Oliver Grah

The Nooksack Indian Tribe appreciates this opportunity to provide these technical comments on the DRAFT SFNR temperature TMDL.
The Tribe initiated technical engagement in the TMDL project in August 2011. At that time we offered the following comments. If the TMDL is applied as a tool to address pollution in the SFNR, in order for the TMDL to be effective it must address the following:
• Climate change
• Upland watershed processes
• Realistic natural conditions
• Focus on impacts to fish – the designated or beneficial use; not just the CWA numeric criteria

We provided at least two sets of comprehensive review comments on earlier preliminary drafts of the TMDL, the most recent was on June 3, 2015. We incorporate those comments by reference.

We worked with the EPA Region 10, EPA-ORD, and Ecology to address these comments from August 2011 through until October 2016 when our involvement on EPA's Climate Change Pilot Research Project was completed. That pilot research project was designed and executed to support the TMDL, even though the three EPA reports on the pilot project were issued well before the date of issuance of the Draft TMDL in September 2018. In general, we believe the regulatory agencies did a reasonable job of addressing our comments except as noted below. We appreciate the close positive collaborative relationship we developed with Ecology, EPA Region 10, EPA-ORD and their consultant Tetra Tech, Inc. on this important project.

We offer the following comments specific to the Draft SFNR Temperature TMDL:

• The hydrologic modeling conducted utilizing Qual2k did not resolve and was not sensitive to forest harvest history and patterns in the SFNR watershed. Although, the draft TMDL discusses land use in general and does identify forestry as a major land use, the TMDL holds the influence of forestry on the SFNR hydrograph and the water quality of the river constant—in other words assumes that forest practices has no impact on flow and quality. This assumption is not realistic. It has been well known for well over 100 years that manipulating forest cover has a subsequent change to the hydrograph. Typically, forest harvest increases annual runoff from a watershed, but that additional water runs off during the "wet months" (November through May) when flow quantity is not a limiting factor to fish and fish habitat. However, the other impact of forest harvest is a narrowing of the hydrograph with resulting lowered late-summer and early-fall flows in the river at a time most critical to several species of Pacific salmon, including the SFNR spring Chinook salmon. Perry and Jones (2016) (see excerpts below) showed through the application of a paired watershed study on the west slope of the Cascade Mountains in Oregon that forest harvest may reduce late season streamflows by up to 50 percent when compared to adjacent watersheds with mature and/or old growth forest stand structure.

• Water quantity and quality are intrinsically connected. Reduced flows in the late summer-early fall period will exacerbate and compound heat loading of the river. By ignoring the impacts of forest harvest on river flows and quality results in an incomplete picture of the dynamics of land management and runoff and water quality.

• Although climate change was addressed in the TMDL through completion of the climate change pilot research project, the cumulative impact of climate change and the impacts of land use (e.g., forest practices) were not adequately addressed for the reasons stated above. Taking projected climate change impacts into consideration is good; however, not linking those impacts with the impact of forestry on river flow and quality is an inadequacy of the TMDL.

• Although the TMDL primarily addresses non-point source pollution and therefor is not regulated, the TMDL needs to more fully consider the importance of full watershed management in the TMDL implementation plan, not just a focus on the river and its riparian buffer. Modifying land use through voluntary action is also needed. The Tribe has initiated a pilot research project to evaluate the impacts of forest practices on late season river flows and what voluntary actions might be implemented to ameliorate those impacts through modified forest harvest prescriptions and land management. The pilot project will address the cumulative impact of land management and climate change on the hydrology of the river. Through this effort we hope to identify measures that can maintain resilience of the watershed to continued projected climate change as well as the impacts of land management.

• We are pleased that the sensitivity analysis conducted at the request of the Tribe suggested that the current numerical standards are reasonably protective of what should be a "truer" natural condition. As such, there is no reason to update or modify the numerical criteria through a legislative process.

• We expect the TMDL to act on every feasible and reasonable tool to reduce temperature and sediment loading to the SFNR so as to support salmon recovery efforts, promote watershed resiliency, and to attain a harvestable surplus of salmon that the Tribe relies on for cultural, heritage, subsistence, and commercial uses.

Perry, T.D., and J.A. Jones. 2016. Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology 2016:1-13. DOI 10.1002/eco.1790. Excerpts from that study:

• Updating an earlier (Jones and Post 2004) synthesis of long-term paired watershed studies in western Oregon, Perry and Jones (2016) reported in this paper that logged watersheds still show no sign of recovery from prolonged depletion of low streamflows by ca. 50% in watersheds logged 40-50 years ago, compared to unlogged watersheds.

• The study summarizes results of long-term paired logged and unlogged watersheds in experimental forests in the central Oregon Cascades and southwest Oregon. The data from the 12 instrumented watersheds are among the only time extended series of data available in the Pacific Northwest to measure the long-term effects of logging and post-logging forest succession on stream conditions.

• The watersheds in this study are considered representative of a vast population of watersheds across western Oregon and the Pacific Northwest where Douglas-fir is the dominant tree species. The relatively consistent and sustained response of low flow deficits among the study basins supports the applicability of the results to watersheds across the Pacific Northwest.

• Mature and old growth Douglas-fir forests appear to be exceedingly efficient in water use and produce steady streamflows compared to second-growth forest plantations.

• Low flow deficits of 50% or greater occurred in all streams where greater than 50 percent of watershed area was logged.

• Low flow deficits caused by logging and post-logging forest regrowth persist for at least 40-50 years, without evidence of recovery to re-logging flows.

• Low flow deficits occur from late June, through July, August, September, and October.

• Flow deficits are caused by more wasteful water use by rapidly-growing trees and other vegetation in post-logging plantations, compared to the much more efficient regulation of water use in mature and old growth forests.
• The results suggest that reported trends of streamflow reduction in recent decades (e.g., Luce and Holden 2009) could be caused as much or more by cumulative effects of logging than by climate change.
• The study also showed that logging treatments produced peak flow increases that still persist decades post-harvest.
• Past widely-cited textbooks and agency plans and assessments reporting 10-15 years for "hydrologic recovery" after clearcutting are fundamentally incorrect, and were based on an erroneous and short-sighted view of experimental watershed data. This longer-term analysis shows that neither peak flow increases nor low-flow deficits return to pre-harvest conditions within 40-50 years of logging.
• Of foremost concern, small low flow increases observed in the first decade post-logging gave way to prolonged flow deficits, with summer, fall and early winter flows depleted to half or less of their pre-logging value persisting at least several decades.
• Because low flow deficits in logged forests are apparently caused by fundamental physiological inefficiency of water use by vegetation in re-growing forests, it appears unlikely that any modification of logging practices can reduce or mitigate the cumulative impact on depletion of streamflows--other than greatly restricting the area and frequency (reducing harvest rotation) of logging.
• Staggering the timing of logging did not and likely will not reduce the adverse depletion of low flows. Sustained low flow depletion occurred in all catchments that were more than 50 percent harvested within the 40-50-year time frame of observations. The flow deficit effect persists for at least 4-5 decades with no measured recovery, so staggering logging within this time frame is ineffective.
• The long-term low flow depletion effect can be reduced and sometimes avoided if half or more of a catchment is retained in mature, natural forested condition. In cases where between 25% and 50% of the basin was harvested, with 50-75% remaining in natural mature forest condition, the long-term low flow depletion effects were substantially reduced in magnitude. By contrast, short-term peak flow increases were not ameliorated and were similar in magnitude and persistence to peak flows in 100% harvested basins.
• Thinning of post-harvest plantations did not measurably ameliorate the long-term low flow depletion effect. Apparently the growth flush of vegetation "released" by thinning increases water demand and quickly consumes any soil water gain made available by thinning. I.e., water used efficiency remains low relative to unlogged forests.
• The great majority of forested watersheds in the Pacific Northwest are likely experiencing severe, but previously unrecognized streamflow deficits caused by past and ongoing logging. From a landscape or regional perspective, it can be concluded that any watershed with greater than half its forested area impacted by logging in the preceding 4-5 decades (and probably longer) is highly likely suffering severe and sustained depletion of summer, fall and early winter stream flows (on the order of 50 percent) compared to its historical, pre-logging condition.
• Most private industrial and small woodlot forest ownerships are found in watersheds where more than 50 percent of the landscape has been logged within the past 50 years. On such lands, any additional harvest exerts harm by prolonging and perpetuating the condition of low flow deficit.
• Where private forests and public forest lands are comingled, reduced and limited harvest rates and fully protected mature forest reserves on federal lands could partially offset and mitigate the flow depletion effects of logging on private lands. However, the degree to which such a mitigation effect

scales up from small catchments to larger watershed areas remains unresolved, and may depend in part on the specific spatial pattern of logging relative to affected streams.

- There may be something akin to a "tipping point" when less than 50 percent of a watershed or landscape of watersheds remains in mature and old growth forest; disturbed beyond this point by logging, severe wildfire, or other catastrophic disturbance. Beyond this point, sustained low flow depletion is highly likely to be expressed in most if not all but a few smaller streams. Below 50% area logged, depending on the specific distribution of vegetation disturbance, many individual streams could experience severe and prolonged flow depletion, but the effects would likely be ameliorated in at least some areas of the watershed.
- Reduced low flows cause elevated summer stream temperatures and restrict movement and reduce cover for young and returning adult fish, compounding the stress of crowding in reduced habitat area.
- Logging-driven low flow deficits could be among the principle causes of lagging recovery of Endangered Species Act-listed and other depressed salmon and steelhead populations across the region.
- Summer low flows also limit withdrawals for domestic, urban and industrial uses, potentially stalling future economic growth.
- Watersheds and river basins with more than 50% of forest area logged in the preceding 50 or more years are likely to experience further loss of low flows in response to warming and drying of climate in the coming decades.
- Streams draining watershed areas dominated by natural, unlogged mature and old growth forests are more likely to retain low flows similar to their historical conditions, thus maintaining resilience to climate change better than harvested areas.

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