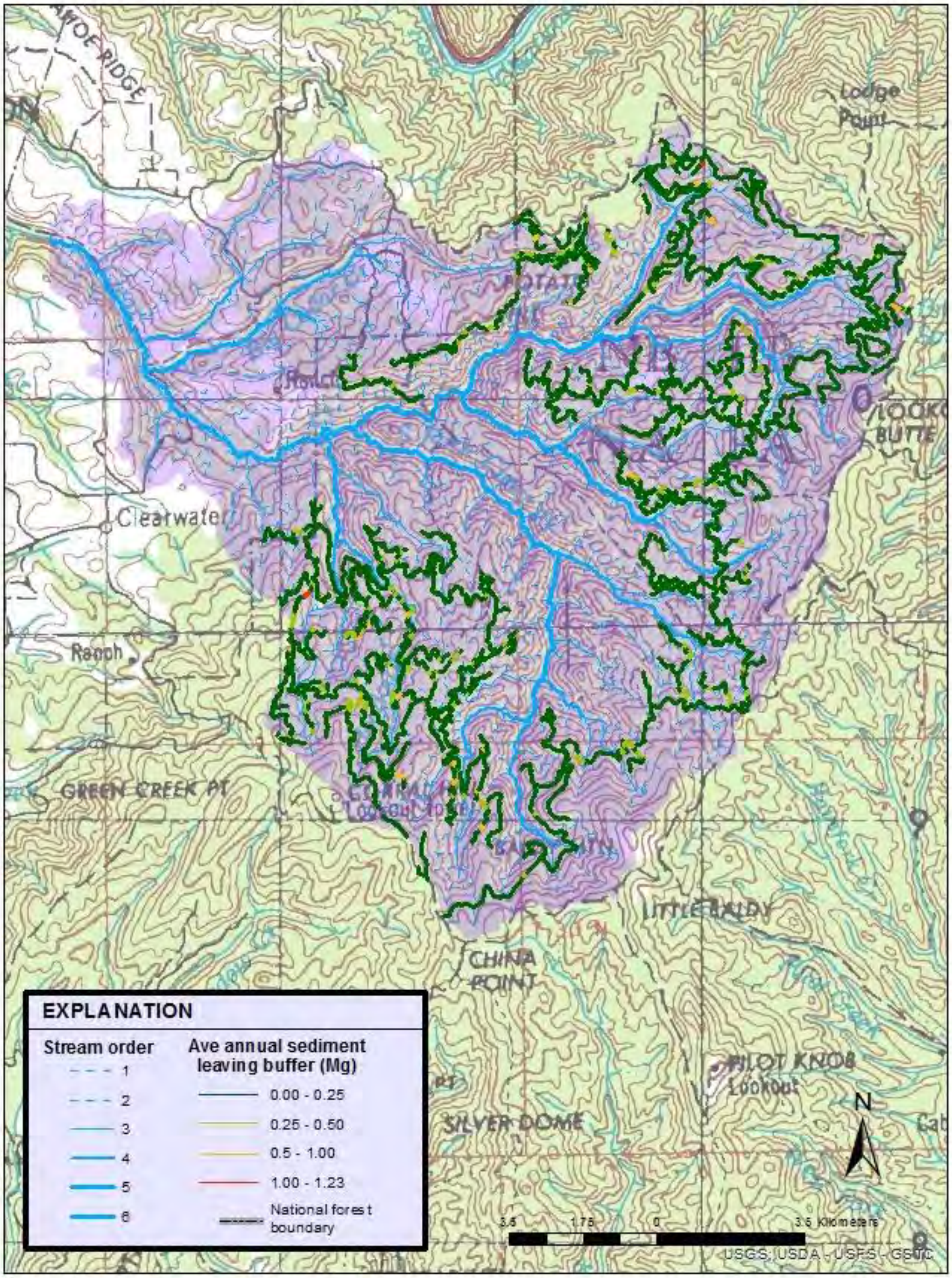



Figure 3. Estimated sediment delivered from the road buffer to the nearest cell with concentrated flow in the Clear Creek Watershed, Nez Perce-Clearwater National Forest

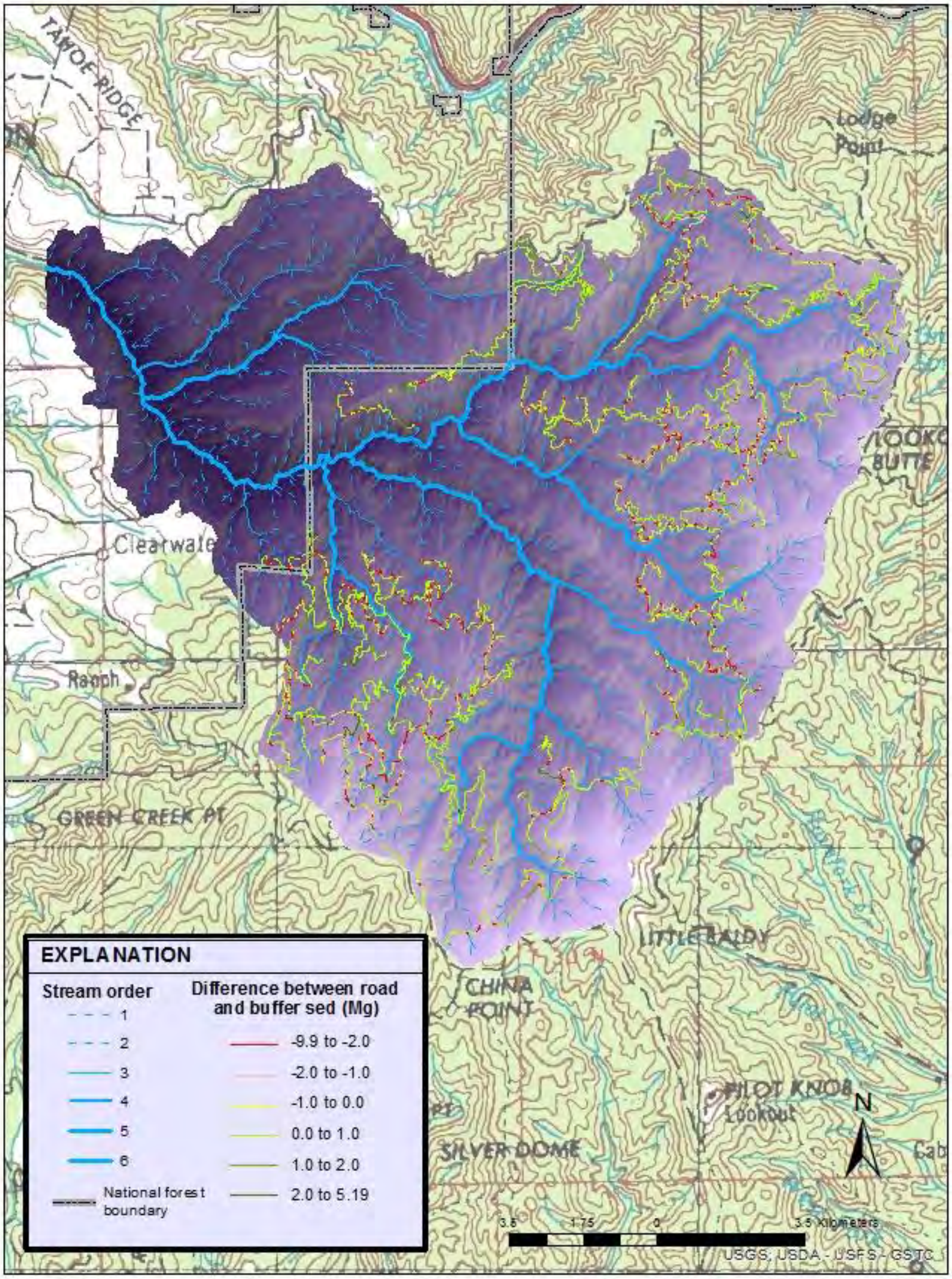



Figure 4. Difference between the estimated amount of sediment leaving the road and the sediment interesecting concentrated flow in the Clear Creek Watershed, Nez Perce-Clearwater National Forest. A large positive value suggests that the buffer is an area of deposition. The negative values indicate that the buffer may be eroding

## Site Visits

RMRS scientists visited the Clear Creek Watershed on five occasions. The first trip was in September 2016 with local specialists to get an overview of the watershed management plan and collect data from the Forest for a watershed analysis (Elliot and Miller, 2017). The second visit was in October, 2016 to attend a meeting with a number of stakeholders and make a short presentation about the overall watershed analysis. In January, 2017, we met with the NPC watershed team at the Moose Creek Ranger Station to give a presentation of our forest management modeling results (Elliot and Miller, 2017), and to discuss our approach to modeling erosion of the road network.

The fourth site visit was in June, 2017, to make onsite road gradient observations of select road segments to compare to LIDAR and other GIS gradient estimation methods. Specific road segments were identified prior to the field visit. In the field, road segments lengths were measured with a tape, and differences in elevation between the ends of the segment were measured with a laser level (Figure 5). The gradient was the change in elevation divided by the segment length. The field observations confirmed that the GIS topographic analysis methods were valid, and could be applied to the larger road network for subsequent erosion analysis. Figure 6 shows that the GIS methodology accounted for 84 percent of the variability in road gradients observed in the field.

A final visit to the site occurred in June, 2018. The purpose of this visit was to confirm the generally low erosion rates for most road segments, and to specifically look at some selected sites that initial analyses had identified as potentially problematic. At the same time, all roads traversed to access the sites could also be inspected. Figure 7 shows the location of the four sites that had been selected.

Figure 5. Measuring the length and steepness of a road segment in the Clear Creek Watershed in June, 2017, to support the development of a GIS topographic analysis technique for analyzing the larger road network.

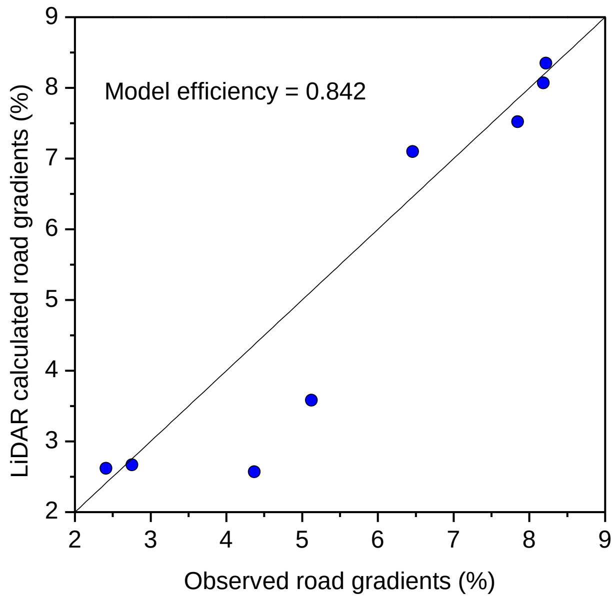



Figure 6. Comparison between the observed and LIDAR-calculated road gradient

Generally, there was no evidence of erosion on the road surfaces (Figure 5). There was some evidence of soil displacement, either erosion or deposition, in road ditches (Figure 8), particularly where road gradients were steeper. All of the main roads were graveled and showed no signs of surface rutting (Figure 5), and the side roads were vegetated so there would be minimal erosion risk (Figure 8).

At site 1 (Figure 7), we found that the road had not been used for many years (Figure 9). There was evidence that in the past it had experienced severe erosion both onsite and offsite, but it was now totally covered in trees that were estimated to be 20 years old. Even in its current condition, it was still concentrating upslope runoff, and was a potential risk for initiating a debris flow (Gorsevski et al., 2006). Should this segment be reopened, enhanced management practices may be needed to limit surface erosion and offsite sediment delivery.

On site 2 (Figure 7), the road had been recontoured and so was no longer a surface erosion risk (Figure 10). The only concern for this site was that the recontouring was on a steep hill adjacent to Hoodoo Creek, so there was a potential that legacy compacted road layers in the soil profile could result in a landslide (Elliot et al., 1996). If the old road surface was removed or scarified as part of the recontouring then the risk of a landslide is minimal.

Both sites 3 and 4 were vegetated so erosion risk was minimum (Figure 8). There was some evidence of soil displacement in the ditch at site 3, but no signs of surface erosion at site 4.

## Discussion

By only running the model for 15 years of stochastic climate, rather than 50 or 100 years, it is possible that there may be underestimation of sediment delivery. The underestimation, however, will be within the plus or minus 50 percent accuracy range associated with any soil erosion model. Figure 11 shows that for a typical 60-m long road segment with a 40-m long buffer, the predicted sediment delivery for a 15-year WEPP:Road run is within the error range for a 100-year long run.

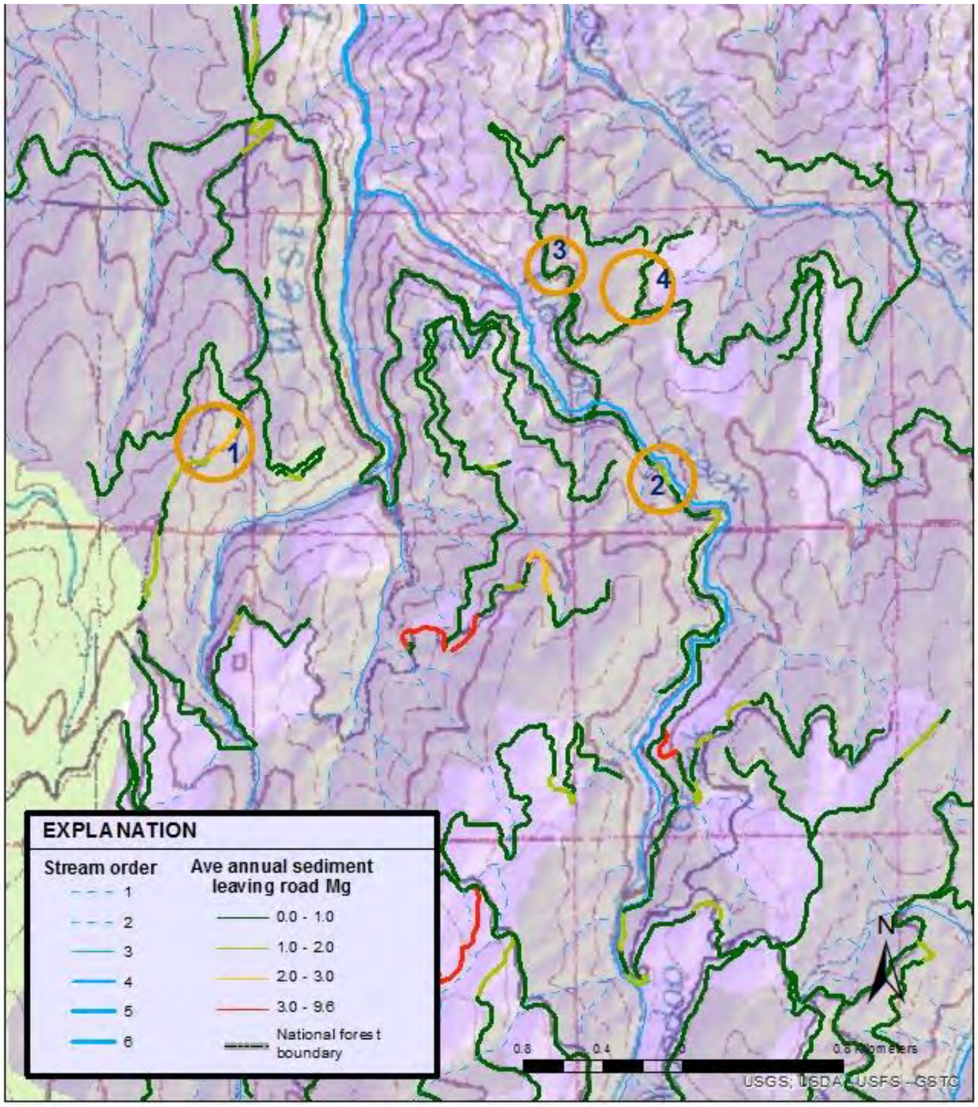



Figure 7. Location of the four sites identified for a detailed site visit in June, 2018

Sediment reduction methods including surface cross drains, graveling or ditch relief culverts are well known and applied to numerous road segments within this watershed. Identifying problem segments using sort functions with the spreadsheet or the GIS attribute tables can aid managers to quickly identify segments that may be at high risk for sediment delivery. It is, however, important to visit the segments predicted to be likely sources of sediment delivery to confirm that there is a problem. Erosion modeling can be used to aid in evaluating alternative mitigation practices for those segments found to be sources of sediment.

The field observations suggest that the total erosion predicted for the road network in this watershed is likely exaggerated. One of the roads high erosion risk roads had not been used for decades and was covered in trees, and the other high risk road that was visited had been removed from the landscape. The low use roads were all vegetated or gated, and unlikely to generate large amounts of sediment (Foltz et al., 2009). Roads that are covered in vegetation can be modeled as “No Traffic” roads in

Figure 8. Typical vegetated cover on road north of site 1. Note some evidence of ditch erosion. Similar grass cover was observed at location 3 (Figure 7).

WEPP:Road, which will reduce the estimated road erosion rate, and depending on topography and location of the road on the landscape, the estimated sediment delivery from the road. Some of these


Figure 9. Road totally overgrown with forest showing evidence of historic erosion, but no recent erosion at location 1 in Figure 7.

Figure 10. Recontoured road prevented accessing location 2 in Figure 7.

changes in road attributes can be made in the cross walk spreadsheet and WEPP:Road batch rerun for those segments.

### Summary and Conclusions

The Nez Perce-Clearwater National Forest provided RMRS with their road network GIS layer. This layer was combined with a management cross walk table and a 10-m DEM to predict the sediment delivery from the road surface across a forested buffer using GIS tools, spreadsheets, and the WEPP:Road Batch

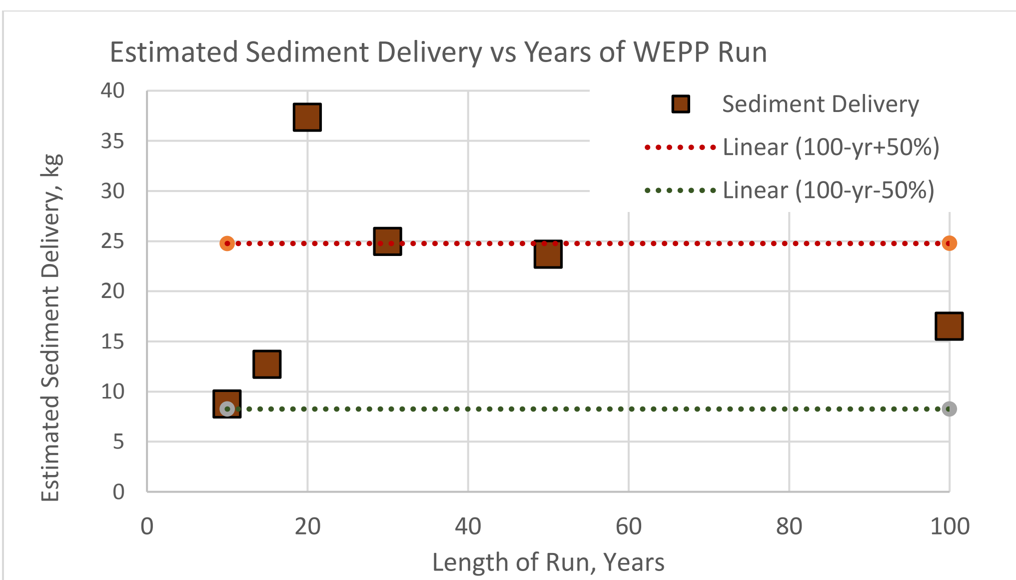



Figure 11. Estimated sediment delivery for a 60-m road segment with a 40-m buffer for different lengths of WEPP Run

interface. We delineated 3276 road segments that made up the 299 km (186 miles) of road network. Total sediment delivery was estimated to average 278 Mg (306 tons) per year. Field surveys confirmed the validity of the GIS topographic analysis, but found that some of the road segments predicted to generate the greatest amounts of sediment were either overgrown with trees, or had been removed. Further site visits can be carried out to confirm that those segments generating the greatest amount of sediment are currently eroding, and if not, the results modified to better reflect sediment generation from the current road network.

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## Appendix: Files shared on the Forest Service Pinyon Drive

Link: https://usfs.box.com/s/go9hy4r4uprn1ncngqdmojkrydb80qo7

Owner: Ina S Miller (suemiller@fs.fed.us )

| File Name | Description |
|---|---|
| **In Road_Map_Figures Directory** | |
| 2017_CC_Road_RD-Buffer-dif.pdf | Map of road segments color-coded to reflect the difference in sediment delivered from the road and sediment delivered from the buffer. Figure 4 in this report. |
| 2017_CC_Road_Erosion.pdf | Map of road segments color-coded to reflect the road running surface erosion rate. Figure 2 in this report. |
| 2017_CC_Road_Buffer_Erosion.pdf | Map of road segments color-coded to reflect the amount of sediment delivered from the road less what was deposited in the forest hillslope between the road cross drain and live water. Figure 3 in this report. |
| **In MapPackages Directory** | |
| Three ArcMap Map Packages that were used to develop the above three Maps | The map packages can be opened in ArcMap to access the data that were used for the above three figures, as inputs to the 180815_CC_GIS_to_WRBatch.xlsx spreadsheet |
| **Spreadsheets** | |
| CC_roads_WEP_RdRuns_AveMg.xlsx | Summary of road erosion and sediment delivery |
| 180815_CC_GIS_to_WRBatch.xlsx | Cross walk spreadsheet from NPC road network and a 10-m DEM to WEPP Road Batch |
| Using GIS to Analyze Road Erosion_OL wepp.pdf | This pdf file is the presentation that Sue Miller made at the ESRI conference in July, 2018. |

United States
Environmental Protection
Agency

Region 10
Office of Water

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# EPA Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards

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The *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* is a product of a three year interagency effort involving the Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, Washington Department of Ecology, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Nez Perce Tribe, Columbia River Inter-Tribal Fish Commission (representing its four governing tribes: the Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes and Bands of the Yakima Nation, and the Confederated Tribes of the Warm Springs Reservation of Oregon), and EPA Region 10.

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Two independent scientific peer review panels were convened to provide comment on various aspects of the guidance and the scientific issue papers.  The peer review scientists are identified in the peer review reports, which are referenced in Section X of the guidance.

EPA issued two public review drafts, the first in October, 2001 and the second in October, 2002, and received valuable comments from the public that helped shape the guidance.

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**To obtain a copy of this guidance free of charge, contact:**

EPA Region 10's Public Environmental Resource Center
Phone: 1-800-424-4372

**This guidance, along with other supporting material, is available on the internet at:**

www.epa.gov/r10earth/temperature.htm

# Forward

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and, where attainable, to achieve water quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. As a means of meeting this goal, section 303(c) of the CWA requires States and authorized Tribes to adopt water quality standards (WQS) and requires the U.S. Environmental Protection Agency (EPA) to approve or disapprove those standards.

At this time, many Pacific Northwest salmonid species are listed as threatened or endangered under the Endangered Species Act (ESA). As a result, the ESA requires that EPA must insure that its approval of a State or Tribal WQS is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of their critical habitat.

Water temperature is a critical aspect of the freshwater habitat of Pacific Northwest salmonids. Those salmonids listed as threatened or endangered under the ESA and other coldwater salmonids need cold water to survive. Human-caused increases in river water temperatures have been identified as a factor in the decline of ESA-listed salmonids in the Pacific Northwest. State and Tribal temperature WQS can play an important role in helping to maintain and restore water temperatures to protect Pacific Northwest salmonids and aid in their recovery. For these reasons, EPA in collaboration with others, developed this guidance to better describe appropriate water temperatures to protect Pacific Northwest salmonids.

The *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* is intended to assist States and Tribes to adopt temperature WQS that EPA can approve consistent with its obligations under the Clean Water Act (CWA) and the Endangered Species Act (ESA). This guidance document, however, does not substitute for applicable legal requirements; nor is it a regulation itself. Thus, it does not impose legally binding requirements on any party, including EPA, other federal agencies, the states, or the regulated community. Comments and suggestions from readers are encouraged and will be used to help improve the available guidance as EPA continues to build experience and understanding of water temperature and salmonids.

L. John Iani, Regional Administrator
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# Table of Contents


Forward . . . . . . . . . . iii

I. Introduction . . . . . . . . . . 1

II. Regulatory Background . . . . . . . . . . 2

III. Relationship of Guidance to EPA's 304(a) Criteria for Water Temperature . . . . . . . . . . 4

IV. Water Temperature and Salmonids . . . . . . . . . . 5

- IV.1. Importance of Temperature for Salmonids . . . . . . . . . . 5
- IV.2. Human Activities That Can Contribute to Excess Warming of Rivers and Streams . . . . . . . . . . 6
- IV.3. Human-Caused Elevated Water Temperatures As A Factor in Salmonid Decline . . . . . . . . . . 7
- IV.4. General Life Histories of Salmonids and When Human-Caused Elevated Water Temperatures May Be A Problem . . . . . . . . . . 12

V. EPA Region 10 Recommendations for Pacific Northwest State and Tribal Temperature WQS . . . . . . . . . . 15

- V.1. Coldwater Salmonid Uses and Numeric Criteria to Protect Those Use . . . . . . . . . . 15
- V.2. Provision to Protect Water Temperatures that are Currently Colder than the Numeric Criteria . . . . . . . . . . 32
- V.3. Provisions to Protect Salmonids from Thermal Plume Impacts . . . . . . . . . . 33

VI. Approaches to Address Situations Where the Numeric Criteria are Unattainable or Inappropriate . . . . . . . . . . 34

- VI.1. Alternative Criteria . . . . . . . . . . 34
- VI.2. Use of a State's or Tribe's "Natural Background" Provisions . . . . . . . . . . 36
- VI.3. Overview of Methods to Estimate Natural Background Temperatures . . . . . . . . . . 39

VII. Using EPA's Guidance to Change Salmonid Use Designations . . . . . . . . . . 42

VIII. Temperature Limits for NPDES Sources . . . . . . . . . . 42

IX. The Role of Temperature WQS in Protecting and Recovering ESA-Listed Salmonids and Examples of Actions to Restore Suitable Water Temperatures . . . . . . . . . . 44

X. References . . . . . . . . . . 46

# EPA Region 10 Guidance
# for
# Pacific Northwest State and Tribal Temperature Water Quality Standards

## I. Introduction

This guidance describes an approach that EPA Region 10 encourages States and authorized Tribes (Tribes) in the Pacific Northwest to use when adopting temperature water quality standards (WQS) to protect coldwater salmonids. The recommendations in this guidance are intended to assist States and Tribes to adopt temperature WQS that EPA can approve consistent with its obligations under the Clean Water Act (CWA) and the Endangered Species Act (ESA). This guidance specifically addresses the following coldwater salmonid species in the Pacific Northwest: chinook, coho, sockeye, chum, and pink salmon; steelhead and coastal cutthroat trout; and bull trout. The information provided in this guidance may also be useful for States and Tribes to protect other coldwater salmonid species that have similar temperature tolerances but are not explicitly addressed in this guidance.

This guidance provides recommendations to States and Tribes on how they can designate uses and establish temperature numeric criteria for waterbodies that help meet the goal of "protection and propagation of fish, shellfish, and wildlife" in section 101(a)(2) of the CWA. States or Tribes that choose to adopt new or revised temperature WQS must submit those standards to EPA for review and approval or disapproval. CWA section 303(c)(2)(A). EPA expects to be able to expedite its review of revised temperature standards that follow the recommendations in this guidance. States and Tribes that choose to follow the recommendations in this guidance, particularly those described in Section V, may wish to reference this guidance when submitting new or revised salmonid use designations and supporting criteria to EPA for approval.

EPA action on State and Tribal WQS that are consistent with this guidance is expected to be significantly expedited because the scientific rationale in support of the State and Tribal WQS would in large part already be described and supported by EPA, and by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (the Services). However, because this is a guidance document and not a regulation, EPA cannot bind itself to approve a WQS submission that follows the recommendation of this guidance. Furthermore, the Services cannot bind themselves to future consultation determinations (i.e., a "no jeopardy" determination) under the ESA. So even though EPA expects the review process to be significantly expedited if this guidance is followed, EPA and the Services must still examine every WQS submission on a case-by-case basis, taking into consideration any public comments received or other new information.

It is also important to note that this guidance does not preclude States or Tribes from adopting temperature WQS different from those described here. EPA would approve any temperature

WQS that it determines are consistent with the applicable requirements of the CWA and its obligations under the ESA. Because this guidance reflects EPA's current analysis of temperature considerations for Pacific Northwest salmonid species, EPA intends to consider it when reviewing Pacific Northwest State and Tribal temperature WQS or promulgating federal temperature WQS in Idaho, Oregon, or Washington.

Temperature WQS are viewed by EPA and the Services as an important tool for the protection and recovery of threatened and endangered salmonid species in the Pacific Northwest. Attaining criteria and protecting existing cold temperatures for waters used by these salmonids will help maintain and improve their habitat and aid in their recovery. Meeting temperature WQS, however, should be viewed as part of the larger fish recovery efforts to restore habitat. Wherever practicable, implementation actions to restore water temperatures should be integrated with implementation actions to improve habitat in general, and should be targeted first toward those reaches within a basin that will provide the biggest benefit to the fish. It should also be noted that the actions needed to improve water temperatures are, in many cases, the same as those needed to improve other fish habitat features. For example, restoring a stream's riparian vegetation can reduce water temperature as well as reduce sediment erosion, provide over bank micro-habitat, and add fallen wood to the river that over time creates pools and a more diverse stream habitat preferred by salmonids.

This guidance was developed with the assistance of representatives of the Pacific Northwest States, the Services, and the Columbia River Inter-Tribal Fish Commission (CRITFC) Tribes. As part of developing this guidance, EPA, with the assistance of technical experts from Federal, State, and Tribal organizations, developed five technical issue papers and a technical synthesis report summarizing technical issues related to water temperature and salmonids. These reports represent the technical foundation of this guidance and summarize the latest literature related to temperature and salmonids. See Section X, References, at the end of this guidance for a list of these technical papers.

## II. Regulatory Background

The goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and, where attainable, to achieve water quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. See CWA section 101(a)(2). As a means of meeting this goal, section 303(c) of the CWA requires States and Tribes to adopt WQS that include designated uses and water quality criteria to protect those designated uses. In addition, Federal WQS regulations require States and Tribes to adopt a statewide antidegradation policy and identify methods to implement such policy. See 40 C.F.R. § 131.12. States and Tribes may also adopt into their standards policies generally affecting the application and implementation of WQS, such as mixing zones and variances. See 40 C.F.R. § 131.13.

EPA is required to approve or disapprove new or revised State and Tribal WQS under section 303(c) of the CWA to ensure they are consistent with the requirements of the CWA and EPA's implementing regulations. See CWA section 303(c)(3). New or revised State and Tribal WQS are not in effect for CWA purposes until they are approved by EPA. If EPA disapproves a new or revised WQS submitted by a State or Tribe, or if the EPA Administrator determines that a new or revised WQS is necessary to meet the requirements of the CWA, EPA must propose and promulgate appropriate WQS itself, unless appropriate changes are made by the State or Tribe. See CWA section 303(c)(4).

Where EPA determines that its approval of State or Tribal WQS may affect threatened or endangered species or their critical habitat, the approval action is subject to the procedural and substantive requirements of section 7(a)(2) of the ESA. Section 7(a)(2) of the ESA requires EPA to ensure, in consultation with the Service(s), that any action it takes is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Under the ESA regulations, such consultations can be concluded informally where EPA determines that its action is not likely to adversely affect listed species or critical habitat, and where the Service(s) concur with that finding in writing. See 50 C.F.R. § 402.13. Where EPA does not make such a determination, or where the Service(s) do not concur in writing, the ESA regulations require EPA to engage in formal consultation, which results in the issuance of a biological opinion by the Service(s). See 50 C.F.R. § 402.14. If the Service(s) anticipate that "take" will occur as a result of the action, the opinion in most cases will include required reasonable and prudent measures and associated terms and conditions to minimize such take, along with an incidental take statement providing EPA legal protection from ESA section 9 take liability for its approval action. See 50 C.F.R. § 402.14(i). Section 7(a)(1) of the ESA requires EPA to use its authorities to carry out programs for the conservation of endangered and threatened species. The ESA, however, does not expand EPA's authorities under the CWA. EPA approval or disapproval decisions regarding State and Tribal WQS must be authorized by the CWA and EPA's implementing regulations.

In addition, EPA has a federal trust relationship with federally recognized Pacific Northwest tribes. In the Pacific Northwest, federal courts have affirmed that certain tribes reserved through treaty the right to fish at all usual and accustomed fishing places and to take a fair share of the fish destined to pass through such areas. *See* Puyallup Tribe v. Department of Game, 391 U.S. 392 (1968); Washington v. Passenger Fishing Vessel, 443 U.S. 658 (1979); United States v. Winans, 198 U.S. 371 (1905). EPA's approval of a State or Tribal WQS, or promulgation of its own WQS, may impact the habitat that supports the treaty fish. EPA has a responsibility to ensure that its WQS actions do not violate treaty fishing rights.

Water Quality Standards set the water quality goals for specific waterbodies and serve as a regulatory basis for other programs, such as National Pollutant Discharge Elimination System (NPDES) permits, listings of impaired water bodies under CWA section 303(d), and total maximum daily loads (TMDLs). In general, NPDES permits contain effluent limitations to meet WQS; section 303(d) lists identify those water bodies where the WQS are not being met; and TMDLs are mathematical calculations indicating the pollutant reductions needed to meet WQS.

## III. Relationship of Guidance to EPA's 304(a) Criteria for Water Temperature

Under CWA section 304(a), EPA issues national criteria recommendations to guide States and Tribes in developing their WQS. When EPA reviews a State or Tribal WQS submission for approval under section 303(c) of the CWA, it must determine whether the adopted designated uses and criteria are consistent with the CWA and EPA's regulations. See CWA section 303(c)(3). Specifically, 40 C.F.R § 131.11 requires States and Tribes to adopt water quality criteria that are based on sound scientific rationale and contain sufficient parameters or constituents to protect the designated uses. For waters with multiple use designations, the criteria must support the most sensitive use. See 40 C.F.R. § 131.11(a). When establishing criteria, States should: (1) establish numerical values based on 304(a) guidance, or 304(a) guidance modified to reflect site-specific conditions, or other scientifically defensible methods; or (2) establish narrative criteria or criteria based upon biomonitoring methods where numerical criteria cannot be established or to supplement numerical criteria. See 40 C.F.R. § 131.11(b).

EPA develops its section 304(a) criteria recommendations based on a uniform methodology that takes into account a range of species' sensitivities to pollutant loadings using certain general assumptions; therefore, the national recommendations are generally protective of aquatic life. However, these criteria recommendations may not be protective of all aquatic life designated uses in all situations. It may be appropriate for States and Tribes to develop different water quality criteria using current data concerning the species present, and taking into account site-specific or regional conditions. EPA approval or disapproval would not depend on whether a criterion adopted by a State or Tribe is consistent with a particular guidance document, such as this guidance or the national 304(a) criteria recommendations, but rather on whether the State or Tribe demonstrates that the criterion protects the most sensitive designated use, as required by section 303(c) of the CWA and EPA's WQS regulations.

EPA's current 304(a) criteria recommendations for temperature can be found in *Quality Criteria for Water 1986*, commonly known as the "gold book." The freshwater aquatic life criteria described in this 1986 document were first established in 1977, and were not changed in the 1986 document. In general, EPA's national temperature recommendations for salmonids and other fish consist of formulas to calculate the protective temperatures for short-term exposure and a maximum weekly average exposure. Protective short term temperature exposure is based on subtracting 2°C from the upper incipient lethal temperature (the temperature at which fifty percent of the sample dies). Protective weekly average temperature exposure is based on the optimal growth temperature plus 1/3 the difference between the optimal growth temperature and the upper incipient lethal temperature. Using these formulas and EPA data for coho and sockeye salmon, the 1986 document calculates suggested temperature criteria for short-term exposure as 22°C (sockeye) and 24°C (coho) and a maximum weekly average exposure of 18°C for both species.

Based on extensive review of the most recent scientific studies, EPA Region 10 and the Services believe that there are a variety of chronic and sub-lethal effects that are likely to occur to Pacific Northwest salmonid species exposed to the maximum weekly average temperatures calculated using the current 304(a) recommended formulas. These chronic and sub-lethal effects include reduced juvenile growth, increased incidence of disease, reduced viability of gametes in adults prior to spawning, increased susceptibility to predation and competition, and suppressed or reversed smoltification. It may be possible for healthy fish populations to endure some of these chronic impacts with little appreciable loss in population size. However, for vulnerable fish populations, such as the endangered or threatened salmonids of the Pacific Northwest, EPA and the Services are concerned that these chronic and sub-lethal effects can reduce the overall health and size of the population.

For these reasons, the national assumptions made when developing the section 304(a) criteria recommendations for temperature may not necessarily protect the vulnerable coldwater salmonids in the Pacific Northwest. EPA Region 10, therefore, has developed this guidance to assist Pacific Northwest States and Tribes in developing temperature criteria that protect the coldwater salmonids in the Pacific Northwest identified above.

## IV. Water Temperature and Salmonids

### IV.1. Importance of Temperature for Salmonids

Water temperatures significantly affect the distribution, health, and survival of native salmonids in the Pacific Northwest. Since salmonids are ectothermic (cold-blooded), their survival is dependent on external water temperatures and they will experience adverse health effects when exposed to temperatures outside their optimal range. Salmonids have evolved and thrived under the water temperature patterns that historically existed (i.e., prior to significant anthropogenic impacts that altered temperature patterns) in Pacific Northwest streams and rivers. Although evidence suggests that historical water temperatures exceeded optimal conditions for salmonids at times during the summer months on some rivers, the temperature diversity in these unaltered rivers provided enough cold water during the summer to allow salmonid populations as a whole to thrive.

Pacific salmon populations have historically fluctuated dramatically due to climatic conditions, ocean conditions, and other disturbances. High water temperatures during drought conditions likely affected the historical abundance of salmon. In general, the increased exposure to stressful water temperatures and the reduction of suitable habitat caused by drought conditions reduce the abundance of salmon. Human-caused elevated water temperatures significantly increase the magnitude, duration, and extent of thermal conditions unsuitable for salmonids.

The freshwater life histories of salmonids are closely tied to water temperatures. Cooling rivers in the autumn serve as a signal for upstream migrations. Fall spawning is initiated when water temperatures decrease to suitable temperatures. Eggs generally incubate over the winter or early spring when temperatures are coolest. Rising springtime water temperatures may serve as a cue for downstream migration.

Because of the overall importance of water temperature for salmonids in the Pacific Northwest, human-caused changes to natural temperature patterns have the potential to significantly reduce the size of salmonid populations. Of particular concern are human activities that have led to the excess warming of rivers and the loss of temperature diversity.

**IV.2. Human Activities That Can Contribute to Excess Warming of Rivers and Streams**

Rivers and streams in the Pacific Northwest naturally warm in the summer due to increased solar radiation and warm air temperature. Human changes to the landscape have magnified the degree of river warming, which adversely affects salmonids and reduces the number of river segments that are thermally suitable for salmonids. Human activities can increase water temperatures by increasing the heat load into the river, by reducing the river's capacity to absorb heat, and by eliminating or reducing the amount of groundwater flow which moderates temperatures and provides cold water refugia. Specific ways in which human development has caused excess warming of rivers are presented in Issue Paper 3 and are summarized below:

1) Removal of streamside vegetation reduces the amount of shade that blocks solar radiation and increases solar heating of streams. Examples of human activities that reduce shade include forest harvesting, agricultural land clearing, livestock grazing, and urban development.

2) Removal of streamside vegetation also reduces bank stability, thereby causing bank erosion and increased sediment loading into the stream. Bank erosion and increased sedimentation results in wider and shallower streams, which increases the stream's heat load by increasing the surface area subject to solar radiation and heat exchange with the air.

3) Water withdrawals from rivers for purposes such as agricultural irrigation and urban/municipal and industrial use result in less river volume and generally remove cold water. The temperatures of rivers with smaller volumes equilibrates faster to surrounding air temperature, which leads to higher maximum water temperatures in the summer.

4) Water discharges from industrial facilities, wastewater treatment facilities and irrigation return flows can add heat to rivers.

5) Channeling, straightening, or diking rivers for flood control and urban and agricultural land development reduces or eliminates cool groundwater flow into a river that moderates summertime river temperatures. These human actions can reduce two forms of groundwater flow. One form is groundwater that is created during over-bank flooding and is slowly returned to the main river channel to cool the water in the summer. A

second form is water that is exchanged between the river and the riverbed (i.e. hyporheic flow). Hyporheic flow is plentiful in fully functioning alluvial rivers systems.

6) Removal of upland vegetation and the creation of impervious surfaces associated with urban development increases storm runoff and reduces the amount of groundwater that is stored in the watershed and slowly filters back to the stream in the summer to cool water temperatures.

7) Dams and their reservoirs can affect thermal patterns in a number of ways. They can increase maximum temperatures by holding waters in reservoirs to warm, especially in shallow areas near shore. Reservoirs, due to their increased volume of water, are more resistant to temperature change which results in reduced diurnal temperature variation and prolonged periods of warm water. For example, dams can delay the natural cooling that takes place in the late summer-early fall, thereby harming late summer-fall migration runs. Reservoirs also inundate alluvial river segments, thereby diminishing the groundwater exchange between the river and the riverbed (i.e., hyporheic flow) that cools the river and provides cold water refugia during the summer. Further, dams can significantly reduce the river flow rate, thereby causing juvenile migrants to be exposed to high temperatures for a much longer time than they would under a natural flow regime.

It should also be noted that some human development can create water temperatures colder than an unaltered river. The most significant example of this occurs when cold water is released from the bottom of a thermally stratified reservoir behind a dam.

## IV.3. Human-Caused Elevated Water Temperature as a Factor in Salmonid Decline

Many reports issued in the past decade have described the degradation of freshwater salmonid habitat, including human-caused elevated temperatures, as a major factor in salmonid decline. The following provides a brief summary of some of these reports:

*National Marine Fisheries Service's Listing and Status Reviews for Pacific Northwest Salmonids*

The National Marine Fisheries Service (NMFS) identified habitat concerns (including alteration of ambient stream water temperatures) as one of the factors for decline of listed west coast steelhead (NMFS 1996), west coast chinook (NMFS 1998), and Snake River spring/summer chinook salmon (Mathews and Waples 1991). Specific effects attributed to increased temperatures by NMFS include increased juvenile mortality, increased susceptibility and exposure to diseases, impaired ability to avoid predators, altered migration timing, and changes in fish community structure that favor competitors of salmonids. NMFS included high water temperatures among risk factors related to the listings under the ESA of the following evolutionarily significant units (ESUs) of chinook salmon: Puget Sound, Lower Columbia River, Snake River spring/summer, and Upper Willamette (Myers et al. 1998). NMFS also noted high water temperatures in its analyses of risk factors related to the ESA listings of Upper Willamette River steelhead and Ozette Lake sockeye.

*U.S. Fish and Wildife Service Listing and Status Reviews for Bull Trout*

When listing bull trout in the Columbia River and Coastal-Puget Sound population segments, USFWS identified activities such as forestry, agriculture, and hydropower that have degraded bull trout habitat and specifically have resulted in increased stream temperatures. Bull trout are found primarily in colder streams, although individual fish are found in larger river systems. Water temperature above 15°C is believed to limit bull trout distribution and this may partially explain their patchy distribution within a watershed. The strict cold water temperature needs of bull trout make them particularly vulnerable to human activities identified by USFWS that warm spawning and rearing waters.

*Return to the River Reports by the Independent Science Group*

The Independent Scientific Group is a group of scientists chartered by the Northwest Power Planning Council to provide independent scientific advice to the Columbia River Basin Fish and Wildlife Program. In their 1996 Return the River report (updated in 2000), they include a section discussing the effects of elevated temperature on salmonids as part of their overall discussion of freshwater habitats. The report states:

> "Temperature is a critical habitat variable that is very much influenced by regulation of flow and impoundments. The mainstem reservoirs are relatively shallow and heat up in late summer causing concern for salmon survival. The lower reaches of some key tributaries also are very warm in late summer because they are dewatered by irrigation withdrawals. Due to the extreme importance of temperature regimes to the ecology of salmonids in the basin, temperature information merits special attention as a key habitat descriptor (Coutant 1999)."

> "Water temperatures in the Columbia River basin have been altered by development and are, at times, suboptimal or clearly detrimental for salmonids. High temperatures alone can be directly lethal to both juvenile and adult salmonids in the Snake River in summer under recent conditions based on generally accepted thermal criteria and measured temperatures."

*Oregon Coastal Salmon Restoration Initiative*

The Oregon Coastal Salmon Restoration Initiative (1997) included water temperature as a factor for decline in populations of Oregon coastal coho salmon, noting that:

> "Water temperatures are too warm for salmonids in many coastal streams. Altered water temperatures can adversely affect spawning, fry emergence, smoltification, maturation

> period, migratory behavior, competition with other aquatic species, growth and disease resistance."

*Summer Chum Salmon Conservation Initiative*

The Summer Chum Salmon Conservation Initiative (2000) for the Hood Canal and Strait of Juan de Fuca region listed elevated water temperature in its limiting factor analysis, noting that:

> "Elevated temperatures impede adult passage, cause direct mortality, and accelerate development during incubation leading to diminished survival in subsequent life stages."

*Interior Columbia Basin Ecosystem Management Project*

The aquatic habitat assessment for the Interior Columbia Basin Ecosystem Management Project (Lee et al. 1997) indicates that:

1. Changes in riparian canopy and shading, or other factors influencing stream temperatures, are likely to affect some, if not most, bull trout populations.
2. In desert climates, the loss of riparian canopy has been associated with elevated water temperature and reduced redband trout abundance.
3. Loss of vegetation has resulted in stream temperatures that have far exceeded those considered optimal for Lahontan Cutthroat Trout.
4. Water temperatures in reaches of the John Day, upper Grande Ronde, and other basins in eastern Oregon commonly exceed the preferred ranges and often exceed lethal temperatures for chinook salmon.

*Northwest Indian Fisheries Commission - Critical Habitat Issues by Basin for Natural Chinook Stocks in the Coastal and Puget Sound Areas of Washington State*

In this report, the Northwest Indian Fisheries Commission reviewed the habitat issues for the basins in the coastal and Puget Sound areas of Washington State, and identified elevated temperature as a critical habitat issue in 12 out of 15 basins reviewed.

*Other Basin and Watershed Studies*

Numerous scientific studies of habitat and elevated water temperature impacts on salmon, steelhead and resident native fish have been completed in the Pacific Northwest over the past two decades. The Northwest Power Planning Council is in the process of developing habitat assessments and restoration strategies for all the sub-basins of the Columbia River Basin. In many of these sub-basin summaries (e.g., Okanogan, Methow, Wenatchee, Yakima, Tucannon, Grande Ronde, Umatilla, and John Day draft summaries - see www.cbfwa.org) elevated temperatures are cited as a major factor contributing to salmonid decline. These and other studies elsewhere in the Pacific Northwest provide a consistent view of the importance of restoring temperatures suitable for coldwater salmonds to aid in their recovery.

One specific study worth noting is by Theurer et al. (1985) in the Tucannon River in southeastern Washington. This study shows how human-caused changes in riparian shade and channel morphology contributed to increased water temperatures, reduced available spawning and rearing space, and diminished production of steelhead and chinook salmon. Using a physically-based water temperature model, the authors concluded that approximately 24 miles of spawning and rearing habitat had been made unusable in the lower river due to temperature changes. If the temperatures were restored, they estimated chinook adult returns would increase from 884 that currently exist to 2240 (near historic levels) and that chinook rearing capacity would increase from 170,000 to 430,000. The authors state that the change in temperature regime caused by the loss of riparian vegetation alone is sufficient to explain the reduction in salmonid population in the Tucannon River, while noting that increased sediment input also has played a subsidiary role.

Another similar analysis was done by Oregon Department of Environmental Quality (ODEQ, 2000) for the upper Grande Ronde River as part of their TMDL for this river. ODEQ modeling showed that restoration of riparian shade, channel width and depth, and water flow would drastically reduce maximum temperatures. As shown in Figure 1 (Figures 11 and 12 in ODEQ 2000), over 90% of the river currently exceeds 68°F (20°C), but with full restoration that percentage drops to less than 5%. Similarly, the percentage of the river that exceeds 64°F (18°C) is reduced from over 90% to less than 50% with full restoration. This represents nearly 50 additional miles that are colder than 18°C, which is a very large increase in available rearing habitat. Although actual estimates of increased fish production were not calculated in this study, one might expect similar results as those calculated for the Tucannon River.

Although temperature is highlighted here as a factor in the decline of native salmonid populations, it by no means is the only factor in their decline. Certainly, degradation of habitat unrelated to temperature (e.g., impassable barriers to spawning and rearing areas and physical destruction or inundation of spawning grounds), fishing harvest, and hatchery operations have all played a role in their decline. However, as described above, elevated temperatures are an important factor in the decline of salmonids and restoring suitable temperature regimes for salmonids is a critical element in protecting salmonid populations.

UPPER GRANDE RONDE SUB-BASIN TMDL

**Figure 11.** Grande Ronde River Temperatures at Current Conditions and Site Potential

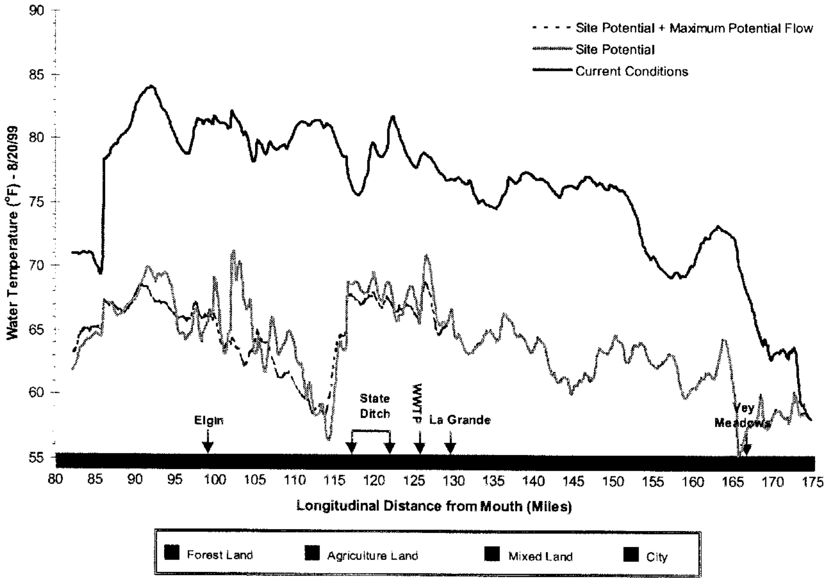
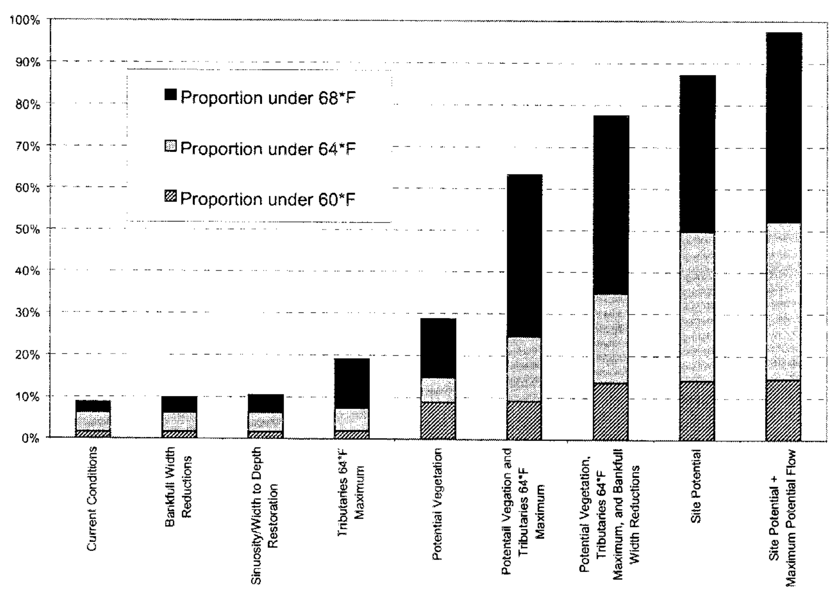



**Figure 12.** Percent of River Temperatures Below Specified Temperature




OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY PAGE 29

APRIL, 2000

Figure 1. Grande Ronde River temperature modeling using ODEQ's Heat Source Model, showing site potential.

## IV.4. General Life Histories of Salmonids and When Human-Caused Elevated Water Temperatures May Be a Problem

Different salmonid species have evolved to take advantage of the Pacific Northwest's cold water environment in different ways. Each species has a unique pattern of when and where they use the rivers, and even for a specific species this pattern of use may change from year to year. This diversity in freshwater life history is a critical evolutionary trait that has allowed salmonids to persist in a freshwater environment that naturally fluctuates and has natural disturbances.

Below is a general summary of the freshwater life history strategies for some of the coldwater salmonids. This summary is intended to provide a "big picture" understanding of how each of these fish use Pacific Northwest rivers and to highlight when and where human elevated water temperatures have impacted these fish. As noted above, because of their life history diversity, the discussion below may be an over-generalization for some situations. Further, because this general discussion on fish distribution is simplified for purposes of understanding, it is not intended to be used as a basis for salmonid use designations.

*Chinook Salmon*

Adult spring chinook salmon generally leave the ocean and enter Pacific Northwest rivers in the spring (April - June) and swim upstream to hold and spawn in the mid-to-upper reaches of river basins. Spawning generally occurs in late summer and fall (August - October). Egg and alevin incubation extends over the winter and fry generally emerge in the early spring (March - May). Juveniles rear in their natal streams and lower in the basin for a year, then migrate out to the ocean the following spring. Human-caused elevated temperatures can adversely affect spring chinook when adults hold and begin to spawn in the late-summer/early fall and throughout the summer when juveniles rear. Human-caused elevated temperatures in these mid-to-upper reaches can "shrink" the available habitat for adult holding/spawning and juvenile rearing limiting spring chinook to habitat higher in the watershed.

Adult fall chinook salmon generally enter Pacific Northwest rivers in the summer (July - August) and swim upstream to hold and spawn in the lower reaches of mainstem rivers and large tributaries. Spawning generally occurs in the fall (October - December). For example, Snake River fall chinook migrate past Bonneville dam from August-October and spawn in the Snake River below Hells Canyon Dam and the lower reaches of the Clearwater, Grand Ronde, Imnaha, and Tucannon rivers. Fry emerge from March through April and begin their downstream migration several weeks after emergence. Downstream migration occurs mainly in the spring under existing conditions, but may extend throughout the summer in some areas (e.g., Columbia River). Historically, juvenile fall chinook out-migrated throughout the summer months, but today human-caused elevated temperatures have made this impossible in some rivers (e.g., Yakima river). Human-caused elevated temperatures can adversely affect fall chinook in lower river reaches during the summer months when the adults are migrating upstream and holding to spawn and when juveniles are migrating downstream. Human-caused elevated temperatures in the early fall may also delay spawning.

*Coho Salmon*

Adult coho salmon generally enter Pacific Northwest rivers in the fall (late September through October) and spawn in low gradient 4$^{th}$ and 5$^{th}$ order streams in fall-winter. Fry emerge in the spring. Juvenile coho rear for 1 to 2 years prior to migrating to sea during the spring. Juvenile coho salmon may migrate considerable distances upstream to rear in lakes or other river reaches suitable for rearing. Coho salmon are most predominant in the rivers of the coastal mountains of Washington and Oregon and the west-slopes of the Washington Cascades. Wild coho populations were extirpated years ago in the Umatilla (OR), Yakima (WA), and Clearwater (ID) rivers but they are now being re-introduced in these rivers. Human-caused elevated temperatures can adversely affect coho salmon in the summer months when juveniles are rearing and in early fall when adults start migrating. Human-caused elevated temperatures may render waters unsuitable for rearing, thereby “shrinking” the amount of available habitat.

*Sockeye Salmon*

Adult sockeye salmon generally enter freshwater from mid summer through early fall and migrate up to lakes and nearby tributaries to spawn in the fall. Juveniles generally rear in lakes from 1 to 3 years, then migrate to the ocean in the spring. Pacific Northwest lakes that support sockeye include Redfish (Idaho), Okanogan, Wenatchee, Baker, Washington, Sammamish, Quinault, and Osoyoos. Historically, there were many other lakes in the Pacific Northwest used by sockeye. Human-caused elevated temperatures can adversely affect sockeye adult salmon as they migrate upstream in the mid-to-late summer.

*Chum Salmon*

Adult chum salmon generally enter freshwater in late-summer and the fall and spawn (October - December) in the low reaches and side channels of major rivers just upstream from tidewater areas. Upon emergence, juveniles begin their short migration to saltwater which generally occurs between March and June. Juveniles will rear in estuaries for a while prior to entering the ocean. Human-caused elevated temperatures can adversely affect adult chum salmon as they migrate upstream in the late summer.

*Pink Salmon*

Adult pink salmon generally enter freshwater in late summer and spawn in the lower reaches of large rivers in late summer and early fall. Like chum, juveniles will migrate to saltwater soon after emerging in the late winter. Human-caused elevated temperatures can adversely affect adult pink salmon as they migrate upstream in the late summer.

*Steelhead Trout*

Adult steelhead enter Pacific Northwest rivers throughout the year, but can generally be divided into a summer run (May - October) and a winter run (November-June). Both runs typically spawn in the spring. Summer steelhead enter freshwater sexually immature and generally travel greater distances to spawn than winter steelhead, which enter freshwater sexually mature (i.e. with well-developed gonads). All steelhead runs upstream of the Dalles Dam are summer steelhead. Fry generally emerge from May through July and juvenile steelhead will rear in the mid-upper reaches of river basins for 1-2 years (sometimes 3 or 4 years) before migrating to the ocean in the spring. Human-caused elevated temperatures can adversely affect steelhead in the summer months when the juveniles are rearing in the mid-upper reaches. Human-caused elevated temperatures may render waters unsuitable for rearing, thereby “shrinking” the amount of available habitat. Human-caused elevated temperatures also can adversely affect summer run adults as they migrate upstream during the summer as well as eggs and fry that incubate into July in some watersheds.

*Bull Trout*

Bull trout generally are freshwater fish (although the adults of a few populations enter saltwater estuaries). Adult bull trout generally migrate upstream in the spring and summer from their feeding grounds (lower reaches in a basin for migrating fluvial forms or a lake for adfluvial forms) to their spawning grounds higher in the basin. Bull trout generally spawn in September-October, but in some watersheds spawning can occur as early as July. Bull trout have a long incubation time with fry emergence generally from March through May. Juveniles will rear in their natal streams for 2-4 years, then the migratory forms will migrate downstream to more productive feeding grounds (i.e., lower river reaches or lakes) in the spring, but some fall downstream migration has also been noted. Human-caused elevated temperatures can adversely affect summer juvenile rearing in the upper reaches where elevated temperatures have rendered water unsuitable for rearing, thereby “shrinking” the amount of available habitat. Adults migrating upstream to spawn in the summer can also experience adverse effects from human-elevated temperatures. Additionally, migratory adults can be adversely affected by the loss of cold water refugia due to human activities.

# V. EPA Region 10 Recommendations for Pacific Northwest State and Tribal Temperature WQS

EPA Region 10 offers the following recommendations to assist States and Tribes in adopting temperature WQS that fully support coldwater salmonids in the Pacific Northwest. The recommendations are intended to assist States and Tribes to adopt temperature WQS that EPA can approve consistent with its obligations under the CWA and the ESA. As noted in Section I, Pacific Northwest States and Tribes that adopt temperature WQS consistent with these recommendations can expect an expedited review by EPA and the Services, subject to new data and information that might be available to during that review.

EPA Region 10 recommends that States and Tribes adopt new or revised temperature WQS that incorporate each of the following elements for the protection of salmonid designated uses. Each of these elements is discussed in more detail below:

1) Coldwater Salmonid Uses and Numeric Criteria to Protect Those Uses;

2) Provisions to Protect Water Temperatures That Are Currently Colder Than the Numeric Criteria; and

3) Provisions to Protect Salmonids from Thermal Plume Impacts.

If a State or Tribe decides to adopt new or revised temperature WQS, it is free, of course, to adopt WQS that are different than these recommendations. EPA would evaluate these submissions on a case-by-case basis to determine if it can approve the WQS consistent with its obligations under the CWA and the ESA.

## V.1. Coldwater Salmonid Uses and Numeric Criteria to Protect Those Uses

Tables 1 and 2 provide a summary of the important water temperature considerations for each life stage for salmon and trout, and bull trout: spawning, egg incubation, and fry emergence; juvenile rearing; and adult migration. Each temperature consideration and associated temperature values noted in Tables 1 and 2 includes a reference to the relevant technical issue papers prepared in support of this guidance (or other studies) that provide a more detailed discussion of the supporting scientific literature. The temperatures noted in Tables 1 and 2 form the scientific basis for EPA's recommended numeric criteria to protect coldwater salmonids in the Pacific Northwest, which are presented in Tables 3 and 4.

### V.1.A. Overall Context for Recommended Uses and Criteria

In addition to Tables 1 and 2, there are a number of other general factors that EPA considered in recommending coldwater salmonid uses and numeric criteria to protect those uses. These factors

**Table 1 - Summary of Temperature Considerations For Salmon and Trout Life Stages**

| Life Stage | Temperature Consideration | Temperature & Unit | Reference |
|---|---|---|---|
| Spawning and Egg Incubation | *Temp. Range at which Spawning is Most Frequently Observed in the Field | 4 - 14°C (daily avg ) | Issue Paper 1; pp 17-18<br>Issue Paper 5; p 81 |
| | * Egg Incubation Studies<br>- Results in Good Survival<br>-Optimal Range | <br>4 - 12°C (constant)<br>6 - 10°C (constant) | <br>Issue Paper 5; p 16 |
| | *Reduced Viability of Gametes in Holding Adults | > 13°C (constant) | Issue Paper 5; pp 16 and 75 |
| Juvenile Rearing | *Lethal Temp. (1 Week Exposure) | 23 - 26°C (constant) | Issue Paper 5; pp 12, 14 (Table 4), 17, and 83-84 |
| | *Optimal Growth<br>- unlimited food<br>- limited food | <br>13 - 20°C (constant)<br>10 - 16°C (constant) | <br>Issue Paper 5; pp 3-6 (Table 1), and 38-56 |
| | *Rearing Preference Temp. in Lab and Field Studies | 10 - 17°C (constant)<br>< 18°C (7DADM) | Issue Paper 1; p 4 (Table 2).<br>Welsh et al. 2001. |
| | *Impairment to Smoltification | 12 - 15°C (constant) | Issue Paper 5; pp 7 and 57-65<br>Issue Paper 5; pp 7 and 57-65 |
| | *Impairment to Steelhead Smoltification | > 12°C (constant) | |
| | *Disease Risk (lab studies)<br>-High<br>- Elevated<br>- Minimized | <br>> 18 - 20°C (constant)<br>14 - 17°C (constant)<br>12 - 13°C (constant) | Issue Paper 4, pp 12 - 23 |
| Adult Migration | *Lethal Temp. (1 Week Exposure) | 21- 22°C (constant) | Issue Paper 5; pp 17, 83 - 87 |
| | *Migration Blockage and Migration Delay | 21 - 22°C (average) | Issue Paper 5; pp 9, 10, 72-74.<br>Issue Paper 1; pp 15 - 16 |
| | *Disease Risk (lab studies)<br>- High<br>- Elevated<br>- Minimized | <br>> 18 - 20°C (constant)<br>14 - 17°C (constant)<br>12- 13°C (constant) | <br>Issue Paper 4; pp 12 - 23 |
| | *Adult Swimming Performance<br>- Reduced<br>- Optimal | <br>> 20°C (constant)<br>15 - 19°C (constant) | <br>Issue Paper 5; pp 8, 9, 13, 65 - 71 |
| | * Overall Reduction in Migration Fitness due to Cumulative Stresses | > 17-18°C (prolonged exposures) | Issue Paper 5; p 74 |

**Table 2 - Summary of Temperature Considerations For Bull Trout Life Stages**

| Life Stage | Temperature Consideration | Temperature & Unit | Reference |
|---|---|---|---|
| Spawning and Egg Incubation | *Spawning Initiation | < 9°C (constant) | Issue Paper 5; pp 88 - 91 |
| | *Temp. at which Peak Spawning Occurs | < 7°C (constant) | Issue Paper 5; pp 88 - 91 |
| | *Optimal Temp. for Egg Incubation | 2 - 6°C (constant) | Issue Paper 5; pp 18, 88 - 91 |
| | *Substantially Reduced Egg Survival and Size | 6 - 8°C (constant) | Issue Paper 5; pp 18, 88 - 91 |
| Juvenile Rearing | *Lethal Temp. (1 week exposure) | 22 - 23°C (constant) | Issue Paper 5; p 18 |
| | *Optimal Growth<br>- unlimited food<br>- limited food | <br>12 - 16 °C (constant)<br>8 - 12°C (constant) | <br>Issue Paper 5; p 90. Selong et al 2001. Bull trout peer review, 2002. |
| | *Highest Probability to occur in the field | 12 - 13 °C (daily maximum) | Issue Paper 5; p 90. Issue Paper 1; p 4 (Table 2). Dunham et al., 2001. Bull trout peer review, 2002. |
| | *Competition Disadvantage | >12°C (constant) | Issue Paper 1; pp 21- 23. Bull trout peer review, 2002. |

and EPA's recommended approach for considering these factors (described below) provide the overall context for EPA's salmonid use and criteria recommendations.

*Coldwater Salmonid Uses*

Coldwater salmonids are considered a sensitive aquatic life species with regard to water temperatures and are a general indicator species of good aquatic health. EPA, therefore, believes it is appropriate for States and Tribes in the Pacific Northwest to focus on coldwater salmonids when establishing temperature criteria to support aquatic life.

Under EPA's WQS regulations, States and Tribes must adopt appropriate uses and set criteria to protect those uses. See 40 C.F.R § 131.10(a). Because Pacific Northwest salmonids have multiple freshwater life stages with differing temperature tolerances, it is generally appropriate to designate uses based on life stages. In addition, EPA's WQS regulations allow States and Tribes to adopt seasonal uses where a particular use applies for only a portion of the year. See 40 C.F.R § 131.10(f). EPA's recommended approach is for States and Tribes to utilize both of these use designation options in order to more precisely describe where and when the different coldwater salmonid uses occur.

In this guidance, EPA recommends seven coldwater salmonid uses (see Tables 3 and 4). Four uses apply to the summer maximum temperature condition and three apply to specific locations and times for other times of the year (except for some instances when these uses may apply during the period of summer maximum temperatures).

*Focus on Summer Maximum Conditions*

In general, increased summertime temperatures due to human activities are the greatest water temperature concern for salmonids in the Pacific Northwest, although temperatures in the late spring and early fall are also a concern in some areas. EPA therefore believes it is appropriate that temperature criteria focus on the summer maximum conditions to protect the coldwater salmonid uses that occur then. Generally, improving river conditions to reduce summer maximum temperatures will also reduce temperatures throughout the summer and in the late spring and early fall (i.e., shift the seasonal temperature profile downward). Thus, the data indicate that, because of the natural annual temperature regime, providing protective temperatures during the summer maximum period will in many areas provide protective temperatures for more temperature sensitive uses that occur other times of the year.

In some areas, however, more temperature-sensitive salmonid uses (e.g., spawning, egg incubation, and steelhead smoltification) that occur in the spring-early summer or late summer-fall may not be protected by meeting the summer maximum criterion. Thus, in addition to summer maximum criteria, EPA also recommends criteria be adopted to protect these more temperature-sensitive uses when and where they occur. Doing so provides an added degree of protection for those situations where control of summer maximum temperatures is inadequate to protect these more temperature-sensitive uses. An additional reason for having these seasonal uses is to provide protection for rivers that are flow-regulated, which can alter the natural annual temperature pattern.

In recommending protective summer maximum criteria, EPA took into consideration that meeting a criterion during the warmest period of the summer (e.g., warmest week) will result in cooler temperatures during other times in the summer. The duration of exposure to near summer maximum conditions, however, can vary from one to two weeks in some areas to over a month in other areas.

*Optimal, Harmful, and Lethal Temperatures for Salmonids*

Each salmonid life stage has an optimal temperature range. Physiological optimum temperatures are those where physiological functions (e.g., growth, swimming, heart performance) are optimized. These temperatures are generally determined in laboratory experiments. Ecological optimum temperatures are those where fish do best in the natural environment considering food availability, competition, predation, and fluctuating temperatures. Both are important considerations when establishing numeric criteria. Exposure to temperatures above the optimal range results in increased severity of harmful effects, often referred to as sub-lethal or chronic effects (e.g., decreased juvenile growth which results in smaller, more vulnerable fish; increased susceptibility to disease which can lead to mortality; and decreased ability to compete and avoid predation), as temperatures rise until at some point they become lethal (See Table 1 and 2). Water temperatures below the optimal range also cause sub-lethal effects (e.g., decreased growth); however, this is generally a natural condition (with the exception of cold water releases from a storage dam) and is not the focus of this guidance.

When determining the optimal range for bull trout and salmon/trout juvenile rearing, EPA looked at both laboratory and field data and considered both physiological and ecological aspects. Optimal growth under limited food rations in laboratory experiments, preference temperatures in laboratory experiments where fish select between a gradient of temperatures, and field studies on where rearing predominately occurs are three independent lines of evidence indicating the optimal temperature range for rearing in the natural environment. As highlighted in Tables 1 and 2 (and shown in detail in the technical issue papers) these three lines of evidence show very consistent results, with the optimal range between 8 - 12°C for bull trout juvenile rearing and between 10 - 16°C for salmon and trout juvenile rearing.

*Use of the 7 Day Average of the Daily Maximum (7DADM) Unit of Measurement*

The recommended metric for all of the following criteria is the maximum 7 day average of the daily maxima (7DADM). This metric is recommended because it describes the maximum temperatures in a stream, but is not overly influenced by the maximum temperature of a single day. Thus, it reflects an average of maximum temperatures that fish are exposed to over a week-long period. Since this metric is oriented to daily maximum temperatures, it can be used to protect against acute effects, such as lethality and migration blockage conditions.

This metric can also be used to protect against sub-lethal or chronic effects (e.g., temperature effects on growth, disease, smoltification, and competition), but the resultant cumulative thermal exposure fish experience over the course of a week or more needs to be considered when selecting a 7DADM value to protect against these effects. EPA's general conclusion from studies on fluctuating temperature regimes (which is what fish generally experience in rivers) is that fluctuating temperatures increase juvenile growth rates when mean temperatures are colder than the optimal growth temperature derived from constant temperature studies, but will reduce growth when the mean temperature exceeds the optimal growth temperature (see Issue Paper 5, pages 51-56). When the mean temperature is above the optimal growth temperature, the "mid-point" temperature between the mean and the maximum is the "equivalent" constant temperature. This "equivalent" constant temperature then can be directly compared to laboratory studies done at constant temperatures. For example, a river with a 7DADM value of 18°C and a 15°C weekly mean temperature (i.e., diurnal variation of ± 3°C) will be roughly equivalent to a constant laboratory study temperature of 16.5°C (mid-point between 15°C and 18°C). Thus, both maximum and mean temperatures are important when determining a 7DADM value that is protective against sub-lethal/chronic temperature effects.

For many rivers and streams in the Pacific Northwest, the 7DADM temperature is about 3°C higher than the weekly mean (Dunham, et al. 2001; Chapman, 2002). Thus, when considering what 7DADM temperature value protects against chronic effects, EPA started with the constant temperatures that scientific studies indicate would be protective against chronic effects and added 1-2°C degrees (see Table 1 for summary of studies done under constant temperatures). For bull trout waters, EPA started with the constant temperatures that scientific studies indicate would be protective for chronic effects and added about 0.5°C because bull trout waters typically have less diurnal variation. Following this general procedure takes into account the maximum and mean temperature (i.e., reflects a “mid-point”) when protecting for growth and other sub-lethal effects.

It is important to note that there are also studies that analyzed sub-lethal effects based on maximum or 7DADM temperature values which need not be translated for purposes of determining protective 7DADM temperatures. For example, there are field studies that assess probability of occurrence or density of a specific species based on maximum temperatures (Issue Paper 1, Haas (2001), Welsh et al. (2001)). These field studies represent an independent line of evidence for defining upper optimal temperature thresholds, which complements laboratory studies.

It is also important to note that there are confounding variables that are difficult to account for but are important to recognize. For instance, the amount of diurnal variation in rivers and streams in the Pacific Northwest varies considerably; therefore, the difference between the 7DADM and the weekly mean will vary. The difference between the 7DADM temperature and the weekly mean may be less than 1°C for rivers with little diurnal variation and as high as 9°C for streams with high diurnal variation (Dunham et al., 2001). Another variable is food availability. The temperature for which there is optimal juvenile growth depends on the food supply. Optimal growth temperatures under limited food supply are lower than those under unlimited/satiated food supply. Generally, EPA believes that laboratory studies under limited food availability are most reflective of environmental conditions fish typically experience. However, there are likely situations where food is abundant, with the result that optimal growth temperatures would be higher. Thus, a particular 7DADM numeric criteria will be more protective in situations where there is high diurnal variation and/or abundant food and will be less protective in situations where there is low diurnal variation and limited food.

*Unusually Warm Conditions*

In order to have criteria that protect designated uses under the CWA, EPA expects that the criteria would need to apply nearly all the time. However, EPA believes it is reasonable for a State or Tribe to decide not to apply the numeric temperature criteria during unusually warm conditions for purposes of determining if a waterbody is attaining criteria. One possible way for a State or Tribe to do this would be to explain in its WQS that it will determine attainment with the numeric temperature criterion based on the 90th percentile of the yearly maximum 7DADM values calculated from a yearly set of values of 10 years or more. Thus, generally speaking, the numeric criteria would apply 9 out 10 years, or all but the hottest year. Another way may be to exclude water temperature data when the air temperature during the warmest week of the year exceeds the 90th percentile for the warmest week of the year based on a historical record (10 years or more) at the nearest weather reporting station.

A State or Tribe wishing to consider adopting a provision to account for unusually warm conditions might be able to justify that decision by pointing out that extreme annual peaks in water temperature typically caused by drought conditions are a natural component of the environment and then concluding, as a matter of policy, that these infrequent conditions should not drive attainment determinations. Salmonids may experience some adverse effects during these periods, but by definition, they would be infrequent. It is important to note that not taking into account unusually warm conditions should only be for CWA 303(d) listing purposes when determining if a waterbody is in attainment with temperature WQS. NPDES permitted facilities should not be exempt from applicable temperature effluent limits during these periods.

Even assuming that a State or Tribe decides to account for unusually warm conditions in its temperature WQS, attainment determinations should be based on all climatic conditions except for the extreme condition in order to protect the salmonid designated uses. Thus, given that river temperatures exhibit year-to-year variation in their maximum 7DADM values, the average maximum 7DADM value from a yearly series, as a statistical matter, would need to be lower than the numeric criteria in order to meet the criteria 9 out of 10 years. Therefore, in most years, the maximum 7DADM temperature would also probably need to be lower than the numeric criteria in order to meet the criteria in the warm years. EPA took this into consideration when it formulated its numeric criteria recommendations.

*A De Minimis Temperature Increase Allowance*

A State or Tribe may, if it has not already done so, wish to consider adopting a provision in its WQS that allows for a de minimis temperature increase above the numeric criteria or the natural background temperature. A State or Tribe might choose to include a de minimis increase allowance as a way of accounting for monitoring measurement error and tolerating negligible human impacts. The data and information currently available to EPA appear to indicate that an increase on the order of 0.25°C for all sources cumulatively (at the point of maximum impact) above fully protective numeric criteria or natural background temperatures would not impair the designated uses, and therefore might be regarded as de minimis.

*Numeric Criteria Should Apply Upstream of the Furthest Downstream Extent of Use*

Water quality criteria must protect the relevant designated uses. See 40 C.F.R. § 131.11(a). Therefore, a criterion should apply to all the river miles for which a particular use is designated, including the lowest point downstream at which the use is designated. Because streams generally warm progressively in the downstream direction, waters upstream of that point will generally need to be cooler in order to ensure that the criterion is met downstream. Thus, a waterbody that meets a criterion at the furthest downstream extent of use will in many cases provide water cooler than the criterion at the upstream extent of the use. EPA took this into consideration when it formulated its numeric criteria recommendations.

EPA also believes that the numeric criteria should apply upstream of the areas of actual use because temperatures in upstream waters significantly affect the water temperatures where the actual use occurs and upstream waters are usually colder. Of course, if a more sensitive use is designated upstream, the more protective criterion would apply upstream. See 40 C.F.R. § 131.11(a).

*Selection of Protective Criteria for the Recommended Salmon Uses*

As described above, numeric criteria that apply to uses that occur during the summer maximum period are intended to apply to the warmest times of the summer, the warmest years (except for extreme conditions), and the lowest downstream extent of use. Because of the conservative nature of this application, EPA believes that it is appropriate to recommend numeric criteria near the warmer end of the optimal range for uses intended to protect high quality bull trout and salmon/trout rearing (see Section V.1.C for use descriptions). EPA expects that adopting a numeric criterion near the warmer end of the optimal range that is applied to the above conditions is likely to result in temperatures near the middle of the optimal range for most of the spring through fall period in the segments where most of the rearing use occurs. EPA has identified two reasons for this. First, if the criterion is met at the summer maximum, then temperatures will be lower than the criterion during most of the year. Second, because the criterion would apply at the furthest point downstream where the use is designated, temperatures will generally be colder across the full range of the designated use.

EPA also recognizes that salmonids will use waters that are warmer than their optimal thermal range and further recognizes that some portions of rivers and streams in the Pacific Northwest naturally (i.e., absent human impacts) were warmer than the salmonid optimal range during the period of summer maximum temperatures. To account for these realities, EPA is also recommending two salmonid uses (see Section V.1.C) during the period of summer maximum temperatures where the recommended numeric criteria exceed the optimal range, but provide protection from lethal conditions and sub-lethal effects that would significantly adversely affect these uses.

If applied collectively, EPA believes its recommended salmonid uses and associated numeric criteria, if attained, will support healthy sustainable salmonid populations. However, EPA notes that it must still consider any new or revised temperature WQS submitted by a State or Tribe on a case-by-case basis and must take into account any new information made available to EPA at that time.

*Determining the Spatial Extent of the Recommended Salmonid Uses*

It is well recognized that the current distribution of salmonids in the Pacific Northwest has significantly shrunk and is more fragmented than their historical distribution due to human development. It is also unlikely that the current distribution of salmonids will provide for sustainable salmonid populations. EPA believes that, in order to meet the national goal of providing for the protection and propagation of fish wherever attainable, salmonid use designations should be of sufficient geographic and temporal scope to support sustainable levels of use. This is because, unless the designated use specifically provides otherwise, a salmonid use reasonably implies a healthy and sustainable population. Because of the importance of restoring healthy salmonid populations in the Pacific Northwest, EPA Region 10 advises States and Tribes not to limit salmonid use designations to where and when salmonid uses occur today when assigning uses in areas with thermally degraded habitat.

For areas with degraded habitat, EPA recommends that coldwater salmonid uses be designated in waters where the defined use currently occurs or is suspected to currently occur, and where there is reasonable potential for that use to occur (e.g., if temperatures or other habitat features, including fish passage improvements, were to be restored in areas of degraded habitat). In most areas of degraded habitat, temperatures have risen, thereby forcing salmonids upstream to find suitable water temperatures for rearing and spawning. As a result, the downstream extent of current use is likely farther upstream than it was prior to habitat degradation. For areas with minimal habitat degradation, where human impacts have not likely altered fish distribution, EPA recommends use designations based on where the use currently occurs or is suspected to currently occur.

EPA's recommendations for designating the spatial extent of the various salmonid uses are described below in Sections V.1.C and V.1.D. The goal of these recommendations is to include the potential use areas for each salmonid use where the habitat has been degraded due to human impacts. For example, for the bull trout rearing use and the salmon/trout core rearing use, which are intended to protect waters of moderate to high density rearing use, EPA recommends that for areas of degraded habitat, these uses cover the downstream extent of low density rearing that currently occurs during the period of maximum summer temperatures (typically July and August). The concept here is that waters where rearing currently occurs in low density during the summer is a reasonable approximation of waters that could support moderate to high density use if the temperature were reduced.

EPA fully recognizes the difficulties in spatially designating the recommended salmonid uses. First, information on fish distribution, particularly juvenile rearing distribution, is sparse in many locations. For example, in some situations there may be fairly good information on spawning areas, but minimal information on juvenile rearing distribution. In those situations, a State or

Tribe could consider using the spawning distribution along with inferences drawn from what information exists on juvenile rearing as the primary basis for designating the bull trout and the core salmon and trout rearing uses. Second, there is a fair degree of both inter-annual and seasonal variability in fish distribution. Third, there is no bright line that defines degraded habitat; rather there is a spectrum from non-degraded to highly degraded.

States and Tribes, therefore, should use the best available scientific information (e.g., the types of information described in Sections V.1.C and V.1.D) and make well-reasoned judgments when designating the various salmonid uses. In some cases, that may mean extrapolating from limited information and making generalizations based on stream order, size, and elevation. Thus, EPA recognizes there is an inherent element of subjectivity to designating the recommended salmonid uses. However, because the recommended salmonid uses are fairly broad scale (applying to large areas of a river basin), EPA believes that the recommended use designations are reasonable given the current level of information. If a State or Tribe decides to revise its salmonid use designations and submit them to EPA for approval, it should include a description of the information and judgments it made to determine the spatial extent of its salmonid uses.

Lastly, EPA also believes that better information on fish distribution is valuable for both CWA and ESA purposes and that adopting the recommended salmonid use designations (or others justified by the best available scientific information) will provide impetus to acquire more and better information in the future.

V.1.B. EPA Region 10's Recommended Salmonid Uses and Numeric Criteria

EPA Region 10's recommended coldwater salmonid uses and criteria to protect those uses are presented in Tables 3 and 4. Table 3 describes uses that occur during the summer maximum temperature conditions. Designating the uses in Table 3 would result in apportioning a river basin to up to 4 salmonid use categories with associated criteria (e.g., 12°C, 16°C, 18°C, and 20°C). The colder criteria would apply in the headwaters and the warmer criteria would apply in the lower river reaches, which is consistent with the typical thermal and salmonid use patterns of rivers in the Pacific Northwest during the summer. It should be noted, however, that there may be situations where a warmer use and criteria would apply upstream of a colder use and criteria (e.g., where a relatively large cold tributary enters a warmer river, which significantly cools the river).

Table 4 describes coldwater salmonid uses that generally occur at times other than during the summer maximum period, except for some circumstances. EPA recommends that these criteria apply when and where these uses occur and may potentially occur.

**Table 3. Recommended Uses & Criteria That Apply To Summer Maximum Temperatures**

*Notes: 1) "7DADM" refers to the Maximum 7 Day Average of the Daily Maximums; 2) "Salmon" refers to Chinook, Coho, Sockeye, Pink, and Chum salmon; 3) "Trout" refers to Steelhead and coastal cutthroat trout*

| Salmonid Uses During the Summer Maximum Conditions | Criteria |
|---|---|
| Bull Trout Juvenile Rearing | 12°C (55°F) 7DADM |
| Salmon/Trout "Core" Juvenile Rearing<br><br>*(Salmon adult holding prior to spawning, and adult and sub-adult bull trout foraging and migration may also be included in this use category)* | 16°C (61°F) 7DADM |
| Salmon/Trout Migration plus Non-Core Juvenile Rearing | 18°C (64°F) 7DADM |
| Salmon/Trout Migration<br><br>. | 20°C (68°C) 7DADM, plus a provision to protect and, where feasible, restore the natural thermal regime |

**Table 4. Other Recommended Uses & Criteria**

*Notes: 1) "7DADM" refers to the Maximum 7 Day Average of the Daily Maximums; 2) "Salmon" refers to Chinook, Coho, Sockeye, Pink, and Chum salmon; 3) "Trout" refers to Steelhead and coastal cutthroat trout;*

| Salmonid Uses | Criteria |
|---|---|
| Bull Trout Spawning | 9°C (48°F) 7DADM |
| Salmon/Trout Spawning, Egg Incubation, and Fry Emergence | 13°C (55°F) 7DADM |
| Steelhead Smoltification | 14°C (57°F) 7DADM |

V.1.C. Discussion of Uses and Criteria Presented in Table 3

*Bull Trout Juvenile Rearing - 12°C 7DADM*

EPA recommends this use for the protection of moderate to high density summertime bull trout juvenile rearing near their natal streams in their first years of life prior to making downstream migrations. This use is generally found in a river basin's upper reaches.

EPA recommends a 12°C maximum 7DADM criterion for this use to: (1) safely protect juvenile bull trout from lethal temperatures; (2) provide upper optimal conditions under limited food for juvenile growth during the period of summer maximum temperature and optimal temperature for other times of the growth season; (3) provide temperatures where juvenile bull trout are not at a competitive disadvantage with other salmonids; and (4) provide temperatures that are consistent with field studies showing where juvenile bull trout have the highest probability to occur (see Table 2).

EPA recommends that the spatial extent of this use include: (1) waters with degraded habitat where high and low density juvenile bull trout rearing currently occurs or is suspected to currently occur during the period of maximum summer temperatures, except for isolated patches of a few fish that are spatially disconnected from more continuous upstream low density use; (2) waters with minimally-degraded habitat where moderate to high density bull trout rearing currently occurs or is suspected to currently occur during the period of maximum summer temperatures; (3) waters where bull trout spawning currently occurs; (4) waters where juvenile rearing may occur and the current 7DADM temperature is 12°C or lower; and (5) waters where other information indicates the potential for moderate to high density bull trout rearing use during the period of maximum summer temperatures (e.g., recovery plans, bull trout spawning and rearing critical habitat designations, historical distributions, current distribution in reference streams, studies showing suitable rearing habitat that is currently blocked by barriers that can reasonably be modified to allow passage, or temperature modeling).

*Salmon and Trout "Core" Juvenile Rearing - 16°C 7DADM*

EPA recommends this use for the protection of moderate to high density summertime salmon and trout juvenile rearing. This use is generally found in a river basin's mid-to-upper reaches, downstream from juvenile bull trout rearing areas. However, in colder climates, such as the Olympic mountains and the west slopes of the Cascades, it may be appropriate to designate this use all the way to the saltwater estuary.

Protection of these waters for salmon and trout juvenile rearing also provides protection for adult spring chinook salmon that hold throughout the summer prior to spawning and for migrating and foraging adult and sub-adult bull trout, which also frequently use these waters.

EPA recommends a 16°C maximum 7DADM criterion for this use to: (1) safely protect juvenile salmon and trout from lethal temperatures; (2) provide upper optimal conditions for juvenile growth under limited food during the period of summer maximum temperatures and optimal temperatures for other times of the growth season; (3) avoid temperatures where juvenile salmon and trout are at a competitive disadvantage with other fish; (4) protect against temperature-induced elevated disease rates; and (5) provide temperatures that studies show juvenile salmon and trout prefer and are found in high densities (see Table 1).

EPA recommends that the spatial extent of this use include: (1) waters with degraded habitat where high and low density salmon and trout juvenile rearing currently occurs or is suspected to currently occur during the period of maximum summer temperatures, except for isolated patches of a few fish that are spatially disconnected from more continuous upstream low density use; (2) waters with minimally-degraded habitat where moderate to high density salmon and trout juvenile rearing currently occurs or is suspected to currently occur during the period of maximum summer temperatures; (3) waters where trout egg incubation and fry emergence and salmon spawning currently occurs during the summer months (mid-June through mid-September); (4) waters where juvenile rearing may occur and the current 7DADM temperature is 16°C or lower; (5) waters where adult and sub-adult bull trout foraging and migration occurs during the period of summer maximum temperatures; and (6) waters where other information indicates the potential for moderate to high density salmon and trout rearing use during the period of maximum summer temperatures (e.g., recovery plans, critical habitat designations, historical distributions, current distribution in reference streams, studies showing suitable rearing habitat that is currently blocked by barriers that can reasonably be modified to allow passage, or temperature modeling).

Please note that at this time EPA is recommending that adult and sub-adult bull trout foraging and migration be included in this use category as opposed to establishing a separate use and associated criterion. Our current knowledge of bull trout migration timing and their *main channel* temperature preference is limited, but we do know that they prefer water temperatures less than 15°C, that they take advantage of cold water refugia during the period of summer maximum temperatures, and that spawning adults move toward spawning grounds during the period of summer maximum temperatures. EPA, therefore, believes its recommended approach would protect migrating and foraging bull trout because average river temperatures will likely be below 15°C, a fair amount of cold water refugia is expected in rivers that attain a maximum 7DADM of 16°C, and maximum temperatures below 16°C are likely to occur upstream of the downstream point of this use designation where most bull trout migration and foraging is likely to occur during the period of summer maximum temperatures. As more is learned about adult and sub-adult bull trout foraging and migration, EPA, in consultation with the U.S. Fish and Wildlife Service, may reconsider this recommendation.

*Salmon and Trout Migration Plus Non-Core Juvenile Rearing - 18°C 7DADM*

EPA recommends this use for the protection of migrating adult and juvenile salmonids and moderate to low density salmon and trout juvenile rearing during the period of summer maximum temperatures. This use designation recognizes the fact that salmon and trout juveniles will use waters that have a higher temperature than their optimal thermal range. For water bodies that are currently degraded, there is likely to be very limited current juvenile rearing during the period of maximum summer temperatures in these waters. However, there is likely to be more extensive current juvenile rearing use in these waters during other times of the year. Thus, for degraded waters, this use designation could indicate a potential rearing use during the period of summer maximum temperatures if maximum temperatures are reduced.

This use is generally found in the mid and lower part of a basin, downstream of the Salmon and Trout Core Juvenile Rearing use. In many river basins in the Pacific Northwest, it may be appropriate to designate this use all the way to a river basin's terminus (i.e., confluence with the Columbia River or saltwater).

EPA recommends an 18°C maximum 7DADM criterion for this use to: (1) safely protect against lethal conditions for both juveniles and adults; (2) prevent migration blockage conditions for migrating adults; (3) provide optimal or near optimal juvenile growth conditions (under limited food conditions) for much of the summer, except during the summer maximum conditions, which would be warmer than optimal; and (4) prevent adults and juveniles from high disease risk and minimize the exposure time to temperatures that can lead to elevated disease rates (See Table 1).

The upstream extent of this use designation is largely driven by where the salmon and trout core juvenile rearing use (16°C) is defined. It may be appropriate to designate this use downstream to the basin's terminus, unless a salmon and trout migration use (20°C) is designated there. Generally, for degraded water bodies, this use should include waters where juvenile rearing currently occurs during the late spring-early summer and late summer-early fall, because those current uses could indicate potential use during the period of summer maximum temperatures if temperatures were to be reduced.

*Salmon and Trout Migration - 20°C 7DADM plus a provision to protect and, where feasible, restore the natural thermal regime*

EPA recommends this use for waterbodies that are used almost exclusively for migrating salmon and trout during the period of summer maximum temperatures. Some isolated salmon and trout juvenile rearing may occur in these waters during the period of summer maximum temperatures, but when it does, such rearing is usually found only in the confluence of colder tributaries or other areas of colder waters. Further, in these waters, juvenile rearing was likely to have been mainly in cold water refugia areas during the period of maximum temperatures prior to human alteration of the landscape. It should also be noted that most fish migrating in these waters do so in the spring-early summer or in the fall when temperatures are cooler than the summer maximum temperatures, but some species (e.g., late migrating juvenile fall chinook; adult summer chinook, fall chinook, summer steelhead, and sockeye) may migrate in these waters during the period of summer maximum temperatures.

This use is probably best suited to the lower part of major rivers in the Pacific Northwest, where based on best available scientific information, it appears that the natural background maximum temperatures likely reached 20°C. When designating the spatial extent of this use, EPA expects the State or Tribe to provide information that suggests that natural background maximum temperatures reached 20°C. However, EPA does not expect the State or Tribe to have conducted a process-based temperature model (see Section VI.3 below for a discussion on methods to demonstrate natural background temperatures). If a State or Tribe determines that the natural background temperature is higher than 20°C for a particular location and wants to establish a numeric criterion higher than 20°C, it should follow the procedures described in Section VI.1.B for the establishment of site-specific numeric criteria based on natural background conditions.

To protect this use, EPA recommends a 20°C maximum 7DADM numeric criterion *plus* a narrative provision that would require the protection, and where feasible, the restoration of the natural thermal regime. EPA believes that a 20°C criterion would protect migrating juveniles and adults from lethal temperatures and would prevent migration blockage conditions. However, EPA is concerned that rivers with significant hydrologic alterations (e.g., rivers with dams and reservoirs, water withdrawals, and/or significant river channelization) may experience a loss of temperature diversity in the river, such that maximum temperatures occur for an extended period of time and there is little cold water refugia available for fish to escape maximum temperatures. In this case, even if the river meets a 20°C criterion for maximum temperatures, the duration of exposure to 20°C temperatures may cause adverse effects in the form of increased disease and decreased swimming performance in adults, and increased disease, impaired smoltification, reduced growth, and increased predation for late emigrating juveniles (e.g., fall chinook in the Columbia and Snake Rivers). Therefore, in order to protect this use with a 20°C criterion, it may be necessary for a State or Tribe to supplement the numeric criterion with a narrative provision to protect and, where feasible, restore the natural thermal regime for rivers with significant hydrologic alterations.

Critical aspects of the natural thermal regime that should be protected and restored include: the spatial extent of cold water refugia (generally defined as waters that are 2°C colder than the surrounding water), the diurnal temperature variation, the seasonal temperature variation (i.e., number of days at or near the maximum temperature), and shifts in the annual temperature pattern. The narrative provision should call for the protection, and where feasible, the restoration of these aspects of the natural temperature regime. EPA notes that the *protection* of existing cold water refugia should already be provided by the State's or Tribe's antidegradation provisions or by the cold water protection provisions discussed in Section V.2 below. Thus, the new concept introduced by the narrative provision EPA recommends here is the *restoration* of the natural thermal regime, where feasible.

Although some altered rivers, such as the Columbia and Snake, experience similar summer maximum temperatures today as they did historically, there is a big difference between the temperatures that fish experience today versus what they likely experienced historically. Unaltered rivers generally had a high degree of spatial and temporal temperature diversity, with portions of the river or time periods that were colder than the maximum river temperatures. These cold portions or time periods in an otherwise warm river provided salmonids cold water refugia to tolerate such situations. The loss of this temperature diversity may be as significant to salmon and trout in the Columbia and Snake Rivers and their major tributaries as maximum temperatures. Therefore, protection and restoration of temperature diversity is likely critical in order for salmonids to migrate through these waters with minimal thermal stress.

The areas where relatively cold tributaries join the mainstem river and where groundwater exchanges with the river flow (hyporheic flow) are two critical areas that provide cold water refugia for salmonids to escape maximum temperatures. As described in Issue Paper 3 and the *Return to the River* report (2000), alluvial floodplains with a high level of groundwater exchange historically provided high quality habitat that served as cold water refugia during the summer for large rivers in the Columbia River basin (and other rivers of the Pacific Northwest). These alluvial reaches are interspersed between bedrock canyons and are like beads on a string along the river continuum. Today, most of the alluvial floodplains are either flooded by dams, altered through diking and channelization, or lack sufficient water to function as refugia. Efforts to restore these alluvial river functions and maintain or cool down tributary flows will probably be critical to protect this use.

As noted above, EPA recommends that States and Tribes include a natural thermal regime narrative provision to accompany the 20°C numeric criterion. If a State or Tribe chooses to do so, TMDL allocations would reflect the protection, and where feasible, the restoration of the cold water refugia and other aspects of the natural thermal regime described above. If it is impracticable to quantify allocations to restore the natural thermal regime in the TMDL load allocations, then the TMDL assessment document should qualitatively address the human impacts that alter the thermal regime. Plans to implement the TMDL (e.g., watershed restoration plans) should include measures to restore the potential areas of cold water refugia and the natural daily and seasonal temperature patterns. See Section VI.2.B below for a similar discussion regarding TMDLs designed to meet temperature targets exceeding 18°C.

V.1.D. Discussion of Uses and Criteria Presented in Table 4

As discussed in Section V.1.B above, EPA recommends additional uses and criteria that would generally apply during times other than the period of summer maximum temperatures. These additional uses and criteria are intended to provide an added degree of protection for those situations where control of the summer maximum temperature is inadequate to protect these sensitive uses. EPA’s recommendations assume that when these uses do occur during the time of summer maximum temperatures, these more sensitive uses and associated numeric criteria would apply.

In many situations, if the summer maximum criteria are attained (e.g., 12°C, 16°C, 18°C, 20°C), EPA expects that temperatures will be low enough due to typical spring warming and fall cooling patterns to support the uses described below. However, in developing this guidance, EPA did not assess data in sufficient detail to determine the extent to which these uses are protected vis-a-vis the summer maximum criterion. With respect to spawning and egg incubation, EPA is most concerned about protecting spawning and egg incubation that occurs during, or soon before or after, the period of summer maximum temperatures (e.g., spring chinook, summer chum, and bull trout spawning that occurs in the mid-to-late summer, and steelhead trout egg incubation that extends into the summer months).

In waters where there is a reasonable basis in concluding that control of the summer maximum criterion sufficiently protects some or all of the uses described below, it may be reasonable not to designate some of all of these specific salmonid uses (i.e., the use will be protected by the summer maximum criterion).

*Bull Trout Spawning - 9°C 7DADM*

EPA recommends this use for the protection waterbodies used or potentially used by bull trout for spawning, which generally occurs in the late summer-fall in the upper basins (the same waters that bull trout juveniles use for summer rearing). EPA recommends a 9°C maximum 7DADM criterion for this use and recommends that the use apply from the average date that spawning begins to the average date incubation ends (the first 7DADM is calculated 1 week after the average date that spawning begins). Meeting this criterion at the onset of spawning will likely provide protective temperatures for egg incubation (2 - 6°C) that occurs over the winter assuming the typical annual thermal pattern.

*Salmon and Trout Spawning, Egg Incubation, and Fry Emergence - 13°C 7DADM*

EPA recommends this use for the protection of waterbodies used or potentially used for salmon and trout spawning, egg incubation, and fry emergence. Generally, this use occurs: (a) in spring-early summer for trout (mid-upper reaches); (b) in late summer-fall for spring chinook (mid-upper reaches) and summer chum (lower reaches); and (c) in the fall for coho (mid-reaches), pink, chum, and fall chinook (the latter three in lower reaches). EPA recommends a 13°C maximum 7DADM criterion to protect these life stage uses for salmon and trout and recommends that this use apply from the average date that spawning begins to the average date incubation ends (the first 7DADM is calculated 1 week after the average date that spawning begins). Meeting this criterion at the onset of spawning for salmon and at the end of incubation for steelhead trout will likely provide protective temperatures for egg incubation (6 - 10°C) that occurs over the winter (salmon) and spring (trout), assuming the typical annual thermal pattern.

*Steelhead Trout Smoltification - 14°C 7DADM*

EPA recommends this use for the protection of waters where and when the early stages of steelhead trout smoltification occurs or may occur. Generally, this use occurs in April and May as steelhead trout make their migration to the ocean. EPA recommends a 14°C maximum 7DADM steelhead smoltification criterion to protect this sensitive use. As described in Table 1, steelhead smoltification can be impaired from exposure to greater than 12°C constant temperatures. The greatest risk to steelhead is during the early stages of smoltification that occurs in the spring (April and May). For the Columbia River tributaries, 90% of the steelhead smolts are typically past Bonneville dam by the end of May (Issue Paper 5, pg 59), indicating that applying this criterion at the mouths of major tributaries to the Columbia River in April and

May will likely protect this use. Applying this criterion to the Columbia River itself is probably unnecessary because the more temperature-sensitive early stages of smoltification occur in the tributaries. If steelhead in the early smoltification process are exposed to higher temperatures than the recommended criterion, they may cease migration or they may migrate to the ocean undeveloped, thereby reducing their estuary and ocean survival.

### V.2. Provisions to Protect Water Temperatures That Are Currently Colder Than The Numeric Criteria

One of the important principles in protecting populations at risk for any species is to first protect the existing high quality habitat and then to restore the degraded habitat that is adjacent to the high quality habitat. Further, EPA's WQS regulations recognize the importance of protecting waters that are of higher quality than the criteria (in this case, waters that are colder than numeric temperature criteria). See 40 C.F.R. § 131.12. EPA, therefore, believes it is important to have strong regulatory measures to protect waters with ESA-listed salmonids that are currently colder than EPA's recommended criteria. These waters likely represent the last remaining strongholds for these fish.

Because the temperatures of many waters in the Pacific Northwest are currently higher than the summer maximum criteria recommended in this guidance, the high quality, thermally optimal waters that do exist are likely vital for the survival of ESA-listed salmonids. Additional warming of these waters will likely cause harm by further limiting the availability of thermally optimal waters. Further, protection of these cold water segments in the upper part of a river basin likely plays a critical role in maintaining temperatures downstream. Thus, in situations where downstream temperatures currently exceed numeric criteria, upstream temperature increases to waters currently colder than the criteria may further contribute to the non-attainment downstream, especially where there are insufficient fully functioning river miles to allow the river to return to equilibrium temperatures (Issue Paper 3). Lastly, natural summertime temperatures in Pacific Northwest waters were spatially diverse, with areas of cold-optimal, warm-optimal, and warmer than optimal water. The 18°C and 20°C criterion described in Table 3 and the natural background provisions and use attainability pathways described in Section VI are included in this guidance as suggested ways to address those waters that are warmer than optimal for salmonids. EPA believes it is important, however, for States and Tribes to balance the effects of the warmer waters by adopting provisions to protect waters that are at the colder end of their optimal thermal range.

EPA, therefore, recommends that States and Tribes adopt strong regulatory provisions to protect waterbodies with ESA-listed salmonids that currently have summer maximum temperatures colder than the State's or Tribe's numeric criteria. EPA believes there are several ways a State or Tribe may do this. One approach could be to adopt a narrative temperature criterion (or alternatively include language in its antidegradation rules) that explicitly prohibits more than a de minimis increase to summer maximum temperatures in waters with ESA-listed salmonids that are currently colder than the summer maximum numeric criteria. Another approach could be to identify and designate waterbodies as ecologically significant for temperature and either establish site-specific numeric criteria equal to the current temperatures or prohibit temperature increases above a de minimis level in these waters. States and Tribes following this latter approach should conduct a broad survey to identify and designate such waters within the state (or tribal lands). For non-summer periods it may be appropriate to set a maximum allowable increase (e.g., 25% of the difference between the current temperature and the criterion) for waters with ESA-listed salmonids where temperatures are currently lower than the criteria.

Provisions to protect waters currently colder than numeric criteria can also be important to ensure numeric criteria protect salmonid uses. As discussed in Section V.1.A, the recommended criteria in this guidance are based in part on the assumption that meeting the criteria at the lowest downstream point at which the use is designated will likely result in cooler waters upstream. Cold water protection provisions as described here provide more certainty that this will be true. Further, if a State chooses to protect some or all of the sensitive uses in Table 4 (e.g., spawning) by using only the summer maximum criteria, it may also be necessary to protect waters currently colder than the summer maximum numeric criteria in order to assure that these sensitive uses are protected. Further, as described in Section V.1.B, protecting existing cold water is likely important in river reaches where a 20°C numeric criterion applies to protect salmon and trout migration use.

### V.3. Provisions to Protect Salmonids from Thermal Plume Impacts

EPA recommends that States and Tribes add specific provisions to either their temperature or mixing zone sections in their WQS to protect salmonids from thermal plume impacts. Specifically, language should be included that ensures that thermal plumes do not cause instantaneous lethal temperatures; thermal shock; migration blockage; adverse impact on spawning, egg incubation, and fry emergence areas; or the loss of localized cold water refugia. The following are examples from the scientific literature of potential adverse impacts that may result from thermal plumes, and EPA's recommendations to avoid or minimize those impacts.

- Exposures of less than10 seconds can cause instantaneous lethality at 32°C (WDOE, 2002). Therefore, EPA suggest that the maximum temperature within the plume after 2 seconds of plume travel from the point of discharge does not exceed 32°C.

- Thermal shock leading to increased predation can occur when salmon and trout exposed to near optimal temperatures (e.g., 15°C) experience a sudden temperature increase to 26 - 30°C for a short period of time (Coutant, 1973). Therefore, EPA suggests that thermal plumes be conditioned to limit the cross-sectional area of a river that exceeds 25°C to a small percent of the river (e.g., 5 percent or less).

- Adult migration blockage conditions can occur at 21°C (Table 1). Therefore, EPA suggests that the cross-sectional area of a river at or above 21°C be limited to less than 25% or, if upstream temperature exceeds 21°C, the thermal plume be limited such that 75% of the cross-sectional area of the river has less than a de minimis (e.g., 0.25°C) temperature increase.

- Adverse impacts on salmon and trout spawning, egg incubation, and fry emergence can occur when the temperatures exceed 13°C (Table 1). Therefore, EPA suggests that the thermal plume be limited so that temperatures exceeding 13°C do not occur in the vicinity of active spawning and egg incubation areas, or that the plume does not cause more than a de minimis (e.g., 0.25°C) increase in the river temperature in these areas.

## VI. Approaches to Address Situations Where the Numeric Criteria are Unachievable or Inappropriate

There are likely to be some streams and rivers in the Pacific Northwest where the criteria recommended in this guidance cannot be attained or where the criteria recommendations would otherwise be inappropriate. The following approaches are available under EPA's regulations to address these circumstances. See 40 C.F.R. Part 131. EPA describes these approaches below and recommends when it believes each approach may be appropriate.

It is important to note that most of these approaches are subject to EPA review and approval on a case-by-case basis (either in the form of a WQS, TMDL, or a 303(d) list approval), and where appropriate, are subject to consultation with the Services and affected Tribes.

### VI.1. Alternative Criteria

The following are three possible ways to establish alternative numeric criteria that would apply to a specific location.

<u>VI.1.A. Site-Specific Numeric Criteria that Supports the Use</u>

Under this approach, the State or Tribe would demonstrate that conditions at a particular location justify an alternative numeric criterion to support the designated salmonid use. See 40 C.F.R. § 131.11(b)(1)(ii). One example may be the adoption of a 13°C 7DADM criterion (instead of EPA's recommended 12°C criterion) to protect bull trout rearing use in areas where competition with other fish is minimal and food sources are abundant. Another example may be where there is exceptionally high natural diurnal temperature variation and where the maximum weekly mean temperature is within the optimal temperature range but, because of the high diurnal variation, summer maximum temperatures exceed the State or Tribe's numeric criteria. In this situation, a State or Tribe may choose to develop a site-specific numeric criterion based on a metric other that the 7DADM (e.g., a maximum weekly mean criterion plus a daily maximum criterion). There may be other situations as well when an alternative site-specific criterion would be appropriate. The State or Tribe would need to provide a clear description of the technical basis and methodology for deriving the alternative criterion and describe how it fully supports the designated use when it submits the criterion to EPA for approval. See 40 C.F.R. § 131.11(a).

VI.1.B. Numeric Criteria Based on Estimates of Natural Background Temperatures

Under this approach a State or Tribe could establish numeric criteria based on an estimate of the natural background temperature conditions. This would be another form of site-specific criteria under 40 C.F.R. § 131.11(b)(1)(ii). Natural background temperatures are those that would exist in the absence of human-activities that alter stream temperatures. States or Tribes following this approach may elect to adopt a single numeric criterion for a particular stream segment, such as a lower mainstem river, or adopt a numeric profile (i.e., a range of numbers typically colder in the headwaters and warmer downstream) for a whole watershed or sub-basin.

EPA views numeric criteria that reflect natural background conditions to be protective of salmonid designated uses because river temperatures prior to human impacts clearly supported healthy salmonid populations. Thus, when establishing site-specific numeric criteria in this manner, EPA believes it is unnecessary to modify the use designations. For example, if a State has designated a waterbody as salmon/trout core juvenile rearing use with an associated numeric criterion of 16°C 7DADM and later estimates the natural background temperature is 18°C 7DADM, the 18°C 7DADM could be adopted as a site-specific criterion that fully supports the salmon and trout core juvenile rearing use. A State or Tribe may also want to modify the spatial extent of its various salmonid use designations within the basin if the estimates of natural background provide new information that warrants such revisions. Additionally, at the time the State revises a salmonid use for a waterbody (e.g., designating a salmon/trout migration use), it could choose to establish a numeric criterion based on natural background conditions for that particular waterbody (e.g., 22°C 7DADM), which may be different from the generally applicable numeric criterion to support that use in the State's WQS (e.g., 20°C 7DADM).

States and Tribes following this approach will need to submit any such new or revised numeric criteria to EPA for approval and must include the methodology for determining the natural background condition. See 40 C.F.R. §§ 131.6 & 131.11(a). An alternative to establishing numeric criteria based on natural background conditions as described here is to adopt a narrative natural background provision, which would then be used in CWA section 303(d) listings, TMDLs, and NPDES permits as described in Section VI.2.

VI.1.C. Numeric Criteria In Conjunction with a Use Attainability Analysis

In situations where it appears that the numeric criterion or natural background provision (see Section VI.2) cannot be attained and the appropriateness of the designated use is in question, a State or Tribe could conduct a use attainability analysis (UAA) pursuant to 40 C.F.R. §§ 131.3(g) & 131.10. If it can be demonstrated that the current designated use is not attainable due to one of the factors at 40 C.F.R § 131.10(g), the State or Tribe must then adopt a different use appropriate to that water. See 40 C.F.R. § 131.10(a). In most cases, EPA expects that the appropriate use would be the most protective salmonid use that is attainable. The State or Tribe must then adopt a temperature criterion sufficient to protect that new use. See 40 C.F.R. § 131.11. EPA notes that, in all cases, uses attained since 1975, referred to as "existing uses," must be protected. See 40 C.F.R Part 131.10(h)(1). The new use could be described as a "compromised" or "degraded" salmonid use. It should be noted that a "compromised" or "degraded" level of use may be appropriate during part of the year (e.g., summer), but that an unqualified, healthy salmonid use may be attainable other times of the year and therefore may be the appropriate use then.

Examples of factors at 40 C.F.R. § 131.10(g) that could preclude attainment of the use include: human caused conditions or sources of pollution that cannot be remedied or would cause more environmental damage to correct than to leave in place; dams, diversions or other types of hydrologic modifications that cannot be operated in such a way as to result in the attainment of the use; and controls more stringent than those required by sections 301(b) and 306 of the CWA that would result in substantial and widespread economic and social impact.

Whenever a State or Tribe adopts new or revised designated uses, such as those described here, it is changing its WQS. Therefore, the State or Tribe must make the proposed change available for public notice and comment and must submit the new use and associated criteria, together with the supporting UAA, to EPA for review and approval. See CWA section 303(c)(1) & (c)(2)(A); 40 C.F.R. §§ 131.5 & 131.6. EPA recommends that a UAA seeking to demonstrate human impacts (including dams, diversions, or other hydrologic modifications) that prevent attainment of the current use, should include a full assessment of all possible mitigation measures and their associated costs when demonstrating which mitigation measures are not feasible. EPA's decision to approve or disapprove a use and criteria change associated with a UAA will need to be made on a case-by-case basis, taking into account the information available at the time, and where appropriate, after consultation with the Services and affected Tribes.

### VI.2. Use of a State's or Tribe's "Natural Background" Provisions

If it has not already done so, a State and Tribe may wish to consider adopting *narrative* natural background provisions in its WQS that would automatically take precedence over the otherwise applicable numeric criteria when natural background temperatures are higher than the numeric criteria. See 40 C.F.R. § 131.11(b)(2). If adopted by a State or Tribe and approved by EPA, narrative natural background provisions would be the applicable water quality criteria for CWA purposes when natural background temperatures are higher than the numeric criteria and would be utilized in 303(d) listings of impaired waterbodies, TMDLs, and NPDES permits in such situations. As discussed in Section V.1.B above, a State could also consider adopting a specific numeric criterion that reflects natural background temperatures (rather than leave natural background temperatures to case-by-case interpretation). The discussion here, however, assumes that a State or Tribe has not done so and instead has adopted a *narrative* natural background provision and would interpret it when necessary for CWA purposes.

VI.2.A. 303(d) Listings

If it can be demonstrated that a particular waterbody exceeds a temperature numeric criterion due to natural conditions (or natural conditions plus a de mimimis human impact, if a State or Tribe has this allowance in its WQS - see Section V.1.A), then the waterbody need not be listed on a State's or Tribe's 303(d) list. Such waterbodies would not be considered impaired because they would be meeting the narrative natural background provisions of the WQS. These waterbodies should be identified as an attachment to a State's or Tribe's section 303(d) list submission to EPA along with the demonstration that these waters do not exceed the natural background provision.

For situations where waterbodies exceed the applicable numeric criteria due to a combination of apparent natural background conditions and known or suspected human impacts (above a de minimis impact level, if applicable), it would be appropriate to list those waters on the 303(d) list because the waters would be exceeding the narrative natural background provision because of the human impacts. The TMDL process, described below, will provide the opportunity to distinguish the natural sources from the human caused sources.

VI.2.B. TMDLs

A State's or Tribe's narrative natural background provisions can be utilized in TMDLs to set water quality targets and allocate loads when natural background conditions are higher than the otherwise applicable numeric criteria. When doing so, estimated temperatures associated with natural background conditions would serve as the water quality target for the TMDL and would be used to set TMDL allocations. Thus, the TMDL would be written to meet the WQS natural background provision, and the load reductions contemplated by the TMDL would be equivalent to the removal of the human impacts (or all but de minimis human impacts, if applicable). It should be noted that if a State or Tribe has a de minimis temperature increase allowance above natural background temperatures (see Section V.1.A), the TMDL allocations should be based on attaining the natural background temperature plus the de minimis temperature allowance (e.g., natural background temperature plus 0.25°C).

When estimating natural background conditions, States and Tribes should use the best available scientific information and the techniques described in Section VI.3 below. For TMDLs, this usually includes temperature models. Those human impacts that cannot be captured in a model (e.g., loss of cooling due to loss of hyporheic flow, which is water that moves between the stream and the underlying streambed gravels) should be identified in the TMDL assessment document (i.e., supporting material to the TMDL itself) along with rough or qualitative estimates of their contribution to elevated water temperatures. Estimates of natural conditions should also be revisited periodically as our understanding of the natural system and temperature modeling techniques advance.

When using natural background maximum temperatures as TMDL targets and to set TMDL allocations, the TMDL assessment document should assess other aspects of the natural thermal regime including the spatial extent of cold water refugia (which, generally are defined as waters that are ≥2°C colder than the surrounding water), the diurnal temperature variation, seasonal temperature variation (i.e., number of days at or near the maximum temperature), and shifts in the annual temperature pattern. Findings from this assessment should be integrated into the TMDL and its allocations to the extent possible. For example, if possible, TMDL allocations should incorporate restoration of the diurnal and seasonal temperature regime and cold water refugia that reflect the natural condition. If it is impracticable to address these impacts quantitatively through allocations, then the TMDL assessment document should qualitatively discuss the human activities that modify these aspects of the natural thermal regime. Plans to implement the TMDL should include measures to restore and protect these unique aspects of the natural condition.

EPA believes it is particularly important for the TMDL itself or the TMDL assessment document to address the above aspects of the natural thermal regime for waterbodies where the natural background maximum 7DADM temperature exceeds 18°C and where the river has significant hydrologic alterations (e.g., dams and reservoirs, water withdrawals, and/or significant river channelization) that have resulted in the loss of temperature diversity in the river or shifted the natural temperature pattern. For example, there may be situations where the natural background maximum temperatures exceed 18°C, but historically the exposure time to maximum temperatures was limited due to the comparatively few number of hours in a day that the water reached these temperatures, the comparatively few number of days that reached these temperatures, and plentiful cold water refugia from cold tributary flows and hyporheic flow in alluvial floodplains where salmonids could avoid the maximum water temperatures.

If human impacts as identified at 40 C.F.R. 131.10(g) are determined to prevent attainment of the natural background conditions, the State or Tribe should follow the UAA process described in Section VI.1.C above and revise the use and adopt numeric criteria that would support a revised use. This new numeric criteria, if approved by EPA, would then be the temperature target in the TMDL and used to set load allocations.

Before determining that some of the human impacts preclude use attainment and pursuing a UAA, EPA Region 10 encourages States to develop and begin implementing TMDLs that reflect the applicable numeric criteria or natural background provisions and allow some time for implementation to proceed. EPA Region 10 encourages this approach because it is often the case that at the time a TMDL is developed there is little information on all the possible implementation measures and their associated costs, which may be important to justify a UAA. Further, after feasible implementation measures are completed, there will be better information as to what is the actual attainable use and associated water temperatures. If information is available at the time, however, it is possible for a State to conduct a UAA concurrently with the TMDL development process and, if appropriate, to revise the designated use and adopt new applicable numeric criteria for use when establishing the TMDL.

VI.2.C. NPDES Permits

When a permitting authority is establishing a temperature water quality-based effluent limit for an NPDES source, it must base the limit on the applicable water quality standards, which could be the numeric criteria or, if applicable, the narrative natural background provision. See 40 C.F.R. § 122.44(d)(1). EPA expects that, in most cases, the natural background temperature will be interpreted and expressed for the first time in a TMDL, but it is possible for the natural background temperature to be determined outside the context of a TMDL, although this would be unusual given the complexities involved in estimating natural background temperatures.

## VI.3. Overview of Methods to Estimate Natural Background Temperatures

There are a number of different ways of estimating natural background temperature conditions for the purposes of either adopting a site-specific criterion (see Section VI.1.B) or interpreting a narrative natural background provision (see Section VI.2). These include: (1) demonstrating that current temperatures reflect natural background conditions, (2) using a non-degraded reference stream for comparison, (3) using historical temperature data, (4) using statistical or computer simulation models, and (5) assessing the historical distribution of salmonids. There may be other ways as well. Each approach has its strengths and weaknesses and therefore may or may not be most appropriate for a given situation. Moreover, all of these approaches have uncertainty, which should be quantitatively described where possible. EPA encourages the use of a combination of approaches to estimate natural background temperatures, where feasible. Below is an overview of the five approaches listed above.

*Demonstrating That Current Temperatures Reflect Natural Background Conditions*

Under this approach, the past and present human activities that could impact the river temperatures are documented and a technical demonstration is made that the human activities do not currently impact temperatures. This approach is most applicable to non-degraded watersheds (e.g., state and national parks, wilderness areas, and protected state and national lands). These watersheds can be used as “reference” streams for estimating the natural background temperatures of degraded streams (see below). If there is a small human impact on temperatures, it may also be possible to estimate the human impact and subtract it from current temperatures to calculate the natural background temperatures.

*Comparisons to a Reference Stream*

It is often reasonable to assume that the natural background temperatures of a thermally degraded stream are similar to that of a non-degraded stream, so long as the location, landscape context, and physical structure of the stream are sufficiently similar. The challenge to this approach is finding a reference stream that is of similar location, landscape context, and physical structure.  Because large rivers are unique and most in the Pacific Northwest have been significantly impacted by human activities, this approach is most applicable to smaller streams where a reference stream with current temperatures at natural background conditions exist.

*Historical Data*

For some rivers, historical temperature data are available that reflect temperatures prior to human influences on the river's temperature regime, and can be used as an estimate of natural background temperatures.  Factors that lend uncertainty to historic temperature data are the uncertain nature of the quality of the data and whether or not humans affected temperature prior to data collection.  Further, historical temperature data often do not adequately capture the spatial and/or temporal variability in stream temperature due to limited spatial or temporal sampling.  Historical data may be useful, however, for verifying estimates of modeled natural background temperatures.

*Temperature Models*

Two major methods have been commonly used for water quality modeling in the United States over the last 20 years: 1) statistical models, which are based on observed relationships between variables and are often used in conjunction with measurements from a reference location, and 2) process-based models, which attempt to quantify the natural processes acting on the waterbody. Process-based models are often employed when no suitable reference locations can be identified.

Statistical models, also referred to as empirical models, estimate the thermal conditions of streams by using statistics to find correlations between stream temperature and those landscape characteristics that control temperature (e.g., elevation, latitude, aspect, riparian cover, etc.).  The equations in statistical models describe the observed relationships in the variables as they were measured in a specific location.  If the specific location is a non-degraded reference stream, then the model can be  used to estimate natural background conditions in degraded streams. Statistical models have the advantage of being relatively simple, as they rely on general data and statistics to develop correlations.

The comparability between the reference waterbody where the statistical correlations are generated and the assessment waterbody strongly affects the applicability of statistical models. Uncertainties in statistical model results increase with increasing dissimilarity between the landscape characteristics of the reference and assessment water bodies.  Uncertainties also increase when models do not include landscape characteristics that control important processes affecting the water temperature.   For these reasons, statistical models are best suited for small headwater streams or for generalized predictions across a large landscape.

Process models, also referred to as simulation models, are based on mathematical characterizations of the current scientific understanding of the critical processes that affect water temperature in rivers.  The equations are constructed to represent the observed or expected relationships and are generally based on physical or chemical principles that govern the fate and transport of heat in a river (e.g., net heat flux from long-wave radiation, direct short wave radiation, convection, conduction, evaporation, streamside shading, streambed friction, and water's back radiation) (Bartholow, 2000).

Estimating water temperature with a process model is generally a two-step process. As a first step, the current river temperatures are estimated with the input parameters (e.g., amount of shade provide by the canopy and river depth, width, and flow) reflecting current conditions and the model error is calculated by comparisons of the model estimate to actual temperature measurements. The second step involves changing the model input parameters to represent natural conditions, which results in a model output that predicts the natural background conditions. In recent years, increases in computer processing power have led to the development of distributed process models, which incorporate a high degree of spatial resolution. These models use Geographical Information Systems (GIS), remotely-sensed data, and site-specific data to vary the model's input parameters at different locations in the waterbody or the landscape.

Unlike statistical models, process models do not rely upon data from reference locations, so they can be used for rivers that have no suitable natural reference comparisons available. Thus, process models are well suited for estimating natural conditions for larger streams and rivers. Although powerful, process models are by no means infallible. Errors can arise when there are locally important factors that the model does not address, or when there is a great deal of uncertainty in input parameters that strongly influence the model results.

In addition to estimating natural background conditions, process-based models are useful for understanding the basic mechanisms influencing water temperature in a watershed, understanding the relative contributions from different sources at different locations, understanding cumulative downstream impacts from various thermal loads, performing "what if" scenarios for different mitigation options, and setting TMDL allocations.

*Historical Fish Distributions*

Maps of historic salmonid distributions and their time of use can provide rough estimates of natural background temperatures. Where and when salmonids existed historically likely provided temperatures suitable for salmonids and, as described in this guidance, we have a fairly good understanding of suitable temperatures for various life stages of salmonids.

## VII. Using EPA's Guidance to Change Salmonid Use Designations

The States of Idaho, Oregon, Washington and Pacific Northwest Tribes with WQS currently have salmonid use designations that are less spatially and temporally specific than those recommended in Section V.1 of this guidance. For instance, several States and Tribes employ broad salmonid use designations (e.g., migration, rearing, spawning) that apply generally to an entire basin or watershed. EPA's recommendations in Section V.1 are intended to assist States and Tribes with broad use designations to more precisely define when and where the different salmonid uses currently occur or may potentially occur within a basin.

For example, at the present time, a State may have a spawning use designated for an entire basin (or large waterbody), but not specify the waterbody segments or times of year to which that use designation should apply. After considering information that indicates where and when spawning currently occurs or may potentially occur, that State might decide that only certain locations and times in the basin should be designated for spawning. This same situation may also occur in the context of rearing and migration uses.

The intent of EPA's recommendations is to encourage States and Tribes, through these types of use refinements, to adopt a suite of interdependent salmonid uses. This suite of uses, in essence, would function as a single aquatic life use designation for the protection, at all life stages, of a sustainable salmonid population. Consequently, EPA believes that, as a general matter, use designations within a basin that reflect, at the appropriate times and places, the complete suite of uses to protect healthy salmonid populations at all life stages would fully protect the CWA section 101(a)(2) aquatic life uses. EPA, therefore, would not expect a UAA to accompany such use refinements as long as the overall sustainable salmonid population use is still being protected. See 40 C.F.R. § 131.10(k). It should be noted, however, that these types of use refinements are changes to a State's of Tribe's WQS and therefore require public notice and review and EPA approval.

## VIII. Temperature Limits for NPDES Sources

Section 301(b)(1)(C) of the CWA requires the achievement of NPDES effluent limitations as necessary to meet applicable WQS. EPA Region 10's general practice is to require that numeric criteria be met at end-of-pipe in impaired waterbodies (i.e., those that exceed water quality criteria). However, EPA Region 10 believes that in some situations numeric criteria end-of-pipe effluent limits for temperature may not be necessary to meet applicable WQS and protect salmonids in impaired waters. This is because the temperature effects from point source discharges generally diminish downstream quickly as heat is added and removed from a waterbody through natural equilibrium processes. The effects of temperature are unlike the effects of chemical pollutants, which may remain unaltered in the water column and/or accumulate in sediments and aquatic organisms. Further, temperature impairments in Pacific Northwest waters are largely caused by non-point sources. However, there may be situations where numeric criteria (or near numeric criteria) end-of-pipe effluent limits would be warranted, such as where a point source heat discharge is significant relative to the size of the river.

If a facility discharging heat into an impaired waterbody is seeking an effluent limit that is different than end-of-pipe numeric criteria, it should undertake a comprehensive temperature study. EPA recommends that regulatory authorities develop guidance on the content of these studies and on how alternative effluent limits may be developed that protect salmonids. EPA recommends that a temperature study, at a minimum, should consist of the following:

- A detailed engineering evaluation of sources of heat and possible measures to eliminate/reduce the heat sources and/or mitigate the effect of the heat sources. This could, for example, take the form of an engineering analysis of manufacturing processes or an investigation of sources of heat into publically-owned treatment plants. The engineering evaluation should include cost estimates for the possible temperature reduction measures.

- A modeling evaluation to determine a preliminary temperature effluent limit that meets the numeric criterion for the waterbody (or natural background temperature if applicable - see Section VI.2.C). For instance, it may be appropriate to use a simple energy balance equation (U.S. EPA, 1996) to calculate an effluent temperature that would ensure any downstream temperature increase above the numeric criterion (or natural background temperature) is de minimis (e.g., less than 0.25°C) after complete mixing. This approach assumes the State's or Tribe's WQS includes a de minimis temperature allowance as described in Section V.1.A. When using this approach, EPA recommends that the upstream water temperatures be assumed to be at the numeric criterion (or natural background temperature) and that a river flow be used that minimizes the percentage of the flow utilized for mixing purposes (e.g., 25% of 7Q10). The preliminary temperature effluent limit using this method should not exceed the current effluent temperature. In some situations it may be appropriate to utilize more complex modeling than described here (e.g., waters with multiple point source impacts).

- An evaluation of localized impacts of the thermal plume on salmonids based on plume modeling. The physical characteristics of the thermal plume (e.g., a 3-dimensional profile of temperatures) can be estimated using a near-field dilution model and adequate input data to run the model (e.g., river and effluent temperatures and flows). The preliminary effluent temperature derived from above (i.e., the effluent temperature derived from the energy balance equation or the current effluent temperature, whichever is lower) should be used in the model along with the current river temperature and flow for the seasons of concern. The preliminary effluent limit should be lowered, if necessary, to ensure that the localized adverse impacts on salmonids described in Section V.3 are avoided or minimized.

The results of these evaluations should be used to assist in the development of the final permit effluent limit in waters where a temperature TMDL has yet to be completed. Modeling evaluations, such as those described above, should be used in temperature TMDLs to help set wasteload allocations that can be used as temperature limits in NPDES permits. It may not be practicable, however, to complete near-field plume modeling for some or all point sources in large-scale temperature TMDLs. In these situations, the TMDL should indicate that the thermal plume modeling be done during permit development, which may result in an effluent limit lower than the TMDL wasteload allocation.

EPA Region 10 also believes that water quality trading may hold some promise to meet temperature WQS in a cost-effective manner that is beneficial for salmonids. In particular, a point source may be able to seek trades with non-point sources as a mechanism to meet its NPDES obligations. For example, a point source may help secure non-point controls beyond minimum state requirements, such as re-vegetation of a river's riparian zone, and use those temperature reductions to help meet its temperature reduction obligations. EPA encourages the use of this potentially valuable approach to help attain temperature WQS.

## IX. The Role of Temperature WQS in Protecting and Recovering ESA-Listed Salmonids and Examples of Actions to Restore Suitable Water Temperatures

EPA Region 10 and the Services believe that State and Tribal temperature WQS can be a valuable tool to protect and aid in the recovery of threatened and endangered salmonid species in the Pacific Northwest. The following are three important ways that temperature WQS, and measures to meet WQS, can protect salmonid populations and thereby aid in the recovery of these species. The first is to protect existing high quality waters (i.e., waters that currently are colder than the numeric criteria) and prevent any further thermal degradation in these areas. The second is to reduce maximum temperatures in thermally degraded stream and river reaches immediately downstream of the existing high quality habitat (e.g., downstream of wilderness areas and unimpaired forest lands), thereby expanding the habitat that is suitable for coldwater salmonid rearing and spawning. The third is to lower maximum temperatures and protect and restore the natural thermal regime in lower river reaches in order to improve thermal conditions for migration.

The following are examples of specific on-the-ground actions that could be done to meet temperature WQS, protect salmonid populations and also aid in the recovery of threatened and endangered salmonid species. Logically, these example actions are oriented toward reversing the human activities that can contribute to excess warming of river temperatures described in Section IV.2. See Issue Paper 3, Coutant (1999), and Return to the River (2000) for more detailed discussion. EPA encourages and hopes to help facilitate these types of actions and recognizes that collaborative efforts with multiple stakeholders holds the most promise to implement many of these measures.

- Replant native riparian vegetation
- Install fencing to keep livestock away from streams
- Establish protective buffer zones to protect and restore riparian vegetation
- Reconnect portions of the river channel with its floodplain

- Re-contour streams to follow their natural meandering pattern
- Increase flow in the river derived from more efficient use of water withdrawals
- Discharge cold water from stratified reservoirs behind dams
- Lower reservoirs to reduce the amount of shallow water in "overbank" zones
- Restore more natural flow regimes to allow alluvial river reaches to function
- Restore more natural flow regimes so that river temperatures exhibit a more natural diurnal and seasonal temperature regime

EPA and the Services acknowledge that efforts are underway on the part of some landowners, companies, non-profit organizations, tribes, local and state governments, and federal agencies in the Pacific Northwest to take actions to protect and restore suitable temperatures for salmonids and improve salmonid habitat generally. A few examples of broad-scale actions to improve temperatures for salmonids are: the Aquatic Conservation Strategy of the Northwest Forest Plan (federal lands); the State of Washington's forest protection regulations; and timber company Habitat Conservation Plans (HCPs), particularly the Simpson HCP, which was done concurrent with a temperature TMDL. Additionally, there are small-scale projects, which are too numerous to list here (e.g., tree plantings, fencing, and re-establishing the natural meandering channel of small streams), that have already contributed or will contribute to improved thermal conditions for salmonids. These efforts represent a good direction and start in the process of restoring stream temperatures in the Pacific Northwest.

EPA and the Services believe it is important to highlight these examples of on-the-ground actions to recognize their contribution to improving water temperatures, to demonstrate their feasibility, and to provide a model for others to take similar actions.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

September 4, 1996 F/NWO

TO: NMFS/NWR Staff

FROM: William Stelle, Jr., NWR Director

SUBJECT: Implementation of "Matrix of Pathways and Indicators" for evaluating the effects of human activities on anadromous salmonid habitat.

The implementation of the Endangered Species Act (ESA) often requires an evaluation of the effects of human activities on listed species and their habitats. The attached document, "Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale", provides guidance for evaluating the effects of human activities in a consistent, accurate manner. The guidance is based on a "Matrix of Pathways and Indicators", which is a simple yet holistic method of representing the information required to characterize environmental baseline conditions and predict the effects of human activities on them.

Staff are encouraged to share this guidance with colleagues from other agencies, particulary those who are conducting ESA consultation with us and require a means of evaluating the effects of their activities. This guidance need not be limited to ESA-related work as it is useful in evaluating the effects of human activities on anadromous salmonid habitat, whether a listed species is present or not. The development of this guidance is an iterative process, and its further refinement should done in cooperation with other agencies.

# Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale

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## Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale

Table of Contents

Overview . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . p. 2
Definitions of Effects, and Examples of Effects Deteminations . . . . . . . . . . . . . . . . . . 6
Matrix of Pathways and Indicators (Table 1) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9
Checklist for Documenting Environmental Baseline and Effects of Proposed Action(s) on Relevant Indicators (Table 2) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13
Dichotomous Key for Making Determinations of Effect (Figure 1) . . . . . . . . . . . . . . . 14
Appendix A - Overview of Some Key Habitat Elements and Activities Affecting Them . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15
Appendix B - Sample Species Narrative[1] . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 21
Appendix C - Comparison of ACS Objectives, Ecological Goals (Snake R. Recovery Plan and LRMP Biol. Opinion) and Factors & Indicators in Matrix . . . 25
Appendix D - ACS Objectives and Ecological Goals . . . . . . . . . . . . . . . . . . . . . . . . . 26

Footnote:

1) The species narrative is intended to provide the biologist or evaluator with an up-to-date source of information on the general biological parameters associated with the particular species being evaluated. References for additional information sources are provided.

## OVERVIEW

The following guidelines are designed to facilitate and standardize determinations of effect for Endangered Species Act (ESA) conferencing, consultations and permits focusing on anadromous salmonids. We recommend that this process be applied to individual or grouped actions at the watershed scale. When the National Marine Fisheries Service (NMFS) conducts an analysis of a proposed activity it involves the following steps: (1) Define the biological requirements of the listed species; (2) evaluate the relevance of the environmental baseline to the species' current status; (3) determine the effects of the proposed or continuing action on listed species; and (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects, and considering measures for survival and recovery specific to other life stages. The last item (item 4) addresses considerations given during a jeopardy analysis.

This document provides a consistent, logical line of reasoning to determine when and where adverse effects occur and why they occur. Please recognize that this document does not address jeopardy or identify the level of take or adverse effects which would constitute jeopardy. Jeopardy is determined on a case by case basis involving the specific information on habitat conditions and the health and status of the fish population. NMFS is currently preparing a set of guidelines, to be used in conjunction with this document, to help in the determination of jeopardy.

This document contains definitions of ESA effects and examples of effects determinations, a matrix of pathways of effects and indicators of those effects, a checklist for documenting the environmental baseline and effects of the proposed action(s) on the relevant indicators, and a dichotomous key for making determinations of effect. None of the tools identified in this document are new inventions. The matrix, checklist, and dichotomous key format were developed by the US Fish and Wildlife Service (USFWS) Region 2 and the USDA Forest Service Region 3 for a programmatic ESA section 7 consultation on effects of grazing (USFWS, May 5, 1995). The matrix developed here reflects the information needed to implement the Aquatic Conservation Strategy (ACS)(appendix D) and to evaluate effects relative to the Northwest Forest Plan ACS Objectives, and the Ecological Goals in the Proposed Recovery Plan for Snake River Salmon (appendix D) and the LRMP consultation on the eight National Forests in Idaho and Oregon.

Using these tools, the Federal agencies and Non-Federal Parties (referred to as evaluators in the remainder of this document) can make determinations of effect for proposed projects (i.e. "no effect"/"may affect" and "may affect, not likely to adversely affect"/"may affect, likely to adversely affect"). As explained below, these determinations of effect will depend on whether a proposed action (or group of actions) hinders the attainment of relevant environmental conditions (identified in the matrix as pathways and indicators) and/or results in "take", as defined in ESA, section 3 (18) of a proposed or listed species.

Finally, this document was designed to be applied to a wide range of environmental conditions. This means it must be flexible. It also means that a certain degree of professional judgement will be required in its application. **There will be circumstances where the ranges of numerics or descriptions in the matrix simply do not apply to a specific watershed or basin. In such a case, the evaluator will need to provide more biologically appropriate values. When this occurs, documentation justifying these changes should be presented in the biological assessment, habitat conservation plan, or other appropriate document so that NMFS can use it in preparation of a section 7 consultation, habitat conservation plan, or other appropriate biologically based document.**

Description of the Matrix:

The "Matrix of Pathways and Indicators" (Table 1) is designed to summarize important environmental parameters and levels of condition for each. This matrix is divided into six overall pathways (major rows in the matrix):

| | |
|---|---|
| -- Water Quality | -- Channel Condition and Dynamics |
| -- Habitat Access | -- Flow/Hydrology |
| -- Habitat Elements | -- Watershed Conditions |

Each of the above represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats. The pathways are further broken down into "indicators." Indicators are generally of two types: (1) Metrics that have associated numeric values (e.g. "six pools per mile"); and (2) descriptions (e.g. "adequate habitat refugia do not exist"). The purpose of having both types of indicators in the matrix is that numeric data are not always readily available for making determinations (or there are no reliable numeric indicators of the factor under consideration). In this case, a description of overall condition may be the only appropriate method available.

The columns in the matrix correspond to levels of condition of the indicator. There are three condition levels: "properly functioning," "at risk," and "not properly functioning." For each indicator, there is either a numeric value or range for a metric that describes the condition, a description of the condition, or both. When a numeric value and a description are combined in the same cell in the matrix, it is because accurate assessment of the indicator requires attention to both.

Description of the Checklist:

The "Checklist for Documenting Environmental Baseline and Effects of Proposed Action(s) on Relevant Indicators" (Table 2) is designed to be used in conjunction with the matrix. The checklist has six columns. The first three describe the condition of each indicator (which when taken together encompass the environmental baseline), and the second three describe the effects of the proposed action(s) on each indicator.

Description of the Dichotomous Key for Making ESA Determinations of Effect:

The "Dichotomous Key for Making ESA Determinations of Effect" (p. 15) is designed to guide determinations of effect for proposed actions that require a section 7 consultation or permit under Section 10 of the ESA. Once the matrix has been tailored (if necessary) to meet the needs of the evaluators, and the checklist has been filled out, the evaluators should use the key to help make their ESA determinations of effect.

How to Use the Matrix, Checklist, and Dichotomous Key

1) Group projects that are within a watershed.

2) Using the Matrix provided (or a version modified by the evaluator) **evaluate environmental baseline conditions** (mark on checklist), use all 6 pathways (identified in the matrix).

**Matrix of Pathways and Indicators**

Use to describe the Environmental Baseline Conditions

Water Quality, Habitat Access, Habitat Elements, Channel Condition and Dynamics, Flow/Hydrology, Watershed Condition

and

Then use the same Pathways and Indicators to evaluate the Proposed Projects

3) **Evaluate effects of the proposed action** using the matrix. Do they restore, maintain or degrade existing baseline conditions? Mark on checklist.

Mark Results on Checklist

4) Take the checklist you marked and the dichotomous key and answer the questions in the key **to reach a determination of effects.**

**Checklist**

| Environmental Baseline | | | Effects of the Action | | |
|---|---|---|---|---|---|
| Properly Funct. | At Risk | Not Properly Funct. | Maintain | Restore | Degrade |

Use Professional Judgement

and the Checklist to

Work through the Dichotomous Key

**Dichotomous Key**

Yes/No

No Effect
May Effect
Not Likely to Adversely Affect
Likely to Adversely Affect

(Note: Actual Matrix is on page 9,10,& 11. Actual Checklist on page 13.  Actual Dichotomous key on page 14)

## DEFINITIONS OF ESA EFFECTS AND EXAMPLES

Definitions of Effects Thresholds

Following are definitions of ESA effects (sources in *italics*). The first three ("no effect," "may affect, not likely to adversely affect," and "may affect, likely to adversely affect") are not defined in the ESA or implementing regulations. However, "likely to jeopardize" is defined in the implementing regulations:

**"No effect:"**

> This determination is only appropriate "if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect or an effect that is unlikely to occur." (From "*Common flaws in developing an effects determination*", Olympia Field Office, U.S. Fish and Wildlife Service). Furthermore, actions that result in a "beneficial effect" do not qualify as a no effect determination.

**"May affect, not likely to adversely affect:"**

> "The appropriate conclusion when effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgement, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur." (From "*Draft Endangered Species Consultation Handbook; Procedures for Conducting Section 7 Consultations and Conferences*," USFWS/NMFS, 1994). The term "negligible" has been used in many ESA consultations involving anadromous fish in the Snake River basin. The definition of this term is the same as "insignificant."

**"May affect, likely to adversely affect"**

> The appropriate conclusion when there is "more than a negligible potential to have adverse effects on the species or critical habitat" (*NMFS draft internal guidelines*). Unfortunately, there is no definition of adverse effects in the ESA or its implementing regulations. The draft Endangered Species Handbook (NMFS/USFWS, June 1994) provides this definition for "Is likely to adversely affect": "This conclusion is reached if any adverse effect to listed species or critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions. In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effects to individuals of the listed species or segments of

the critical habitat, then the proposed action 'is likely to adversely affect' the listed species or critical habitat."

The following is a definition specific to anadromous salmonids developed by NMFS, the FS, and the BLM during the PACFISH consultation; "Adverse effects include short or long-term, direct or indirect management-related, impacts of an individual or cumulative nature such as mortality, reduced growth or other adverse physiological changes, harassment of fish, physical disturbance of redds, reduced reproductive success, delayed or premature migration, or other adverse behavioral changes to listed anadromous salmonids at any life stage. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival and recovery of listed anadromous salmonids" (From *NMFS' Pacfish Biological Opinion, 1/23/95*). Interpretation of part of the preceding quotation has been problematic. The statement "...impacts of an individual or cumulative nature..." has often been applied only to actions and impacts, not organisms. NMFS' concern with this definition is that it does not clearly state that the described impacts include those to individual eggs or fish. However, this definition is useful if it is applied on the individual level as well as on the subpopulation and population levels.

For the purposes of Section 7, any action which has more than a negligible potential to result in "take" (see definition at bottom of Dichotomous Key, p. 14 of this document) is likely to adversely affect a proposed/listed species. It is not possible for NMFS or USFWS to concur on a "not likely to adversely affect" determination if the proposed action will cause take of the listed species. Take can be authorized in the Incidental Take Statement of a Biological Opinion after the anticipated extent and amount of take has been described, and the effects of the take are analyzed with respect to jeopardizing the species or adversely modifying critical habitat. Take, as defined in the ESA, clearly applies to the individual level, thus actions that have more than a negligible potential to cause take of individual eggs and/or fish are "likely to adversely affect."

**"Likely to jeopardize the continued existence of"**

The regulations define jeopardy as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (*50 CFR §402.02*).

"**Take**"

The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct". The USFWS further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering".

Examples of Effects Determinations

**"No effect"**

NMFS is encouraging evaluators to conference/consult at the watershed scale (i.e., on all proposed actions in a particular watershed) rather than on individual projects. Due to the strict definition of "no effect" (above), the interrelated nature of in-stream conditions and watershed conditions, and the watershed scale of these conferences, consultations, and activities "no effect" determinations for all actions in a watershed could be rare when proposed/listed species are present in or downstream from a given watershed. This is reflected in the dichotomous key, however the evaluator may identify some legitimate exceptions to this general rule.

Example:

The proposed project is in a watershed where available monitoring information indicates that in-stream habitat is in good functioning condition and riparian vegetation is at or near potential. The proposed activity will take place on stable soils and will not result in increased sediment production. No activity will take place in the riparian zone.

**"May affect, not likely to adversely affect"**

Example:

The proposed action is in a watershed where available monitoring information indicates that in-stream habitat is in good functioning condition and riparian vegetation is at or near potential. Past monitoring indicates that this type of action has led to the present condition (i.e., timely recovery has been achieved with the kind of management proposed in the action). Given available information, the potential for take to occur is negligible.

**"May affect, likely to adversely affect"**

Example:

The proposed action is in a watershed that has degraded baseline conditions such as excess fine sediment, high cobble embeddedness, or poor pool frequency/quality. If the action will further degrade any of these pathways, the determination is clearly "likely to adversely affect".

A less obvious example would be a proposed action in the same watershed that is designed to improve baseline conditions, such as road obliteration or culvert repair. Even though the intent is to improve the degraded conditions over the long-term, if any short-term impacts (such as temporary turbidity and sedimentation) will cause take (adverse effects), then the determination is "likely to adversely affect."

# TABLE 1. MATRIX of PATHWAYS AND INDICATORS

**(Remember, the ranges of criteria presented here are not absolute, they may be adjusted for unique watersheds. See p. 3)**

| PATHWAY | INDICATORS | PROPERLY FUNCTIONING | AT RISK | NOT PROPERLY FUNCTIONING |
|---|---|---|---|---|
| Water Quality: | Temperature | 50-57° F[1] | 57-60° (spawning)<br>57-64° (migration &rearing)[2] | > 60° (spawning)<br>> 64° (migration & rearing)[2] |
| | Sediment/Turbidity | < 12% fines (<0.85mm) in gravel[3], turbidity low | 12-17% (west-side)[3],<br>12-20% (east-side)[2],<br>turbidity moderate | >17% (west-side)[3],<br>>20% (east side)[2] fines at surface or depth in spawning habitat[2], turbidity high |
| | Chemical Contamination/ Nutrients | low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5] | moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[5] | high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[5] |
| Habitat Access: | Physical Barriers | any man-made barriers present in watershed allow upstream and downstream fish passage at all flows | any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows | any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows |
| Habitat Elements: | Substrate | dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%[3] | gravel and cobble is subdominant, or if dominant, embeddedness 20-30%[3] | bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[2] |
| | Large Woody Debris | Coast: >80 pieces/mile >24"diameter >50 ft. length[4]; East-side: >20 pieces/ mile >12"diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas | currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard | does not meet standards for properly functioning and lacks potential large woody debris recruitment |

| | | | | |
|---|---|---|---|---|
| | Pool Frequency<br><br>channel width # pools/mile[6]<br>5 feet 184<br>10 " 96<br>15 " 70<br>20 " 56<br>25 " 47<br>50 " 26<br>75 " 23<br>100 " 18 | meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above) | meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time | does not meet pool frequency standards |
| | Pool Quality | pools >1 meter deep (holding pools) with good cover and cool water[3], minor reduction of pool volume by fine sediment | few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment | no deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment |
| | Off-channel Habitat | backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)[3] | some backwaters and high energy side channels[3] | few or no backwaters, no off-channel ponds[3] |
| | Refugia (important remnant habitat for sensitive aquatic species) | habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7] | habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[7] | adequate habitat refugia do not exist[7] |
| Channel Condition & Dynamics: | Width/Depth Ratio | <10[2,4] | 10-12 (we are unaware of any criteria to reference) | >12 (we are unaware of any criteria to reference) |
| | Streambank Condition | >90% stable; i.e., on average, less than 10% of banks are actively eroding[2] | 80-90% stable | <80% stable |
| | Floodplain Connectivity | off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession | reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession | severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly |

| | | | | |
|---|---|---|---|---|
| Flow/Hydrology: | Change in Peak/ Base Flows | watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography | some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography | pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography |
| | Increase in Drainage Network | zero or minimum increases in drainage network density due to roads[8,9] | moderate increases in drainage network density due to roads (e.g., 5%)[8,9] | significant increases in drainage network density due to roads (e.g., 20-25%)[8,9] |
| Watershed Conditions: | Road Density & Location | <2 $mi/mi^2$[11], no valley bottom roads | 2-3 $mi/mi^2$, some valley bottom roads | >3 $mi/mi^2$, many valley bottom roads |
| | Disturbance History | <15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed[10] | <15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed[10] | >15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention |
| | Riparian Reserves | the riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact),and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/ composition >50%[12] | moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species ( 70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[12] | riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25%[12] |

[1] Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.

[2] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.

[3] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

[4] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.

[5] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.

[6] USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

[7] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on

Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[8] Wemple, B.C., 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

[9] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

[10] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[11] USDA Forest Service, 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

[12] Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p277.

## TABLE 2. CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

| PATHWAYS: INDICATORS | ENVIRONMENTAL BASELINE | | | EFFECTS OF THE ACTION(S) | | |
|---|---|---|---|---|---|---|
| | Properly Functioning[1] | At Risk[1] | Not Propr. Functioning[1] | Restore[2] | . . Maintain[3] | Degrade[4] |
| Water Quality: Temperature | | | | | | |
| Sediment | | | | | | |
| Chem. Contam./Nut. | | | | | | |
| Habitat Access: Physical Barriers | | | | | | |
| Habitat Elements: Substrate | | | | | | |
| Large Woody Debris | | | | | | |
| Pool Frequency | | | | | | |
| Pool Quality | | | | | | |
| Off-channel Habitat | | | | | | |
| Refugia | | | | | | |
| Channel Cond. & Dyn: Width/Depth Ratio | | | | | | |
| Streambank Cond. | | | | | | |
| Floodplain Connectivity | | | | | | |
| Flow/Hydrology: Peak/Base Flows | | | | | | |
| Drainage Network Increase | | | | | | |
| Watershed Conditions: Road Dens. & Loc. | | | | | | |
| Disturbance History | | | | | | |
| Riparian Reserves | | | | | | |

Watershed Name:______________________________ Location:______________________________

1 These three categories of function ("properly functioning", "at risk", and "not properly functioning") are defined for each indicator in the "Matrix of Pathways and Indicators" (Table 1 on p. 10 ).

2 For the purposes of this checklist, "restore" means to change the function of an "at risk" indicator to "properly functioning", or to change the function of a "not properly functioning" indicator to "at risk" or "properly functioning" (i.e., it does not apply to "properly functioning" indicators).

3 For the purposes of this checklist, "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

4 For the purposes of this checklist, "degrade" means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a "not properly functioning" indicator may be further worsened, and this should be noted.

## FIGURE 1. DICHOTOMOUS KEY FOR MAKING ESA DETERMINATION OF EFFECTS

1. Are there any proposed/listed anadromous salmonids and/or proposed/designated critical habitat in the watershed or downstream from the watershed?

   NO . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . No effect

   YES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . May affect, go to 2

2. Does the proposed action(s) have the potential to hinder attainment of relevant properly functioning indicators (from table 2)?

   YES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Likely to adversely affect

   NO . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Go to 3

3. Does the proposed action(s) have the potential to result in "take"[1] of proposed/listed anadromous salmonids or destruction/adverse modification of proposed/designated critical habitat?

   A. There is a negligible (extremely low) probability of take of proposed/listed anadromous salmonids or destruction/adverse modification of habitat . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Not likely to adversely affect

   B. There is more than a negligible probability of take of proposed/listed anadromous salmonids or destruction/adverse modification of habitat. . . Likely to adversely affect

[1] "Take" - The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct". The USFWS (USFWS, 1994) further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering".

## Appendix A
## Overview of Some Key Habitat Elements and Activities Affecting Them

The following are excerpts from A Coarse Screening Process For Potential Application in ESA Consultations (CRITFC, 1994). The excerpts are intended to stimulate the biologist's thought processes into evaluating all of the pathways through which habitat degradation could occur. Unfortunately this is not an all inclusive list. However, it is a start. We recommend that biologists review the entire "Coarse Screening" document and any other documents that are available to them. The "Coarse screening" document is available from The National Marine Fisheries Service, Portland, Oregon. We also highly recommend reviewing a report prepared by ManTech Environmental Research Services Corporation while under contract to the National Marine Fisheries Service (NMFS), Environmental Protection Agency and US Fish and Wildlife Service. The document is entitled "An Ecosystem Approach to Salmonid Conservation". This document is also available from the NMFS in Portland, Oregon.

**Channel Substrate:**

"Salmon survival and production are reduced as fine sediment increases, producing multiple negative impacts on salmon at several life stages. Increased fine sediment entombs incubating salmon in redds, reduces egg survival by reducing oxygen flow, alters the food web, reduces pool volumes for adult and juvenile salmon, and reduces the availability of rearing space for juveniles rendering them more susceptible to predation. Reduced survival-to-emergence (STE) for salmon caused by elevated fine sediment increases is of particular concern because it is a source of density-independent mortality that can have extremely significant negative effects on salmon populations even at low seeding.

The rearing capacity of salmon habitat is decreased as cobble embeddedness levels increase. Overwinter rearing habitat may be a major limiting factor to salmon production and survival. The loss of overwintering habitat may result in increased levels of mortality during rearing life stages."

**Channel Morphology**

"Available data indicate that the production of salmon is reduced as pool frequency and volume decrease. Large pools are required by salmon during rearing, spawning, and migration. Pools provide thermal refugia, velocity refugia during storm events, resting habitat for migrating salmon, and important rearing habitat for juvenile salmon."

"Fine sediment is deposited in pools during waning flows. Residual pool volume is the volume of a pool not filled by fine sediment accumulations. Fine sediment volumes in pools reduce pool quality and reduce residual pool volumes (the pool volume available for salmon use)."

"Available data indicate that salmon production increases as Large Woody Debris (LWD) increases. LWD provides cover, velocity refugia, and plays a vital role in pool formation and the maintenance of channel complexity required by salmon in natal habitat. LWD also aids in reducing channel erosion and buffering sediment inputs by providing sediment storage in headwater streams."

**Bank Stability**

"Bank stability is of prime importance in maintaining habitat conditions favoring salmon survival. Bank instability increases channel erosion that can lead to increased levels of fine sediment and the in-filling of pools. Unstable banks can lead to stream incisement that can reduce baseflow contributions from groundwater and increase water temperature. Bank instability can cause channel widening that can significantly exacerbate seasonal water temperature extremes and destabilize LWD."

**Water Temperature**

"Available information indicates that the elevation of summer water temperatures impairs salmon production at scales ranging from the reach to the stream network and puts fish at greater risk through a variety of effects that operate at scales ranging from the individual organism to the aquatic community level. Maximum summer water temperatures in excess of 60°F impair salmon production. However, many smaller streams naturally have much lower temperatures and these conditions are critical to maintaining downstream water temperatures. At the stream system level, elevated water temperatures reduce the area of usable habitat during the summer and can render the most potentially productive and structurally complex habitats unusable. Decreases in winter water temperatures also put salmon at additional risk. The loss of vegetative shading is the predominant cause of anthropogenically elevated summer water temperature. Channel widening and reduced baseflows exacerbate seasonal water temperature extremes. Elevated summer water temperatures also reduce the diversity of coldwater fish assemblages."

**Water Quantity and Timing**

"The frequency and magnitude of stream discharge strongly influence substrate and channel morphology conditions, as well as the amount of available spawning and rearing area for salmon. Increased peak flows can cause redd scouring, channel widening, stream incisement, increased sedimentation. Lower streamflows are more susceptible to seasonal temperature extremes in both winter and summer. The dewatering of reaches can block salmon passage."

<u>Some Major Activities and their Effects</u>

**Logging**

Regional differences in climate, geomorphology, soils, and vegetation may greatly influence timber harvest effects on streams of a given size. However, some broad generalizations can be made on how timber harvest affects the hydrologic cycle, sediment input, and channel morphology of streams:

*1. Hydrologic cycle.* Timber harvest often alters normal streamflow patterns, particularly the volume of peak flows (maximum volume of water in the stream) and base flows (the volume of water in the stream representing the groundwater contribution). The degree these parameters change depend on the percentage of total tree cover removed from the watershed and the amount of soil disturbance caused by the harvest, among other things. For example, if harvest activities remove a high percentage of tree cover and cause light soil disturbance and compaction, rain falling on the soil will infiltrate normally. However, due to the loss of tree cover, evapotranspiration (the loss of water by plants to the atmosphere) will be much lower than before. Thus, the combination of normal water infiltration into the soil and greatly decreased uptake and loss of water by the tree cover results in substantially higher, sustained streamflows. Hence, this type of harvest results in higher base flows during dry times of the year when evapotranspiration is high, but does not greatly affect peak flows during wet times of the year because infiltration has not decreased and evapotranspiration is low. On the other hand, if the harvest activities cause high soil disturbance and compaction, little rainfall will be able to penetrate the soil and recharge groundwater. This results in higher surface runoff and equal or slightly higher base flows during dry times of the year. During wet times of the year, the compacted soils deliver high amounts of surface runoff, substantially increasing peak flows. In general, timber harvest on a watershed-wide scale results in water moving more quickly through the watershed (i.e., higher runoff rates, higher peak and base flows) because of decreased soil infiltration and evapotranspiration. This greatly simplified model only partly illustrates the complex hydrologic responses to timber harvest (Chamberlain et al. 1991, Gordon et al. 1992).

*2. Sediment input.* Timber harvest activities such as road-building and use, skidding logs, clear-cutting, and burning increase the amount of bare compacted soil exposed to rainfall and runoff, resulting in higher rates of surface erosion. Some of this hillside sediment reaches streams via roads, skid trails, and/or ditches (Chamberlain et al. 1991). Appropriate management precautions such as avoiding timber harvest in very wet seasons, maintaining buffer zones below open slopes, and skidding over snow can decrease the amount of surface erosion (Packer 1967). Harvest activities can also greatly increase the likelihood of mass soil movements occurring, particularly along roads and on clear-cuts in steep terrain (Furniss et al. 1991, O'Loughlin 1972). Increased surface erosion and mass soil movements associated with timber harvest areas can result in an increase in sediment input to streams. Fine sediment may infiltrate into relatively clean streambed gravels or, if the supply of fine sediment is large, settle deeper into the streambed (Chamberlain et al. 1991).

*3. Stream channel morphology.* The hydrologic and sedimentation changes discussed above can influence a stream's morphology in many ways. Substantial increases in the volume and frequency of peak flows can cause streambed scour and bank erosion. A large sediment supply may cause aggradation of the stream channel, pool filling, and a reduction in gravel quality (Madej 1982). Streambank destabilization from vegetation removal, physical breakdown, or channel aggradation adds to sediment supply and generally results in a loss of stream channel complexity (Scrivener 1988). In addition, losses of in-stream large woody debris supplies (i.e., removal of riparian trees) also result in less channel complexity as wood-associated scour pools decrease in size and disappear (Chamberlain et al. 1991).

**Roads**

"Roads are one of the greatest sources of habitat degradation. Roads significantly elevate on-site erosion and sediment delivery, disrupt subsurface flows essential to the maintenance of baseflows, and can contribute to increased peak flows. Roads within riparian zones reduce shading and disrupt LWD sources for the life of the road. These effects degrade habitat by increasing fine sediment levels, reducing pool volumes, increasing channel width and exacerbating seasonal temperature extremes."

**Grazing**
The impacts of livestock grazing to stream habitat and fish populations can be separated into acute and chronic effects. Acute effects are those which contribute to the immediate loss of individual fish, and loss of specific habitat features (undercut banks, spawning beds, etc.) or localized reductions in habitat quality (sedimentation, loss of riparian vegetation, etc.). Chronic effects are those which, over a period of time, result in loss or reductions of entire populations of fish, or widespread reductions in habitat quantity and/or quality.

**Acute Effects**
Acute effects to habitat include compacting stream substrates, collapse of undercut banks, destabilized streambanks and localized reduction or removal of herbaceous and woody vegetation along streambanks and within riparian areas (Platts 1991). Increased levels of sediment can result through the resuspension of material within existing stream channels as well as increased contributions of sediment from adjacent streambanks and riparian areas. Impacts to stream and riparian areas resulting from grazing are dependent on the intensity, duration, and timing of grazing activities (Platts 1989) as well as the capacity of a given watershed to assimilate imposed activities, and the pre-activity condition of the watershed (Odum 1981).

**Chronic Effects**
Chronic effects of grazing result when upland and riparian areas are exposed to activity and disturbance levels that exceed assimilative abilities of a given watershed. Both direct and indirect fish mortality are possible, and the potential for mortality extends to all life cycle phases. As an example, following decades of high intensity season-long grazing on BLM lands in the Trout Creek Mountains of southeast Oregon, the Whitehorse Creek watershed had extensive areas of degraded upland and riparian habitat (BLM 1992). An extreme rain-on-snow event in late winter 1984 and subsequent flooding of area streams flushed adult and juvenile trout through area streams and into Whitehorse Ranch fields and the adjacent desert.

Although less extreme, increases in stream temperature and reduced allochthonous inputs following removal of riparian vegetation, increased sedimentation, and decreased water storage capacity work together to reduce the health and vigor of stream biotic communities (Armour et al. 1991, Platts 1991, Chaney et al. 1990). Increased sediment loads reduce primary production in streams. Reduced instream plant growth and riparian vegetation limits populations of terrestrial and aquatic insects. Persistent degraded conditions adversely influence resident fish populations (Meehan 1991).

**Mining**
"Mining activities can cause significant increases in sediment delivery. While mining may not be as geographically pervasive as other sediment-producing activities, surface mining typically increases sediment delivery much more per unit of disturbed area than other activities (Dunne and Leopold, 1978; USFS, 1980; Richards, 1982; Nelson et al. 1991) due to the level of disruption of soils, topography, and vegetation. Relatively small amounts of mining can increase sediment delivery significantly."

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Appendix B
Species Narrative

Umpqua River Sea-Run Cutthroat Trout (*Oncorhynchus clarki*)

Endangered Species Act Status: Proposed Endangered, July 8, 1994, Umpqua River Basin, in Southwestern Oregon. All life forms are included in this proposal.

**Description.** Sea-run cutthroat trout is a profusely spotted fish which often has red or sometimes orange slash marks on each side of the lower jaw. Coastal sea-run cutthroat trout often lose the cutthroat marks when in seawater. Some other trouts, such as Apache trout, Gila trout and Redband trout may also have yellowish or red slash marks. Other identifying marks include; the presence of basibranchial teeth, located on the basibranchial plate behind the tongue. The upper jaw is typically more than half the length of the head with the eye being well forward of the back of the maxilla.

The spots on cutthroat trout are small to medium, irregularly shaped, dispersed evenly over the entire body including the belly and anal fin. Coloration of sea-run fish is often silvery with a slight yellow tint. This silver coloration often masks the spots. Sea-run fish darken and take on spots after a period in freshwater. Freshwater fish are often more colorful with pale yellow colors on the body and red-orange or yellow on the lower fins. The gill plates sides and ventral areas may tinted a rosy color as spawning time draws nearer (description from Stolz and Schnell, 1991).

**Distribution.** Coastal cutthroat trout range from northern California to the Gulf of Alaska. The distribution of the proposed Umpqua River Sea-run cutthroat trout is the greater Umpqua River Basin located in Douglas County in southwestern Oregon. The Umpqua River Basin stretches from the Cascade Mountains in the east to the Pacific Ocean at Reedsport, Oregon. The drainages of the North and South Umpqua Rivers together make up about 2/3 of the greater Basin drainage, and each river is about 170 km long. The mainstem Umpqua River flows in a northwesterly direction another 180 km to the ocean. Together, the three rivers form one of the longest coastal basins in Oregon, approximately 340 km in length, with a drainage area of over 12,200 sq. km. Major tributaries of the mainstem Umpqua River include Calapooya (River Kilometer [RKm] 164), Elk (RKm 78), and Scholfield Creeks (Rkm 18) and the Smith River (Rkm 18). The estuary of the Umpqua River is one of largest on the Oregon coast and has a large seawater wedge that extends as far inland as Scottsburg, Oregon at Rkm 45. (From Status Review For Oregon's Umpqua River Sea-Run Cutthroat Trout, Johnson et al. 1994)

**Life Forms**
Sea-Run (anadromous) cutthroat trout

Cutthroat trout have evolved to exploit habitats least preferred by other salmonid species

(Johnston 1981). Unlike other anadromous salmonids, sea-run cutthroat trout do not over-winter in the ocean and only rarely make long extended migrations across large bodies of water. They migrate in the near-shore marine habitat and usually remain within 10 km of land (Sumner 1972, Giger 1972, Jones 1976, Johnston 1981). While most anadromous cutthroat trout enter seawater as 2- or 3-year-olds, some may remain in fresh water for up to 5 years before entering the sea (Sumner 1972, Giger 1972).

Resident (nonmigratory) cutthroat trout

Some cutthroat trout do not migrate long distances; instead, they remain in upper tributaries near spawning and rearing areas and maintain small home territories (Trotter 1989). Resident cutthroat trout have been observed in the upper Umpqua River drainage (Roth 1937, FCO and OSGC 1946 , ODFW 1993a)

During a radio tagging study Waters (1993) found that fish smaller than 180mm maintained home ranges of less than 14m of stream length and moved about an average of 27m during the study. Fish larger than 180mm had home ranges of about 76m and moved and average total distance of about 166m. This study was conducted in three tributaries of Rock Creek on the North Umpqua River drainage. (In Johnson et al. 1994)

River-Migrating (Potamodromous) cutthroat trout

Some cutthroat trout move within large river basins but do not migrate to the sea.

**Life History/Migration.**
The following descriptions are condensed from status review (Johnson et al. 1994)

Cutthroat trout spawning occurs between December and May and eggs begin to hatch within 6-7 weeks of spawning, depending on temperature. Alevins remain in the redds for a further few weeks and emerge as fry between March and June, with peak emergence in mid-April (Giger 1972, Scott and Crossman 1973). Newly emerged fry are about 25 mm long. They prefer low velocity margins, backwaters, and side channels, gradually moving into pools if competing species are absent. If coho fry are present they will drive the smaller cutthroat fry into riffles, where they will remain until decreasing water temperatures reduce the assertiveness of the coho fry (Stolz and Schnell, 1991). In winter , cutthroat trout go to pools near log jams or overhanging banks (Bustrad and Narver 1975).

**Parr Movements**
After emergence from redds, cutthroat trout juveniles generally remain in upper tributaries until they are 1 year of age, when they may begin extensive movement up and down streams.

Directed downstream movement by parr usually begins with the first spring rains (Giger 1972) but has been documented in every month of the year (Sumner 1953, 1962, 1972; Giger 1972; Moring and Lantz 1975; Johnston and Mercer 1976; Johnston 1981). As an example, from 1960 to 1963 (Lowry 1965) and from 1966 to 1970 (Giger 1972) in the Alsea River drainage, large downstream migrations of juvenile fish began in mid-April with peak movement in mid-May. Some juveniles (parr) even entered the estuary and remained there over the summer, although they did not smolt nor migrate to the open ocean (Giger 1972). In Oregon, upstream movement of juveniles from estuaries and mainstem to tributaries begins with the onset of winter freshets during November, December, and January (Giger 1972, Moring and Lantz 1975). At this time, these 1-year and older juvenile fish averaged less than 200 mm in length.

**Smoltification**

Time of initial seawater entry of smolts bound for the ocean varies by locality and may be related to marine conditions or food sources (Lowry 1965, 1966; Giger 1972; Johnston and Mercer 1976; Trotter 1989). In Washington and Oregon, entry begins as early as March, peaks in mid-May, and is essentially over by mid-June (Sumner 1953, 1972; Lowry 1965; Giger 1972; Moring and Lantz 1975; Johnston 1981). Seaward migration of smolts to protected areas appears to occur at an earlier age and a smaller size than to more exposed areas. On the less protected Oregon coast, cutthroat trout tend to migrate at an older age (age 3 and 4) and at a size of 200 to 255 mm (Lowry 1965, 1966; Giger 1972).

**Timing of smolt migrations in the Umpqua River**

Trap data from seven locations in the North Umpqua River in 1958 and from three locations in Steamboat Creek (a tributary of the North Umpqua River downstream of Soda Springs Dam) between 1958 and 1973 indicate that juvenile movement is similar to that reported by Lowry (1965) and Giger (1972) in other Oregon coastal rivers. Movement peaked in May and June, with a sharp decline in July, although some juveniles continued to be trapped through September and October. It is unknown whether Umpqua River cutthroat trout juveniles migrate from the upper basin areas to the estuary, but it seems unlikely considering the distance (well over 185 km) and the river conditions (average August river temperature at Winchester Dam (located on the main Umpqua River where the Interstate 5 highway crosses the Umpqua) since 1957 is 23.3° C) (ODFW 1993a).

**Estuary and Ocean Migration**

Migratory patterns of sea-run cutthroat trout differ from Pacific salmon in two major ways: few, if any, cutthroat overwinter in the ocean, and the fish do not usually make long open-ocean migrations, although they may travel considerable distances along the shoreline (Johnston 1981, Trotter 1989, Pauley et al. 1989). Studies by Giger (1972) and Jones (1973, 1974, 1975) indicated that cutthroat trout, whether initial or seasoned migrants, remained at sea an average of only 91 days, with a range of 5 to 158 days.

**Adult Freshwater Migrations**

In the Umpqua River, it is reported (ODFW 1993a) that cutthroat trout historically began upstream migrations in late June and continued to return through January with bimodal peaks in late-July and October. Giger (1972) reported a similar return pattern, but with slightly later modal peaks (mid-August and late-October to mid-November) on the Alsea River.

**Spawning/Rearing**

Cutthroat trout generally spawn in the tails of pools located in small tributaries at the upper limit of spawning and rearing sites of coho salmon and steelhead. Streams conditions are typically low stream gradient and low flows, usually less than 0.3 $m^3$/second during the summer (Johnston 1981). Spawn timing varies among streams, but generally occurs between December and May, with a peak in February (Trotter 1989).

Cutthroat trout are iteroparous and have been documented to spawn each year for at least 5 years (Giger 1972), although some cutthroat trout do not spawn every year (Giger 1972) and some do not return to seawater after spawning, but remain in fresh water for at least a year (Giger 1972, Tomasson 1978). Spawners may experience high post-spawning mortality due to weight loss of as much as 38% of pre-spawning mass (Sumner 1953) and other factors (Cramer 1940, Sumner 1953, Giger 1972, Scott and Crossman 1973).

**Food.**
In streams cutthroat trout feed mainly on terrestrial and aquatic insects that come to them in the drift. When in the marine environment cutthroat trout feed around gravel beaches, off the mouths of small creeks and beach trickles, around oyster beds and patches of eel grass. They primarily feed on amphipods, isopods, shrimp, stickleback, sand lance and other small fishes. (Stolz and Schnell, 1991)

**Additional Information**
Much of what is presented here was take from two sources. They are the Status Review for Oregon's Umpqua River Sea-Run Cutthroat Trout, June 1994, available from the National Marine Fisheries Service, Northwest Fisheries Science Center, Coastal Zone and Estuarine Studies Division, 2725 Montlake BLVD. E., Seattle, WA 98112-2097 and the book The Wildlife Series, Trout, Edited by Judith Stolz and Judith Schnell, Stackpole Books, Cameron and Kelker Streets, P.O. Box 1831, Harrisburg, PA 17105 (ISBN number 0-8117-1652-X). Both documents contain a lot more information for those that are interested.

Appendix C

A comparison between ACS Objectives, Ecological Goals, and the pathways and indicators used in the effects matrix.

| Aquatic Conservation Strategy Objectives - Northwest Forest Plan | Ecological Goals - Snake River Recovery Plan/ LRMP | Pathways / Indicators |
|---|---|---|
| 2,4,8,9 | 2,5,9,10 | Water Quality / Temperature |
| 4,5,6,8,9 | 5,6,7,9,10 | Water Quality/Sediment./Turbidity. |
| 2,4,8,9 | 2,5,9,10 | Water Quality/Chemical Concentration/Nutrients |
| 2,6,9 | 2,7,10 | Habitat Access/ Physical Barriers |
| 3,5,8,9 | 3,6,9,10 | Habitat Elements/Substrate |
| 3,6,8,9 | 3,4,7,9,10 | Habitat Elements/Large Woody Debris |
| 3,8,9 | 3,4,9,10 | Habitat Elements/Pool Frequency |
| 3,5,6,9 | 3,4,6,7,10 | Habitat Elements/Pool Quality |
| 1,2,3,6,8,9 | 1,2,3,7,9,10 | Habitat Elements/Off-Channel Habitat |
| 1,2,9 | 1,2,10 | Habitat Elements/Refugia |
| 3,8,9 | 3,9,10 | Channel Condition/Dynamics/Width/Depth Ratio |
| 3,8,9 | 3,9,10 | Channel Condition/Dynamics/Streambank Condition |
| 1,2,3,6,7,8,9 | 1,2,3,7,8,9,10 | Channel Condition/Dynamics/Floodplain Connectivity. |
| 5,6,7 | 6,7,8 | Flow/Hydrology/Change in Peak/Base Flow |
| 2,5,6,7 | 2,6,7,8 | Flow/Hydrology/Increase in Drainage Network |
| 1,3,5 | 1,3,6 | Watershed Conditions/Road Density & Location |
| 1,5 | 1,6 | Watershed Conditions/Disturbance History |
| 1,2,3,4,5,8,9 | 1,2,3,4,5,6,9,10 | Watershed Conditions/Riparian Reserves |

Appendix D
ACS Objectives and Ecological Goals

**ACS Objectives**

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

**Ecological Goals**

NMFS restated, refined, and expanded the PACFISH goals to provide added detail on ecological function needed for listed salmon and to include landscape and habitat connectivity perspectives. These goals provide consistency with NMFS' basin-wide Ecological Goals for all Federal land management agencies contained in the Proposed Recovery Plan for Snake River Salmon. Consistency with these goals will help NMFS determine whether land management actions avoid jeopardy or adverse modification of critical habitat during watershed-scale and project-scale consultations. However, although consistency with the goals and their associated guidelines generally is necessary to achieve informal concurrence under section 7 of the Endangered Species Act, concurrence cannot be guaranteed since the goals and other guidance were not structured to eliminate short-term adverse effects. Also, some of the guidelines (particularly with regard to grazing, mining, and how to proceed following watershed analysis) are not specific enough to eliminate the requirement for project-specific interpretation and analysis. The goals and guidelines described below do not include NMFS' long-term expectations for the eastside environmental impact statements. The Ecological Goals are as follows:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore timing, volume and distribution of large woody debris (LWD) recruitment by protecting trees in riparian habitat conservation areas. Addition of LWD to streams is inappropriate unless the causes of LWD deficiency are understood and ameliorated.

5. Maintain and restore the water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival,

growth, reproduction, and migration of individuals composing aquatic and riparian communities.

6. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

7. Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats, retain patterns of sediment, nutrient, and wood routing, and optimize the essential features of designated critical habitat. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows should be maintained, where optimum, and restored, where not optimum.

8. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

9. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

10. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

| | |
|---|---|
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| **Date:** | Tuesday, November 13, 2018 4:19:00 PM |
| **Attachments:** | 2018-11-13 Nez Perce Tribe Comments to Nez Perce Clearwater - Clear Creek DSEIS.pdf |

Ms. Zoanne Anderson:

Attached are the Nez Perce Tribe's comments on the Clear Creek Integrated Restoration Project Draft Supplemental Environmental Impact Statement.  Please let me know if you have any problems accessing the attachment.  Thank you.

Lisa Anderson
Legal Assistant
Office of Legal Counsel
Nez Perce Tribe
P.O. Box 305
Lapwai, ID 83540
(208) 843-7355
(208) 843-7377 - fax
lisaa@nezperce.org

**From:** Anderson, Zoanne - FS
**To:** Lisa Anderson
**Subject:** Automatic reply: Nez Perce Tribe Comments to Nez Perce Clearwater National Forest re Clear Creek DSEIS.pdf
**Date:** Tuesday, November 13, 2018 4:20:26 PM

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I am currently out of the office. I will return on November 19, 2018. Thank you for your message, I will get back to you as soon as possible. Zo

| | |
|---|---|
| **From:** | FS-comments-northern-nezperce-moose-creek |
| **To:** | Lisa Anderson |
| **Subject:** | Your document was received by the comment-northern-nezperce-moose-creek mailbox. |
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| **From:** | FS-comments-northern-nezperce-moose-creek |
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# Clear Creek Integrated Restoration Project #38021

## Thank you for Your Comment.

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Your comment has been received by our system on 11/13/2018
Your letter ID is **38021-1190-9**. Please save or print this page for your records.

Regards,
The Clear Creek Integrated Restoration Project Team