Clarks Creek
Dissolved Oxygen and Sediment
Total Maximum Daily Load

Water Quality Improvement Report and Implementation Plan

Appendix K

Response to Public Comments

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Water Quality Program

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Introduction

During the public comment period, Ecology received comments from a variety of stakeholders and private citizens. In the following appendix, Ecology answers each of these questions individually. The TMDL was developed with help from a stakeholder group (Pierce County, city of Puyallup, WSU Puyallup, local citizens, WSDOT, Puyallup Tribe, EPA, and Ecology) which was formed in May 2009.

The reason Ecology developed a water cleanup plan (TMDL) on Clarks Creek is because Clarks Creek is an impaired water body due to low dissolved oxygen and excess sediment. Low dissolved oxygen levels, excess fine sediment and sand, and the overgrowth of elodea (Elodea nuttalii) create conditions in Clarks Creek that harm fish and their supporting habitat.

This four-mile spring-fed tributary to the Puyallup River is an important area for salmon. Five salmon species spawn, rear, and migrate here. The creek and its tributaries run through the city of Puyallup and unincorporated Pierce County. People live on the creek and depend on it for fishing, swimming, boating, farming, and its natural beauty. If the conditions in Clarks Creek are ignored, these uses will be lost and fish habitat will slowly disappear.

Federal and state law require Ecology to develop a plan that will protect these uses, improve its current condition, and get it back to meeting State Water Quality Standards.

Ecology appreciates all the support the stakeholder group has provided during the development of the Clarks Creek Dissolved Oxygen and Sediment TMDL. The implementation of the TMDL will need to include the continued partnership of all stakeholders.

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Clarks Creek Dissolved Oxygen and Sediment TMDL Response to Comments

Pierce County – Letter

Comment: **<u>Allocation Concerns</u>**
Our primary concerns about the Pierce County waste load allocation is that the 50% reduction/treatment of stormwater does not derive from the model results. A model scenario was run that included a 50% reduction/treatment, and the results showed that water quality standards could be achieved. However, there was no effort to model other potential solutions, such as a 40% reduction/treatment, or a 25% reduction/treatment or a nutrient reduction strategy within the City of Puyallup. Indeed, the goal of this TMDL effort was to use stormwater as a surrogate for DO. So all other potential solutions to low DO have been ignored, even if these solutions might be more certain and more cost effective.

In addition, the supporting studies need to quantitatively define the relationship between "excess sediment" and "overgrowth of elodea to nuisance levels" in order to establish the basis for a reasonable load allocation. The model contains no mechanisms to describe the relationship between stormwater controls and resulting Elodea density in Clarks Creek. These relationships, which dictate the level of required stormwater controls, are all assumed outside of the model and specified as model input.

We request that Ecology perform a more thorough examination of scenarios that could identify more effective strategies for increasing DO in Clarks Creek, and more equitably distribute the costs among stakeholders.

Ecology response: *The comment states that the 50% reduction/treatment of stormwater scenario "does not derive from the model results" and that other alternative scenarios "such as a 40% reduction/treatment or…a reduction strategy within the City of Puyallup" were not run. These statements are not true. The final allocations are based on multiple QUAL2Kw runs with various levels of reduction in the many components contributing to reduced DO under critical conditions (detailed in Tetra Tech, 2011a and 2012b). It was found as a result of these runs that a 50 percent reduction/treatment level (in certain specified sources of stormwater flow) was an appropriate level for achieving water quality standards. Further, a scenario with reductions only within the City of Puyallup is not reasonable because less than 50 percent of the flow to listed segments of the creek derive from within the City's jurisdiction (see Table 12 of the TMDL).*

The comment further states that "the goal of this TMDL effort was to use stormwater as a surrogate for DO" and implies that "all other potential solutions to low DO have been ignored." The "goal" of the TMDL – as in all TMDLs – is to achieve water quality standards and support designated uses of the water body. Dissolved oxygen and sediment impairment of Clarks Creek involves complex interactions of multiple stressors and sources, the majority of which are ultimately related to stormwater runoff and associated pollutant loading. The TMDL itself is specified in terms of DO deficit. However, stormwater volume provides a useful surrogate measure for evaluating implementation of the TMDL and summarizing the many different implementation options into a single score. The "surrogate" is in no way the goal of the TMDL; rather, it is a suggested measure useful in implementation planning that will provide considerable flexibility to permittees.

Regarding the claim that "all other potential solutions to low DO have been ignored" we are not aware of any such alternative solution and the comments do not list such alternatives. Ecology would welcome from Pierce County a viable alternative solution that would meet the legal requirement of addressing water *quality impairments in Clarks Creek. We explored numerous options during development of the TMDL and focused on the viable solutions prescribed in the TMDL.*

The comments suggest a need "to quantitatively define the relationship between 'excess sediment' and 'overgrowth of Elodea to nuisance levels'" and suggests the model "contains no mechanisms to describe the relationship between stormwater controls and resulting Elodea density." It is true that the model does not contain an explicit, quantitative prediction of Elodea density. Indeed, a review of the literature indicates that there are not available and validated processed based models of the growth of Elodea nuttalli *available at this time. In contrast, the qualitative role of excess sediment (leading to shallowing) and excess nutrients in promoting Elodea growth is well documented. The focus of the TMDL is on achieving DO standards, not on simulating Elodea growth. It is necessary for the TMDL model to estimate the net effects of Elodea on DO, but not to quantitatively simulate Elodea growth, which is only one of many different processes that affect the overall DO balance. As in all environmental modeling studies, it is necessary to make best reasonable assumptions for processes that cannot be derived from first principles or direct observational data. Indeed, the TMDL regulations make clear that lack of knowledge about processes is not an excuse for inaction. Additional field studies to more explicitly define the relationship between excess sediment and Elodea growth are an option in the future; however, such studies would require considerable time, effort, and funding and should not prohibit implementation of the TMDL.*

Comment: <u>DO Modeling Concerns</u>

We have multiple concerns with the modeling, which we have consistently expressed during the development of the TMDL. One concern is the choice of calibrating the QUAL2Kw model with only one lorge storm event (October 21, 2003), which itself is anomalous (23 year rainfall event, and 1-2 year flow event) and that came during a period of time even EPA/Ecology/Puyallup Tribe of Indians characterize as "questionable" and "extreme". We question the accuracy of the recurrence interval in the document for this event. Recent modeling of the City of Puyallup MS4 system appears to show this storm event as a 25 year recurrence interval for the stormwater facility, which is considerably higher that the BMP design standard (According to SWMMWWW, 2012, "the design storm for sizing wetpool treatment facilities is the 6 month, 24-hour precipitation amount may be assumed to be 72 percent of the 2 year, 24-hour amount). We request that Ecology review the recent modeling for City of Puyallup and critically compare with the results the Clarks Creek Flow modeling, and choose a different high flow event that is closer to the flows used for designing stormwater facilities.

During the October 21, 2003 event, flow in Clarks Creek increased sharply over a short distance. At the USGS gauging station at Tacoma Road it was measured at 138 cfs daily average (173 cfs peak flow) an at 56th Street instantaneous flow measurements showed 279 cfs. The assumptions in the model downplay the role of groundwater on the decrease in DO over the same stream reach, and instead attribute much of the increase in flow to surface water. Our own reexamination of the October 21, 2003 storm event using the USGS groundwater model (with MODFLOW) shows that groundwater discharge from the Alluvial Aquifer to the mainstem of Clarks Creek below the USGS station, and discharge to Rody Creek near its confluence to Clarks Creek, accounts for up to a third of the increased stream flow between the two monitoring points, and a DOD of about 3 mg/l (see attached MODFLOW modeling description). We request that Ecology choose re-run the HSPF and QUAL2K2 model using current information from USGS groundwater contribution to Clarks Creek during storm events.

In addition, the DO model does not adequately characterize the role of sediment oxygen demand (SOD) in Clarks Creek. The model currently attributes dry weather dissolved oxygen problems solely to a lumped sediment oxygen demand term that includes both sediment oxygen demand and oxygen consumption from Elodea detritus. The model used a calibrated SOD value of 8 g O_2/M^2/d, which is much larger than the field measured 1.58-4.71 g O_2/M^2/d for in-situ chamber SOD and Community Substrate Oxygen Demand (CSOD). Further, it seems that DO demand directly from the sediments is less than half of the CSOD based on the in situ chamber test for the TMDL study. Since the model is unable to distinguish the relative contribution of these two sources, we request that additional field data be conducted to resolve this uncertainty.

Ecology response: *The model was calibrated to four dry weather and two wet weather events (as is stated in Appendix B). Here is a summary of this information:*

7/10/09: Represents the system at baseflow conditions before elodea cutting
7/20/09: Represents the system at baseflow conditions when elodea cutting had proceeded only up to Tacoma Road'
8/6/09: Represents the system at a date after full elodea cutting with baseflow conditions
8/20/02: Represents the system near baseflow conditions, assuming no elodea cutting,
9/12/03: Represents the system during stormflow with flows 20-percent above baseflow conditions,
10/21/03: Represents the system during 2-year runoff event - this is the critical condition.

It is true that calibration addressed only one "large" storm event. More events would be desirable, but this is the extent of events for which synoptic measurements of flow and DO were available at the time the modeling was conducted. Model parameters perform well across the range of dry and wet condition events available for calibration.

Despite an apparent desire for more storm event calibration, the comment goes on to criticize use of the October 21, 2003 event as "extreme." This objection seems to be based on the fact that the recurrence interval for measured precipitation on October 20, the day preceding this flow event (which we agree is in the 23-25 year range) is larger than the recurrence interval of the design storm used in the BMP design standard. The October 21, 2003 runoff event was selected to represent the critical condition for TMDL because, among the documented events it is the one requiring the largest reduction in mass of DO deficit (DOD). The low recurrence frequency is appropriate for calculation of the TMDL and allocations which require reasonable assurances that water quality standards will be achieved. Reference to the recurrence interval of the BMP design storm is not relevant to the calculation of the TMDL, but is relevant to the interpretation of the TMDL into implementation planning. It should be noted, however, that the proposed implementation plan allows credit for "treatment" if stormwater is routed through a BMP designed according to the standards described in the permit.

As noted, during the October 21, 2003 event the flow in Clarks Creek increased strongly between the USGS gauging station at Tacoma Road and 56th Street. This increase is likely in part due to groundwater inflow and in part due to variations in precipitation intensity between the precipitation observation site and different portions of the watershed. The TMDL model does not "ignore" the possibility of groundwater inflow in this reach (indeed, it appears likely), but accounts for the incremental flow as a general diffuse inflow.

The comment cites results from a large-scale regional USGS groundwater model to suggest that about 1/3 of the flow during this event was derived from groundwater discharges. This model (Johnson et al., 2011) was developed at a monthly time scale and no information has been presented to validate its accuracy in simulating discharges to surface flows in Clarks Creek during individual storm events. An analysis in Pierce Co. Attachment 3 presents an estimate of groundwater contribution of 40 percent based on temperature differences. That analysis is, however flawed as it assumes that the surface water temperature is equal to the median air temperature of the day (18.6 °C) and that the discharging groundwater temperature is equal to 12 °C based on USGS measurements in 1987. The upstream flow in Clarks Creek is typically cooler than the median air temperature, in part because it is supported by upstream springs, while rainfall occurring during this event was likely cooler than the ground-level air temperature. The *groundwater temperatures used in this analysis are from wells, not from discharging shallow ground water, and are not contemporaneous with the event in question. Even small variations in the temperatures of both end members would radically change the estimates of the percentage of flow due to groundwater by this method. The QUAL2Kw model of this event fits the temperature data well with an assumption that the diffuse inflow occurring below Tacoma Road has temperature of 15 °C and is significantly warmer than the stream temperature below Maplewood Springs (see figure). We therefore conclude that this inflow is likely dominated by discharge from stormwater conveyances (some of which may ultimately derive from groundwater) and is not a cooler deep groundwater source. This finding is consistent with additional fall-winter synoptic monitoring undertaken in fall-winter of 2011-2012.*

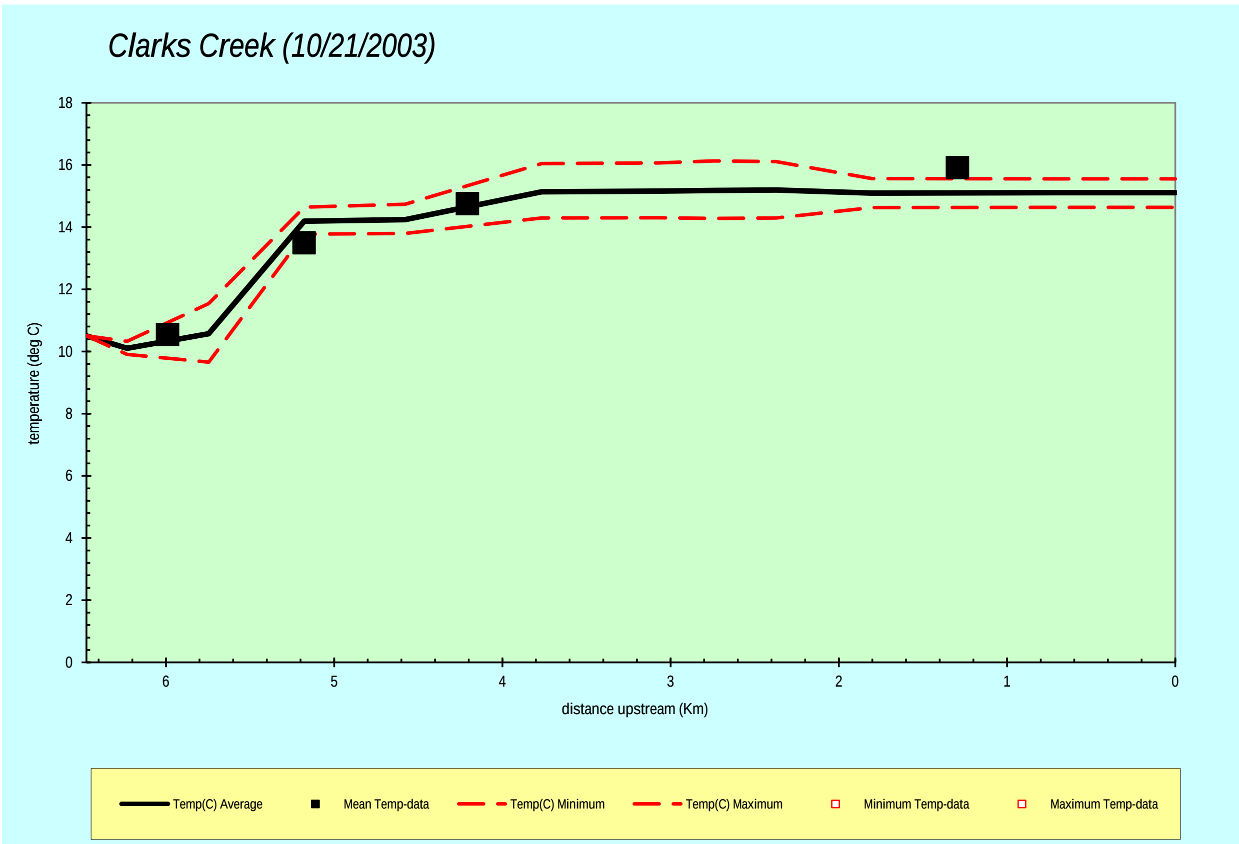


Figure K-1. Simulated and Observed Water Temperature for the October 21, 2003 Event

When Ecology evaluated compliance with standards using the TMDL modeling framework, the baseflow sensitivity analysis based on the QUAL2Kw models indicated that minimum instream DO at baseflow conditions is most sensitive to sediment oxygen demand (SOD), while the dissolved gases criterion is most sensitive to Elodea growth rate. The comments suggest that the DO model "does not adequately characterize" the role of SOD because the combined demand attributed to direct sediment oxygen demand and demand generated within the Elodea mats (8 g O2/m2/d) is greater than field measurements for in-situ chamber SOD and Community Substrate Oxygen Demand (CSOD). Direct measurement of SOD using the preferred chamber method requires that the bottom of the chamber have contiguous contact with the bed sediment and no transfer of water or other substances occur between the inside of the chamber and the surrounding water column. Since aquatic vegetation creates an uneven surface and precludes these conditions, the chambers must be placed in areas absent aquatic vegetation. SOD is expected to be higher within aquatic vegetation beds compared to open areas because of senescence and decomposition of organic *matter, and, therefore, the SOD measurements were expected to underestimate effective SOD concentrations in the stream. The total community substrate oxygen demand (CSOD) measurements were also highly uncertain, as stated in the TMDL report, both because they were not directly measured within the Elodea beds and because they are based on the net effects of oxygen demand and reaeration, but no direct measurements of reaeration were obtained. When the model is run with SOD set equal to the rate reported for open areas only, the observed instream DO concentrations cannot be replicated with reasonable assumptions for reaeration. In contrast to the high uncertainty in the measured estimates, Tetra Tech (2011) demonstrated that the SOD rate of 8 g-O2/m2/d resulted in a close fit to the observed DO daily range and longitudinal profile and is within the range of values cited in Tables A-25 and A-26 in USEPA (1997).*

Comment: <u>Sediment Modeling Concerns</u>
As with the DO modeling, we have many concerns with the sediment modeling. We are concerned that Ecology's choice to use the Toxics and Aesthetics criteria to regulate sediment in streams is an expansion of the intended purpose of that criterion. The conceptual model that Ecology is using in this TMDL is focused on sediment solely because it provides a substrate for Elodea growth and propagation. It is thought that reducing the sediment load in the creek will reduce the ability of Elodea to grow, and thereby reduce the impact of Elodea on DO. We believe that the Toxics and Aesthetics Criteria do not apply in this condition.

Another major concern we have with the model is that it fails to identify the particle size class that is of most important for addressing the growth of Elodea and the reduced DO. The sediment study indentifies potential sources of erosion, but not sources of silt and fine sediments that form the substrate for Elodea growth. Furthermore, the proposed remedies are costly capital improvement projects to control erosion in areas that produce gravel and sand. But there is no effort to identify whether those projects will actually control the silt and fine sediments that are the primary concern. The selection of stormwater treatment options depends directly on the particle size to be removed, and instream erosion control may have little benefit if fine particles are coming from uncontrolled upland sources. We recommend that Ecology refocus its modeling efforts on the particle size classes that are the actual source of concern, and abandon its current approach of simply regulating erosion.

Ecology response: *The Toxics and Aesthetics Criteria (which include deleterious material concentrations) are presented as an additional line of evidence supporting both the need to reduce sediment loads in Clarks Creek and the general magnitude of the proposed reductions to support cold water aquatic life uses in the waterbody. These criteria are not used in the sediment modeling and are not a direct basis for calculating the DO TMDL, so criticisms on those grounds is not appropriate. It is clear that excess sediment loading is directly associated with the formation of aquatic vegetation beds. When sediment loading increases above the capacity of the stream to transport sediment, the excess sediment accumulates within the stream bed and provides an ideal habitat for aquatic vegetation. The presence of aquatic vegetation, in turn, slows streamflow and increases the rate of sediment deposition. This causes a feedback loop that exacerbates vegetation growth and can result in nuisance levels of aquatic vegetation. In this way, sediment is defined as a "deleterious material" according to WAC 173-201A-260(2)(a). Sediment loading applies to the first part of the criteria ("a" below) because it is a major cause in the formation of nuisance aquatic vegetation, which is adversely affecting water uses and sensitive biota in Clarks Creek. In addition, the effect of sediment loading on creating conditions for aquatic plant nuisance growth directly applies as "the presence of materials or their effects" as stated in the second part of the criteria ("b" below):*

(a) Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health (see WAC 173-201A-240, toxic substances, and 173-201A-250, radioactive substances).

(b) *Aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste (see WAC 173-201A-230 for guidance on establishing lake nutrient standards to protect aesthetics).*

The comments go on to express a concern that the model "fails to identify the particle size class that is of most important [sic] for addressing the growth of Elodea and the reduced DO." In this case, "the model" apparently refers to the HSPF sediment simulation, which does indeed include separate simulations of sand, silt, and clay-sized sediment. Included in the list of conditions leading to impairment, the TMDL states that both excess fine sediment and sand are among the major factors creating conditions in Clarks Creek that harm fish and their supporting habitat. Conditions encouraging Elodea growth include shallowing (aggradation) and the presence of nutrient supplies associated with fine sediments. The deposition of all sediment classes, including sand and gravel, during large flow events is an important cause of aggradation which sets the stage for Elodea growth. The combination of reduced channel capacity and extensive growth of macrophytes further reduces flows and causes enhanced deposition of fine sediment, resulting in a feedback loop that further enhances Elodea growth potential and also traps organic material that supports sediment oxygen demand. Thus, all size classes of sediment are of concern in the complex inter-related impairments of Clarks Creek

The TMDL section "Potential pollutant sources" clearly states that land disturbance is a source of fine sediment. The implementation targets contained in the TMDL focus on reduction or treatment of upland stormwater volumes, which is exactly the type of source control that is most likely to reduce fine sediment loading. The comments talk about "costly capital improvement projects to control erosion" and notes that "instream erosion control may have little benefit." The TMDL clearly states that there is a benefit associated with instream erosion control, but does not prescribe it as the focus for implementation. Rather, it provides flexibility and a potential method under which permittees, at their option, may apply for and receive credit for stream channel restoration projects as a means to achieve a portion of the overall required reductions. While not required to pursue such alternatives, the commenters should note that instream restoration can compare favorably on a cost-benefit basis for upland retrofit efforts to control sediment and nutrient loads (see, for instance, D. Medina and S. Curtis. 011. Comparing LID and stream restoration. Available at www.stormh20.com/SW/Articles/15206.aspx).

Comment: <u>Certainty of Success</u>
We believe the DO and Sediment modeling is best suited towards enhancing understanding of relevant processes, and guiding future data collection and/or adaptive management. It is not suitable for mandating stormwater controls. This sentiment is contained in the DO model documentation (TetraTech, 2010), which states:

> "In sum, the QUAL2Kw model is being employed in an investigative mode in this project, with the aim of testing the potential significance of different stressor sources and processes (e.g., SOD versus lack of ripiarian cover). This in turn will help to lay the foundations for the design of an implementation plant to address water quality impairments – and to identify areas in which additional data collection may be needed to reach firm conclusions."

Application of the model to define specific Wasteload allocations for stormwater sources is inconsistent with the limitations noted in the model documentation.

Ecology response: *The load and wasteload allocations are defined in terms of dissolved oxygen deficit (DOD) and sediment loading.*

The quotation provided in this comment is from Tetra Tech (2011). The language in Tetra Tech (2011) refers specifically to the initial exploratory and sensitivity analyses conducted and documented within the same report. Under the "Modeling Framework" section of the TMDL report, the sensitivity analyses are listed as one of several potential uses of the QUAL2Kw model. Tetra Tech (2011) represents a preliminary assessment of QUAL2Kw capabilities in the initial steps of building a conceptual representation of processes controlling DO. The statement in Tetra Tech (2011), which is taken out of context in this comment, is not applicable to the subsequent TMDL modeling.

Comment: <u>Implementation Concerns</u>
Our major concerns about the implementation of the TMDL are two-fold. First, Pierce County is required to develop plans focused on capital improvement projects: Stormwater Retrofit Plan and a Sediment Reduction Plan. No other stakeholder is required to develop two plans. And no other stakeholder will be required to bear the extremely high costs to implement these plans. The financial obligation of this TMDL falls overwhelmingly on Pierce County, even though the majority of the source of nutrient pollution that is causing the low DO is coming from the City of Puyallup and other stakeholders. We request that Ecology reexamine the onerous actions imposed on Pierce County and find a more equitable, more certain and more cost effective solution to low DO in Clarks Creek. Second, the individual stormwater projects suggested in the Allocation Memo ignore site specific concerns, such as the inability to infiltrate on till soils, construction access, landowner permission, and other issues (see attached comments).

Ecology response: *The City of Puyallup and Pierce County are both obligated to develop a plan to address DO and sediment reductions within the basin. The implementation portion of the TMDL has been clarified for Pierce County so that it is made clear that only one plan needs to be developed which addresses both DO and sediment reduction requirements (see future comments). These same clarifications have also been added to the City of Puyallup's implementation section and plan development as well.*

Ecology understands that the projects Pierce County proposed for inclusion in the Accountability Memo were proposals only. The TMDL offers Pierce County the flexibility to meet the TMDL allocations through a variety of stormwater projects that treat and reduce stormwater volume depending on the location. It is up to the jurisdiction to pick and plan projects they deem feasible.

Comment: <u>Clean Water Act Consistency Concerns</u>

Finally, Pierce County notes that the draft Clarks Creek TMDL attempts to regulate stormwater flows as a pollutant, which it is not. Federal courts have already ruled that stormwater flow is not a pollutant under the Clean Water Act and EPA cannot require wasteload allocations that attempt to do so.

Ecology response: *As noted in the TMDL, Pierce County's assertion that the Draft Clarks Creek TMDL attempts to regulate stormwater flow as a pollutant is incorrect. The Clarks Creek TMDL sets implementation targets for stormwater that can be used to meet the pollutant reductions for DO and sediment.*

Ecology does not agree with the interpretation that federal courts have ruled that stormwater flow is not a pollutant under the Clean Water Act. If Pierce County is referring to the U.S. District Court's decision on the EPA-issued Accotink TMDL, it is important to note that the district court's decision about the validity of the Accotink TMDL is not binding outside of that particular TMDL. In addition, the court limited its decision to an interpretation of the parts of the Clean Water Act that are relevant to TMDLs, and it did not discuss the permitting aspects of the Clean Water Act. The decision, therefore, does not address in any way the EPA's municipal separate storm sewer system (MS4) permitting program or the parts of the Clean Water Act or EPA's regulations that address that program.

The Clarks Creek DO and Sediment TMDL is issued by the Washington Department of Ecology and must meet state regulations. State regulations must be equal or more stringent to federal Clean Water Act *standards. The district court ruling on the Accotink decision does not apply to the use of stormwater flow surrogates by Ecology for TMDL pollutant allocations when following guidance established by the EPA and as authorized by State and Federal laws and rules. Ecology has successfully used surrogate measures for TMDLs in the past and will continue to use them where appropriate to establish meaningful and achievable water cleanup targets.*

The EPA continues to believe that, under appropriate conditions, surrogate TMDLs can be a valuable tool for restoring and protecting impaired waterbodies. They also may, in appropriate circumstances, provide a more efficient and cost-effective means for addressing certain impairments caused by multiple pollutants rather than by using a pollutant-by-pollutant approach. For example, addressing impairments caused by stormwater discharges and runoff in a way that is measurable, that adequately represents the pollutants and stressors contributing to the impairment, and that facilitates implementation can serve as a cost-effective tool for restoring urban waters affected by stormwater pollutants. One of the benefits of the surrogate approach is that it highlights the benefits to state and local governments of focusing their efforts on controlling high flow storm events rather than engaging in pollutant-by-pollutant reduction strategies.

Comment: In conclusion, the extreme uncertainty of the predictions of the TMDL calls for the use of adaptive implementation, rather than specification of potentially enforceable pollution reduction targets. We request that Ecology abandon its current TMDL approach, and work with stakeholders through a non-regulatory alternative "straight to implementation" approach that would concentrate on identifying, prioritizing, and constructing projects that have a high likelihood of success. Pierce County has indicated its willingness to do this since November 2012. Such as approach should include a monitoring and adaptive management component that would ensure that projects perform as intended in improving water quality and aquatic habitat in Clarks Creek.

Ecology response: *Ecology appreciates Pierce County's efforts in the Clark Creek basin and looks forward to working with the county during implementation of the Clarks Creek Dissolved Oxygen and Sediment TMDL. We also appreciate your willingness to look for solutions and for meeting with Ecology, EPA and the Puyallup Tribe of Indians in November 2012 to discuss the Straight to Implementation (STI) option. However; as outlined in the formal response letter to you and titled "Re: Straight-to-implementation Pierce County Informal Proposal for Clarks Creek TMDL":*

> *"Section 303(d) of the federal Clean Water Act requires that TMDLs be completed for impaired waters on the 303(d) list to meet water quality standards. In 2009 the Department of Ecology (Ecology) proposed the concept of STI as a way to meet water quality standards for impaired water on the 303(d) list where proven best management practices (BMPs) could easily be implemented and where nonpoint sources are the principle source of pollutants. Ecology's guidance, which outlines those conditions where STI can be used, states that point sources cannot be addressed through an STI approach.*
>
> *STI project have been successful in addressing pollution in agricultural-dominated streams in eastern Washington where livestock were the only known sources of pollutants causing impairment. As you are well aware, Clarks Creek is heavily influenced by stormwater point sources. Given the multitude of point sources in the Clarks Creek watershed causing impairments, and the requirement that water quality standards can be met, the STI guidance cannot be used there."*

Attachment One

Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL
Detailed Comments and Questions

1. (Page Xiii, paragraph 2)
Comment: Pierce County does not feel it had the opportunity to be adequately represented in the development and vetting of certain technical aspects during the different phases of development with the TMDL models. In particular, it is the County's position that there was a lack of opportunity for constructive engagement at critical junctures in the process during the populating of certain HSPF and QUAL2Kw modules (i.e. data collection, model input preparation, parameter evaluation). In addition, Pierce County would have liked to been intermittently updated during the modeling development in order to confirm the decisions being made during the calibration process (i.e. validation, calibration, post-audit, independent peer review and alternatives analysis). The lack of opportunity to engage in the TMDLs development has undermined the County's sense of transparency regarding the veracity of modeling having been used to develop the numeric Waste Loads Allocations.

Question A: Please respond to the County's complaint that critical steps for selecting and populating the input parameters for different operational modules within HSPF.

Question B: Please respond to the County's complaint that the model's calibration and validation processes were not intermittently shared at critical moments during the models preparation and prior to operational runs. Pierce County maintains the position that there were critical junctures during the model preparation process that should have been revealed and shared with the jurisdictions, particularly those the draft TMDL asserts would be responsible to reorient and invest millions of programmatic dollars based on the models analysis?

Ecology response A and B: *Department of Ecology, Puyallup Tribe of Indians and the EPA have worked together closely with the Clarks Creek Initiative Team whose original members included Pierce County, City of Puyallup, and Washington State University. Other stakeholders such as Washington Department of Transportation, Pierce Conservation District, USGS and local citizens have also been involved. The Clarks Creek Initiative Team met originally in May 2010 to discuss the Clarks Creek TMDL for dissolved oxygen and reviewed the goals and tasks for the request for proposal for contractors. The Team helped to choose the contractor, and met monthly from 2010-2012 then approximately quarterly in 2013-2014 to provide information, evaluate data and results, and comment on technical approaches and findings. In addition, Ecology met individually with stakeholders and responded to phone calls and letters throughout the entire TMDL development process. As described in the team's initial meeting in May 2010 and echoed throughout the entire process, Ecology values the involvement of stakeholders in the Clarks Creek TMDL and maintained frequent communication with all stakeholders.*

2. (Page Xiii, paragraph 2)
Comment: The development of the Clarks Creek TMDL Implementation Plan was not the result of a collaborative process that included Pierce County's Capital Improvement Project program (CIP) and the "actions" referred to in the Plan are considered conceptual. The projects cited are not necessarily matched to the "Hot Spot" analysis described in the latter section of the TMDL report. The projects listed have not been adequately characterized for their pollution abating performance or designed to the minimal 30 percent level of details and specifications. No preferred alternative analysis been conducted. It is the County's position that the County's CIP requires project concepts to be evaluated by the appropriately scaled (project level) model to determine its pollution abating performance (e.g. Hydrology, Hydraulics and Load Reductions) before any preferred alternative design can be selected and advanced to permitting and implementation. It is

the County's position that HSPF does not have the fidelity to model project level designs at the appropriate scale in order to evaluate flow or load reductions or develop alternatives.

Question: Please confirm that it is the purview of the County as a Phase 1 NPDES Permittee with the right and obligation to develop its own programmatic TMDL Implementation Plan; which will include the appropriate list of Capital Improvement Projects and alternative Operations and Maintenance actions?

Ecology response: *The Clarks Creek Implementation Plan was part of the TMDL stakeholder process. As described in the response to Attachment 1, comment 1, the Clarks Creek TMDL involved extensive stakeholder participation in the review of the technical approach and best management practices to prioritize projects in the Clarks Creek basin.*

The intent of the implementation targets was to save the stakeholders the time and resources necessary to model dissolved oxygen and sediment reductions and to show reductions with currently proposed project — giving them the flexibility to choose the projects.

The plan must show how Pierce County will:

- *Meet the Clarks Creek TMDL DO Wasteload allocation <u>or</u> reduce/treat stormwater discharging to the Clarks Creek Watershed by 50% and*
- *Reduce sediment levels by 66%*

The plan must outline how the above will be achieved and it must follow the steps identified in the implementation plan section of the Clarks Creek Dissolved Oxygen and Sediment TMDL, Table 19, Page 134.

3. (Page XV, paragraph 2)
Comment: Pierce County is concerned over the "weight of evidence" approach employed for developing a suite of models that will be used as a regulatory platform for generating localized water quality standards and attainment targets (WLAs and LAs). For example, the calibration of critical HSPF parameters that affect components of the annual water balance including soil moisture storage flux, infiltration rates, vegetative evapo-transpiration rates and losses to deeper groundwater percolation/recharge were based on gross assumptions derived from data sources not designed or intended to populate a model for this purpose (EPA BASINS web site: information on HSPF parameters, Tech Note #6 parameter estimation guidance). Documented HSPF liabilities are that it has no comprehensive parameter guidance available for populating specific operational modules, it has limited ability for spatial definition (i.e., lumped parameter approach) and the hydraulics is limited to only simulating unidirectional flows in simplified representations of urban drainage systems (e.g. culverts, pipes, CSOs).

Question: Within the context of Question 1, please respond to the concern as to how data, which was primarily collected for monitoring status and trends and permit compliance (and not specifically designed to populate a watershed model) were prepared for use in populating specific operational modules of HSPF?

Ecology response: *Data from compliance monitoring can be used to populate certain HSPF operational modules. The HSPF model for this watershed was used to simulate flow and sediment. Detailed parameter guidance for flow simulation is contained in BASINS Technical Note 6 while guidance on sediment parameters is contained in BASINS Technical Note 8. Parameter values for the model were developed in accordance with the ranges and procedures in this guidance and in relation to known, site-specific properties of local soils, geology, land use, and climate.*

The criticism that HSPF has "limited ability for spatial definition" is inaccurate. The model is technically lumped and resolution can be set at as fine a level as the user desires. For the Clarks Creek watershed, a high level of discretization is maintained through the use of small modeling subbasins, short reach segments, and hydrologic response units that are based on a detailed overlay of soil, slope, and land use properties. Further, while HSPF does not directly simulate conservation of momentum in channel hydraulics, it incorporates hydraulic behavior through tables that represent stage-volume-discharge relationships. These relationships were developed for most of the watershed using the hydraulic simulation from HEC-RAS and SWMM models. Outside of the range of these models hydraulics were estimated through application of the WinXSPro model to channel cross section information.

It should be noted that previous HSPF model applications were developed separately for the Clarks Creek watershed, one by Pierce County in 2006 for the Clear/Clarks Creek Basin Plan (Pierce County, 2006) and one by USGS in 1994 (Mastin, 1996). These calibrated models successfully represented conditions in the watershed. The HSPF model used in the TMDL builds on the experience of these earlier models, but uses a smaller spatial scale and more refined GIS analyses of land use and topography to improve the resolution of the TMDL model.

4. (Page XVii, paragraph 1)
Comment: Based on conversations with Ecology staff, Pierce County understands that "properties adjacent to the Creek" is referring to parcels located in areas that are "hydrologic intervening areas", meaning parcels of land positioned along the lower interfluves, which drain directly to in-stream surface waters and not laterally into County stormwater conveyance or infrastructure. (See related Comment 36)

Question A: Is this preceding definition correct?

Ecology response A: *Yes, "properties adjacent to the creek" refers to those properties that drain directly to the creek and that are not connected to stormwater conveyance infrastructure.*

Question B: If the County's understanding is correct, who will enforce the Load Allocations assigned to the "properties adjacent to the creek" and how will the LAs be applied?

Ecology response: *TMDLs develop load reduction targets for both point sources subject to NPDES permits and nonpoint sources. These target reductions must be achieved in order for a water body to meet water quality standards which is the ultimate goal of a TMDL. Thus, all sources must implement technologies and/or management practices to reduce their impacts. This includes nonpoint sources.*

Nonpoint source pollution reduction requires involvement and commitment at both the local and state level. Local governments have a role to play in addressing nonpoint source pollution, and are well suited to address local water quality issues. They are more directly tied to the community and have unique opportunities to work directly with residents to address identified pollution issues such as those outlined in a TMDL. Local governments also have more control over land use regulation via critical area ordinances, zoning or other ordinances.

TMDLs encourage people to proactively address nonpoint pollution and comply with the load allocation by taking advantage of existing regulatory and financial incentive programs. To address nonpoint pollution, local governments can conduct a variety of activities such as education and outreach, code enforcement and code development, create and/or implement local pollution reduction programs such as pollution identification and correction programs, and develop incentive programs to promote the adoption of best management practices. These are a few examples of how local government can provide oversight and monitoring of nonpoint source pollution, which also can be used to address water quality impacts that stem from the lack of stream-side vegetative buffers.

Ecology also has laws and regulations that can be used to prevent or correct nonpoint source pollution such as RCW 90.48, the Water Pollution Control Act. Ecology staff often coordinates with local governments to *assist in the implementation of TMDLs and TMDL related programs, and can provide regulatory compliance assistance when needed or appropriate.*

In EPA's 1991 "Guidance for Water Quality-Based Decisions: The TMDL Process", they state "In order to allocate loads among both point and nonpoint sources, there must be reasonable assurances that nonpoint source loads will in fact be achieved. Where there are not reasonable assurances, under the CWA, the entire load reductions must be assigned to point sources."

5. (Page XVii, 2nd paragraph)
Comment: Pierce County is not clear as to who the "we" in this paragraph is referring too.

Question: Is this use of the word intended to represent a collective agreement among all the stakeholders regarding the veracity and appropriateness of the conclusions and directives contained within the Clarks Creek TMDL?

Question: Please clarify who "we" is referring too. Is it the Department of Ecology, EPA and the Puyallup Tribe of Indians collectively or is it also implying the inclusion of all the Permittees and entities affected by the findings (issued WLAs and LAs) of the TMDL?

Ecology response: *Agreed, to clarify Ecology will change the following:*

From: *"We need to reduce sediment and increase dissolved oxygen concentrations, and we will ultimately measure our success by meeting sediment and dissolved oxygen requirements. Controlling flow is important to controlling these impacts."*

To: *"To successfully meet the sediment and Dissolved Oxygen requirements it's necessary to reduce sediment and increase dissolved oxygen concentrations. Controlling flow is important to controlling these impacts."*

6. (Page XVii, paragraph 2)
Comment: If the implementation targets are "estimates" based on the results derived from models then to what level of precision will TMDL water quality standards and attainment targets be measured (particularly at the scale of CIP implementation and NPDES permit compliance)?

Ecology response: *The TMDL will use adaptive management and monitoring to measure success. Beginning in 2020, monitoring will be used to check progress on where Clarks Creek is meeting state water quality standards for dissolved oxygen and sediment.*

7. (Page XVii, paragraph 2)
Comment: The implementation target for Dissolved Oxygen states "…to reduce 50 percent of the stormflow volume or treat 50 percent of untreated stormwater". Given the highly constrained nature of the watershed's soils to infiltrate water, "treat and release" may be an unavoidable tactical reality driving water quality project designs) NOTE: site constrained soils are discussed further in comment-question 24.

Question A: Does the word "reduce" include detaining the stormwater flow volume to attenuate the peak of an urbanized hydrograph or does it only infer infiltration?

Ecology response: *The Clarks Creek TMDL sets implementation targets for stormwater that can be used to meet the pollutant reductions for DO and sediment. The County has the flexibility to choose the location and types of projects based on site conditions.*

The word "reduce" 50 percent of stormwater flow volume refers to numerically reducing the volume of stormwater discharging to Clarks Creek by 50%. For projects specific examples and guidance refer to appendix H Allocation Accounting.

Question B: Does "treat" include capturing and settling-out a targeted "proportional mass of specifically sized sediments" (e.g. the fine sediment load comprised of particles < 2 mm) and convey that load to an engineered facility to decant and release cleaner stormwater to discharge to Clarks Creek? If not, then what are the operational definitions associated with "treat" as implied by this TMDL?

Ecology response: *Please refer to Appendix H. Allocation accounting*

Question C: Since the regions creeks and streams are sensitive to Hydromodification, reducing 50 percent of the flow or treating 50 percent of the jurisdictions stormwater could have potentially significant implications for resetting local stream morphology. River morphological responses and channel adjustment provoked by a TMDL Implementation Plan focused on reducing flows by 50 percent is necessary before the County designs and commences a program focused on achieving the currently prescribed WLAs and TMDL targets. It is the County's position that this type of analysis would be part of the County's approach to a developing its own TMDL Implementation Plan, what is Ecology's position on this position?

Ecology response: *Potential morphological responses under TMDL implementation have been studied in detail.*

The implementation targets are based on geomorphological analysis and the morphological outcome of the targets were analyzed and the results of these analyses are documented and cited in the TMDL document. The reduction in flow is expected to reduce erosion of stream banks and channels and reduce sediment loading to the creek, and this expected outcome is based on the evaluation of geomorphological conditions ranging from an estimate of natural through buildout conditions. According to the geomorphological analyses (Tetra Tech, 2012; Brown and Caldwell, 2013) the implementation targets would achieve flows and sediment loading that are estimated to be well above natural conditions. Similar conditions would have occurred at some point in the development of the Clarks Creek watershed, indicating that the creek and its tributaries have the capacity to handle the changes in stormwater volume described by the implementation targets.

More specifically, the geomorphological outcome of the 50 percent reduction in stormwater volume was analyzed in Tetra Tech (2012) and Brown and Caldwell (2013). The Clarks Creek Sediment Study Model Report (Tetra Tech, 2012) compared natural, current, and buildout conditions in terms of flow, sediment loading, and channel degradation, among other measures. Building on this analysis, Brown and Caldwell (2013) analyzed the geomorphological conditions resulting from Alternative 3, which represents the achievement of a 50 percent stormwater volume reduction. More specifically, Alternative 3 represents a suite of recommended projects designed to encourage a return to more stable morphological conditions. The results of this analysis indicated that a 50 percent reduction in stormwater flows would result in more stable morphological conditions that partially mitigate the large deviations from the natural flow regime that have resulted from increased impervious area in the watershed and have caused extensive channel degradation in various stream segments.

While the 50-percent reduction in or the 50-percent treatment of untreated of stormwater flow volume is necessary to bring the Clarks Creek into compliance with water quality standards, the TMDL allows the jurisdictions flexibility in the implementation of how they achieve the WLA/LAs. Additionally, it is also important to note that the TMDL specifies a 20-year timeframe for implementation. Implementation is *expected to occur gradually over this time frame, and gradual volume reductions are expected to allow the stream geomorphology to adjust over time in Clarks Creek, its tributaries, and downstream waterbodies.*

8. (Page 2, paragraph 1)
Comment: The statement reads, "Therefore, all potential non-point sources in the watershed must use the appropriate best management practices to reduce impacts to water quality".

Question: Since there are no NPDES permit requirements for capturing non-point Load Allocations how will the "must" in the preceding statement be monitored and enforced?

Ecology response: *Please refer to previous Ecology response under Comment 4 Question B*

9. (Page 4, paragraph 1)
Comment: The statement "If a pollutant comes from a diffuse source not subject to an NPDES permit, such as general urban, residential or farm runoff land uses, the cumulative share is called a load allocation" creates a question for Pierce County regarding the issue of fair share appropriation of programmatic responsibility for implementing remedies and solutions to Clarks Creek water quality impairment. What instruments for compliance will Ecology or the EPA use to enforce the WLAs and LAs issued to the different jurisdictions (NPDES permits) and entities (not operating under a NPDES permit) identified in the TMDL?

Question A: What assurances can Ecology provide the NPDES Permittees as to how there will be a proportional accounting, reporting and enforcement of WLAs and LAs across all the parties identified in the report as contributing and being responsible for Clarks Creek water quality impairment?

Ecology has identified in the Reasonable Assurance section on Page 125-127 in the Clarks Creek TMDL subsection, *Identified programs to achieve the NPS reductions*" this section outlines how all non-point source reductions will be achieved.

Question B: If Pierce County demonstrates TMDL target attainment consistent with the expectations of its Waste Load Allocation and the Load Allocations are conversely judged not to be in attainment and the numerical targets and milestones are failing to be met, who and how will enforcement of non-complying Load Allocations proceed?

Ecology response: *Please refer to previous Ecology response under Comment 4 Question B*

10. (Page 4, paragraph 5)
Comment: The EPA website for TMDL development states that "…the non-point source load and the natural load should be separately distinguished whenever possible."

Question: Pierce County expects that all the different source categories be properly identified and numerically distinguished in order to tract and corroborate the load accounting being reported the TMDL document. Why was the "natural load" not quantitatively identified and distinguished separately in the TMDL report?

Ecology response: *This question implies that the natural loads were not quantified, which is incorrect. The natural load is quantitatively identified for both the dissolved oxygen and sediment TMDLs. The natural instream DOD load corresponds to 100 percent saturation of DO. On page 47 of the TMDL document, DOD is defined such that the natural conditions would represent a DOD load of 0:*

> *Daily average DO deficits (DOD; defined as the difference between DO saturation and observed DO concentration) are a useful way of expressing how much a given source depletes DO from its natural condition (DO at saturation).*

The naturally occurring sediment load is defined on page 88 (first bullet) of the TMDL document:

> *The current, modeled average annual sediment load (673 tons/year) is over 16 times greater than the sediment load that would naturally occur (41 tons/year).*

11. (Page 5, paragraph 5)
Comment: The statement "Ample evidence of the sediment impairment has been collected through studies on fine sediment and fine sediment levels compared to reference streams conditions, sediment loadings and biotic integrity" prompts the question.

Question A: Why did this sentence not receive a reference citation to corroborate the statement "Ample evidence of the sediment impairment has been collected through studies on fine sediment…"?

Ecology response: *Ecology added the following references to the TMDL, Brown and Caldwell, 2012 and Hayslip, 2013. Also see Ecology Response to comment 18 below.*

Question B: Are the reference streams being used located in the South Puget Sound lowlands? If not, which specific reference systems were used?
Question C: Are the reference streams being used because they are the only documented river systems in the South Puget Sound or because they really represent a reasonable and defendable analog for providing comparable physical, chemical and biological standards for assessing the health or impairment of Clarks Creek (Lower Puyallup River)?

Ecology response B & C: *For our analysis, we selected reference sites based on three criteria. First, the reference sites needed to be located in the same ecoregion, the Puget Lowland ecoregion, as Clarks Creek. Second, the reference sites were required to have minimal human disturbance. Third, we looked for the reference sites that had a consistent data set for B-IBI and percent sand/fines that was collected under an approved Quality Assurance Project Plan (QAPP). The reference sites that were used to develop the reference condition were: Big Beef Creek, Chuckanut Creek, Coal Creek, Coulter Creek tributary, Crandall Creek tributary, Dewatto River, Oyster Creek, and Surveyor Creek. We then used the range of data from all of these sites, not any one specific site, to compare to Clarks Creek.*

Question D: How were the comparisons for "reference streams conditions, sediment loadings and biotic integrity" organized and integrated to develop this calibrated regulatory set of standards?

Ecology response: *The TMDL analysis is not a standard-setting process. Rather, the TMDL analysis is Ecology's interpretation of the applicable narrative water quality standards (WAC 173-201A-260(2)). The method of integrating reference stream conditions, sediment loading, and biotic integrity is explained in the TMDL.*

Table 9 in the table provides a summary of the percent fines, percent sand and fines, TSS and turbidity for the Puget Sound lowland reference streams. The TMDL used a 90th percentile value for percent of fines and sands in the reference streams and compared it to the value in Clarks Creek. The difference was then used in conjunction with model estimates of current Clarks Creek sediment loading to develop the sediment reduction allocation. See the Compliance with Standards section of the TMDL for a more detailed description of the analysis.

12. (Page 5, paragraph 5)
Comment: This is the first of many references throughout the document mentioning "fine sediment" without distinguishing the categorical dimensions of what is specifically meant by the term "fine sediment".

Question: What are the categorical dimensions or particle (grain) size range that define the term "fine sediment"?

Ecology response: *The term "fine sediment" refers to silt and clay particles, or any particle that is smaller than what is generally understood as sand. Pertaining to the grain size distribution (GSD) study described on pages 67-70 in the TMDL document, the TMDL refers the reader to Brown and Caldwell (2013) for the methods used for the GDS study. Grain sizes are defined in Appendix C of Brown and Caldwell (2013). Grain size for silt and clay ranged from less than 3.2 µm to 75 µm in diameter.*

Brown and Caldwell. 2013. Clarks Creek Sediment Reduction Action Plan, Final. Prepared for Puyallup Tribe of Indians. Brown and Caldwell, Seattle, WA. March 21, 2013.

13. (Page 6, paragraph 2)
Comment: The statements "…the nuisance weed Elodea was mechanically harvested. Weed fragments and re-suspended fine sediment from the channel bed clogged tribal hatchery pond intakes…Harvesting the Elodea in this fashion served to accelerate the growth of Elodea… "

Question: Does statement 3) "methods (i.e. mechanically harvested) long employed to control flooding and manage water levels in the creek compromised tribal hatchery operations" still hold true now that DASH is the current Elodea abatement method being practiced?

Ecology response: *Comment noted - Ecology can't speak on behalf of the tribal hatchery, however during the development of the TMDL the Elodea task force was formed and Elodea removal is being vetted through this process and stakeholders. The county has members on the Elodea task force. If the county has suggestions on operations, Ecology would suggest the county work with the Task force on these suggestions. Ultimately, Ecology believes that planting trees and creating shade is the best solution for reducing Elodea densities in Clarks Creek.*

14. (Page 8, paragraph 3)
Comment: The statements "The entire reach of Clarks Creek (mouth to headwaters) was included as Category 2 water (a "water of concern") for DO impairment on the 2004 and 2008 Integrated Reports. The middle portion of Meeker Creek was also listed as Category 2 in the 2008 listing cycle. Excursions were measured in these reaches during this time period, but not a sufficient number to warrant listing in Category 5. PTI provided data to show that these waters were impaired for DO (Brown and Caldwell, 2009). These impaired waters would have been included on the Category 5 list had Ecology been aware of the impairment at the time the list was completed. In January 2013, these water bodies impaired for DO were added to Category 5 of the 303(d) List." concerns Pierce County and provokes the following questions.

Question: Is it reasonable and appropriate to employ and rely on data that is more than 5 years old (2008 and earlier) to make a present day regulatory determination for a systems impairment regarding dissolved Oxygen? If yes, why and how is the use of relatively antiquated data (more than 5 years) reasoned to be defendable and appropriate for use in this present day regulatory application?

Ecology response: *Ecology Policy 1-11: Under Listing Cycles and Call for Data, "Data collected within ten years of the published call-for-data end date for each Assessment will be consolidated and assessed with other data of the same waterbody segment and parameter."*

15. (Page 8, paragraph 4)
Comment: It is Pierce County's position that is was a critical analytic moment during the modeling development for the TMDL when "it became apparent that the dissolved oxygen violations in Clarks Creek were ostensibly linked to sediment loading, both suspended and bedded."

Question A: How and when did it become "apparent" during the modeling of the Dissolved Oxygen TMDL that sediment loading represented the critical nexus supporting the determination of water quality impairment?
Question B: Was this important revelation shared with and explained to the stakeholders and jurisdictions at the time of its discovery in the TMDL modeling process?

Ecology response: *Initial data analyses and modeling included the development of a conceptual model of processes affecting DO and examination of the sensitivity of responses to the range of observed pollutant concentrations. In the conceptual diagram of dissolved oxygen, developed through CART analysis and modeling, sediment affects dissolved oxygen in several ways. Sediment oxygen demand was clearly a large contributor to DO problems based on initial model testing and analysis of Clarks Creek water quality. This finding was subsequently confirmed by SOD data that were collected. Literature also shows that excess sediment provides a substrate for elodea mats to grow, and elodea in turn, depletes dissolved oxygen when it dies or respires. The Clarks Creek Initiative Team discussed the findings of the CART analysis, conceptual diagram of dissolved oxygen, model development, planning for SOD data collection, and results of the SOD analyses in several meetings between 2010-2012.*

16. (Page 8, paragraph 5)
Comment: Pierce County is confused by the statement "In addition, observations made by PTI, a survey of the streambed composition…"

Question: Are the "observations made by PTI" the same as saying previously executed surveys or data collection generated by PTI?

Comment: The statement "…a survey of streambed composition in Clarks Creek showed…"

Question: What kind of streambed composition sampling protocol is being referred to in this sentence? Was the streambed composition sampling protocol the USGS Protocol for Collecting and Processing Stream Bed Sediment Samples, or was it a Wolman's pebble count, a Bevenger and King pebble count, the EPA's Environmental Monitoring and Assessment Program (EMAP) streambed-sediment protocol, the U.S. Forest Service's PACFISH Monitoring streambed-sediment protocol or use of a McNeil Sediment Core sampler? Please provide a further description of what kind of survey it was to help the County better understand the information that was retrieved and the modeling interpretations that are being advanced.

Ecology response: *Please refer to the Technical Memorandum on Field Investigations prepared by Brown and Caldwell for the Puyallup Tribe of Indians on October 24, 2011, in Section 3. Sediment Sampling and Analysis, Subsection 3.1 Methodology –*

Five surficial sediment subsamples were taken at equally spaced intervals along each cross-section. The subsamples were collected using a scoop where stream conditions allowed easy access. A Van Veen sampler was used where the benthic layer was not reachable or flow rates were too high. The five subsamples were combined in a stainless-steel mixing bowl to form one composite sample for laboratory analysis. The composite sediment samples were poured into two containers: one for analysis of conventional parameters and one for particle size distribution analysis. The containers were then packed in ice and delivered to the lab at the end of each sampling day.

The sediment samples were analyzed for total organic carbon (TOC), total Kjeldahl nitrogen (TKN), nitrate and nitrite nitrogen, total phosphorus (TP), biochemical oxygen demand (BOD), fecal coliform bacteria, total solids (TS), and grain size distribution (GSD). All samples were collected between July 27, 2011, and August 9, 2011. The samples were collected shortly after the City of Puyallup and Pierce County had completed their annual cutting of elodea in Clarks Creek downstream of sampling site Clarks-04.

The observations made by PTI are referring to observations made by the Tribe's fisheries biologists when doing spawning surveys in Clarks Creek. Specifically, the Tribe's annual salmon report states "The *remaining stream channel below the surveyed reach (RM 3.4) contains little gravel and the substrate consists of fine sand and mud, subsequently, little or no spawning has been observed below this point…. Due to the limited amount of available spawning habitat, increased spawning densities of chinook and chum have resulted in a high amount of redd superimposition throughout this short reach." (p. 21). The annual report can be found at http://www.scribd.com/doc/6165286/Puyallup-Tribe-Salmon-Trout-and-Char-Report-2008*

The following reference will be added to the TMDL

Marks, E.L., R.C. Ladley, B.E. Smith, and T.G. Sebastion. 2009. 2008-2009 Annual salmon, steelhead, and bull trout report: Puyallup/White River watershed water resource inventory area 10. Puyallup Tribal Fisheries, Puyallup, WA.

17. (Page 9, paragraph 1)

Comment: . The Pierce County Surface Water Management Division conducts the majority of B-IBI surveys used in the Clarks Creek TMDL analysis and the B-IBI sampling areas are located on the lowest reaches of Diru and Rody Creeks just before their confluence with the mainstream of Clarks Creek. Only the B-IBI site located below the WDFW Hatchery is positioned in the upper reach of the system.

Question: Why is it appropriate to extend the benthic impairment interpretation that predominates in the B-IBI sampling of the lower reaches to the upper reaches of the system?

Ecology response 17*: The B-IBI is a quantitative measure of the biological health of a particular stream reach that can be tracked for changes through time as well as for comparison with scores from other stream reaches. The applicability of the B-IBI within the Puget Lowland is broad enough to be relevant at multiple scales. The Pierce County Watershed Health Monitoring Program collected benthic macroinvertebrate data at three locations within the Clarks Creek basin between 2001 – 2010. The samples were collected on Diru, Rody and Clarks Creek. The B-IBI scores tabulated at the sites ranged between Fair and Poor. On the B-IBI index categorical scale (adapted from Karr et al., 1986 and Morley, 2000) this means "total taxa richness is reduced – particularly intolerant, long-lived, stonefly, and clinger taxa; the relative abundance of predators has declined; and the proportion of tolerant taxa continues to increase" and the "Overall taxa diversity is depressed; the proportion of predators are greatly reduced as is long-lived taxa richness; there are few stoneflies or intolerant taxa present; and the dominance by the three most abundant taxa are often very high." The decline of total tax richness, intolerant, long-lived, stonefly and clinger taxa are all indicative of human disturbance and sediment deposition in the stream (see attached table). While additional data is always useful, Ecology used the best available data in the basin to support the TMDL.*

Description of Metrics	
Metric	***Stressor***
Total Taxa Richness	*The biodiversity of a stream declines as flow regimes are altered, habitat is lost, chemicals are introduced, energy cycles are disrupted, and alien taxa invade. Total taxa richness includes all the different invertebrates collected from a stream site: mayflies, caddis flies, stoneflies, true flies, midges, clams, snails, and worms.*
Ephemeroptera (Mayfly) Taxa Richness	*The diversity of mayflies declines in response to most types of human influence. Many mayflies graze on algae and are particularly sensitive to chemical pollution (e.g., from mine tailings) that interferes with their food source. Mayflies may disappear when heavy metal concentrations are high while caddis flies and stoneflies are unaffected. In nutrient-poor streams, livestock feces and fertilizers from agriculture can increase the numbers and types of mayflies present. If many different taxa of mayflies are found while the variety of stoneflies and caddis flies is low, enrichment may be the cause.*

Description of Metrics	
Metric	***Stressor***
Plecoptera (Stonefly) Taxa Richness	*Stoneflies are the first to disappear from a stream as human disturbance increases. Many stoneflies are predators that stalk their prey and hide around and between rocks. Hiding places between rocks are lost as sediment washes into a stream. Many stoneflies are shredders and feed on leaf litter that drops from an overhanging tree canopy. Most stoneflies, like salmonids, require cool water temperatures and high oxygen to complete their life cycles.*
Trichoptera (Caddisfly) Taxa Richness	*Different caddisfly species (or taxa) feed in a variety of ways: some spin nets to trap food, others collect or scrape food on top of exposed rocks. Many caddis flies build gravel or wood cases to protect them from predators; others are predators themselves. Even though they are very diverse in habit, taxa richness of caddis flies declines steadily as humans eliminate the variety and complexity of their stream habitat.*
Intolerant Taxa Richness	*Animals identified as intolerant are the most sensitive taxa; they represent approximately 5-10% of the taxa present in the region. These animals are the first to disappear as human disturbance increases.*
Clinger Taxa Richness and Percent	*Taxa defined as clingers have physical adaptations that allow them to hold onto smooth substrates in fast water. These animals typically occupy the open area between rocks and cobble along the bottom of the stream. Thus they are particularly sensitive to fine sediments that fill these spaces and eliminate the variety and complexity of these small habitats. Clingers may use these areas to forage, escape from predators, or lay their eggs. Sediment also prevents clingers from moving down deeper into the stream bed, or hyporheos, of the channel.*
Long-Lived (Semi-Voltine) Taxa Richness	*These invertebrates require more than one year to complete their life cycles; thus, they are exposed to all the human activities that influence the stream throughout one or more years. If the stream is dry part of the year or subject to flooding, these animals may disappear. Loss of long-lived taxa may also indicate an on-going problem that repeatedly interrupts their life cycles.*
Percent Tolerant	*Tolerant animals are present at most stream sites, but as disturbance increases, they represent an increasingly large percentage of the assemblage. Invertebrates designated as tolerant represent the 5-10% most tolerant taxa in a region. In a sense, they occupy the opposite end of the spectrum from intolerant taxa.*

18. (Page 9, paragraph 2)
Question A: When stating "Fish and habitat *factors* involving sediment have been *observed* in Clarks Creek", what does *factors* mean precisely?

Question B: What do *observations* mean precisely? Does it mean the *observations* were based on recorded data retrieved through following a (known) standard protocol over time or is it referring to a composite interpretation represented from successive years of in-stream inventories or does it represent anecdotal impressions?

Question C: Are there any published peer reviewed citations available to support the statement?

Ecology response 18A, B & C: *The full sentence reads, "Fish and habitat limiting factors involving sediment have been observed in Clarks Creek and include flooding, channel erosion, and deposition of fine sediment." The factors refer to flooding, channel erosion and deposition of fine sediment. The Salmon Habitat Limiting Factors Report for the Puyallup River Basin (Kerwin, 1999) specifically identifies habitat limiting factors in Clarks Creek, Diru Creek, Meeker Creek, and Rody Creek (Table 2) as "fish passage, floodplain connectivity, bank stability, LWD, Pools, side channel habitat, substrate fines, riparian, and water quality." Specifically, the report says tributary streams in the lower Puyallup River Subbasin (including Clarks Creek, Meeker, Diru, and Rody Creeks) "…have suffered the fate of most streams found in* *urban settings. They carry high levels of fecal coliform bacteria and stormwater that is contaminated with heavy metals, oil, grease and organic compounds. Large amounts of fine sediments are also typically found in most reaches." There is a large body of literature to support sediment as a limiting factor on salmon. Here are a few citations: Kerwin, J., 1999, Jensen et al., 2009; Reiser, D.W., 1998; Waters, T.F., 1995.*

Jensen, D.W., E.A. Steel, A.H. Fullerton, G.R. Pess, 2009. Impact of Fine Sediment on Egg-To-Fry Survival of Pacific Salmon: A Meta-Analysis of Published Studies. Reviews in Fisheries Science: V17:I 3.

Kerwin, J. 1999. Salmon Habitat Limiting Factors Report for the Puyallup River Basin (Water Resource Inventory Area 10). Washington Conservation Commission, Olympia, WA.

Reiser, D.W., 1998. "Sediment in gravel bed rivers: Ecological and biological considerations." Gravel-Bed Rivers in the Environment. P.C. Kingeman, R.L. Beschta, P.D. Komar, and J.B. Bradley, eds., Water Resources Publications, Highlands Ranch, Colorado, 199-225.

Waters, T.F. 1995. Sediment in streams—Sources, biological effects, and control. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, MD.

Additionally, the factors influencing fish communities have also been shown to negatively influence stream macroinvertebrate communities. Several references are provided below.

Cuffney, T.F., Brightbill, R.A., May, J.T., Waite, I.R. 2010. Response of benthic macroinvertebrates to environmental changes associated with urbanization in nine metropolitan areas. Ecological Applications 20: 1384-1401.

Larsen, S., Pace, G., Ormerod, S.J. 2011. Experimental effects of sediment deposition on the structure and function of macroinvertebrate assemblages in temperate streams. River Research and Applications 27: 257-267.

US Environmental Protection Agency. 2000. National water-quality inventory. Office of Water, US Environmental Protection Agency, Washington, DC.

19. (Page 9, paragraph 2)
Comment: The statement "The WDFW sediment pond hinders the fluvial movement of gravel further downstream to remaining stream channel, while the transport of fine sediment past the pond fills in the existing gravel with fine sand and silt." compels Pierce County to ask the following questions

Question A: How was the WDFW sediment pond located at the hatchery characterized in the HSPF model for its contribution to the Clarks Creek sediment budget?

Ecology response: *The sediment pond is represented by a hydraulic functional table (FTable) in the HSPF model that was in turn derived from the Clarks Creek HEC-RAS model (originally developed by Northwest Hydraulic Consultants (NHC, 2005) and later expanded in geographical scope by Brown and Caldwell using additional stream cross sections), which simulates hydraulic behavior based on observed morphometry from measured cross sections. The FTable parameters represent the hydraulics and associated shear stresses in the reach containing the sediment pond that can limit throughput of coarser sediment. HSPF uses these parameters to simulate flow and sediment loading from the pond's reach, and the simulation distinguishes between coarse and fine sediment. For more details on the HEC-RAS modeling, see Section 4.2.1 of Appendix C of the TMDL document (Tetra Tech, 2012) or Section 4.2.1 of Brown and Caldwell (2013).*

Question B: Was this point source (or sink) quantitatively distinguished in the HSPF model and analysis? If so, where is this analysis and information? If the answer is no, why was it not distinguished in the HSPF model and analysis?

Ecology response: *As noted in the previous response, the hatchery pond is represented in the model. Detailed results for the reach including the hatchery pond (RCHRES 135) can be obtained by directing results from this reach at the appropriate time step to the binary output (hbn) file. Such results are not presented in the model calibration report as there are not quantitative measurements of sediment transport available for comparison.*

20. (Page 10, bullet point 1)
Comment: In the U.S. G.S. Water Report 86-4154 Water Quality in the Lower Puyallup River Valley And Adjacent Uplands, Pierce County, Washington by J. C. Ebbert, Bortleson, Fuste and Prych, 1987 (prepared in cooperation with the Puyallup Tribe of Indians) direct sampling of Maplewood Springs was reporting pH ranging from 6.3 to 8.2 and dissolved oxygen at 8.7 mg/L (at 9.1 degrees C).

Question A: Given the absence of any direct measurements or any real-time data for dissolved oxygen or in-stream flow volumes originating from Maplewood Springs, why is it being represented that the upper reaches were determined to be Category 5 impaired waters as inferred by the statement "…due to the naturally low pH of the groundwater feeding these streams"?

Ecology response: *The question reflects a misinterpretation of page 10, bullet 1. This bulleted list refers to TMDL listings other than the DO and sediment impairments addressed by the subject TMDL document. This first bullet describes previous 303(d) listing of Category 5 impaired waters for pH that has since been removed from Category 5 due to the determination, as part of the Clarks Creek Fecal Coliform TMDL, that this is caused by a natural condition. The Clarks Creek Fecal Coliform TMDL provides conclusions from 97 data points sampled between 2002-2003 at 10 stations in the Clarks Creek basin. The TMDL concludes, "of the 97 data points, five are outside the water quality criterion of 6.5 to 8.5 standard units (SU)…. Four of the five pH violations are probably not due to conditions that would cause consistent pH problems in Clarks Creek. The remaining pH excursion in one of the intermittent streams cannot be explained with the available information, but it also does not seem to be a consistent problem." This bullet is not referring to the dissolved oxygen impairment.*

Question B: The modeling assumption represented later in the document on page 45, paragraph 2 states that "the model calibration was best fit by setting the dissolved oxygen concentration at 8.5 mg/L of dissolved oxygen in diffuse inflows" (i.e. groundwater). How was the assumption for calibrating dissolved oxygen concentration at 8.5 mg/L determined?

Ecology response: *Diffuse inflow is not equivalent to direct ground water input, although it may contain ground water. Diffuse inflow represents all minor sources that enter the creek through locations other than defined and explicitly represented tributaries and stormwater conveyances. This includes minor tributaries, direct runoff from lands along the creek, anthropogenic inputs from irrigation or exterior washing activities, springs, other direct groundwater input, and ground water that seeps to the surface on land adjacent to the stream.*

The comment is referring to the model assumption, under baseflow conditions, for DO concentration in diffuse inflows. This assumption was actually 8 mg/L, not 8.5 mg/L, as documented in both Tetra Tech (2011) and the TMDL document. The basis for this assumption is explained in paragraphs 1 and 2 on page 45 of the TMDL document:

> *During baseflow conditions, flow in Clarks Creek is primarily derived from springs (such as Maplewood Springs) that emerge from the base of hillslopes at the edge of the glacial till. The DO concentration in these springs helps determine instream DO concentrations. Measurements are not directly available for DO concentrations in groundwater emerging through these springs; however,*

their net impact on DO is known to be small based on the relatively high DO concentrations observed during baseflow conditions in monitoring near the state hatchery, in the groundwater discharge zone. These springs are fed by high permeability sand layers in the till, which has a low organic matter content and is likely to maintain well-oxygenated conditions, with additional re-aeration occurring at the discharge points.

Shallow groundwater in the alluvial plain further downstream has been noted as having low DO (Jones et al., 1999; Brown and Caldwell, 2009). Apparently, this is due to low permeability and incorporated organic peat and muck deposits, although DO concentrations in discharging groundwater in this region have not been directly measured. Groundwater derived from the alluvial plain, however, represents only a small fraction of the total flow in Clarks Creek during baseflow conditions. Calibration of the QUAL2Kw model found that a good fit was obtained by setting the DO concentration in diffuse inflows direct to Clarks Creek downstream of Maplewood Springs to 8 mg/L during summer baseflow conditions. Urban and alluvial plain groundwater may in part account for reduced DO concentrations in water discharged from Meeker Creek and other conveyances. The QUAL2Kw calibration approach is summarized in Appendix B and described in detail in Tetra Tech (2011a).

The 8 mg/L DO assumption for summer baseflow is preferable to the 8.7 mg/L measured value for a number of reasons. Since flow in Clarks Creek is primarily derived from springs during baseflow conditions, it is important that this parameter reflects, as closely as possible, DO in groundwater emerging from the springs and discharging directly to Clarks Creek. By setting the DO in diffuse inflows during baseflow to 8 mg/L, the resulting simulated instream DO concentrations corresponds well to measured DO concentrations in the groundwater discharge zone near the state hatchery. Values above and below 8 mg/L resulted in a divergence from the measured DO concentrations during baseflow. This approach of setting a model parameter to fit measured instream concentrations is a well-supported and standard practice for water quality model calibration. In addition, the value of 8.7 mg/L DO was a single measured value from groundwater wells over 20 years prior to this TMDL document. While this value helps support that high DO concentrations can be found in groundwater near Maplewood Springs, its use as a model parameter would result in a weakened model fit and could result in an overestimation natural background DO concentrations in baseflow. Additionally, more recent sampling by USGS of Maplewood Springs on 6/18/1996 measured in-situ DO at 7.2-mg/L, temperature of 9.7 degree-C, and a pH of 7 (Jones et al., 1999).

21. (Page 12, paragraph 4)

Comment: The statement "Whether or not the water body's temperature is naturally high is determined using a model. The model roughly approximates natural conditions, and is appropriate for determining implementation of the temperature criteria" is worthy of inquiry and some clarifying explanations.

Question A: Which model is being used, was it HSPF, QUAL2Kw or some other model?

Ecology response: *The model used to assess temperature in Clarks Creek is the QUAL2Kw model.*

Question B: Why is the determination of compliance for the temperature criteria not made using real-time data reporting or scheduled on site sampling? Does the model take this data and fabricate a continuous daily temperature profile to determine compliance?

Ecology response: *This section references to temperature standards and applicable numeric criteria. This section is not referring to the model developed for the dissolved oxygen and sediment TMDL.*

Compliance with temperature criteria is determined using real-time continuous data submitted to Ecology's Environmental Information Management database at the time of the Water Quality Assessment. A model, often developed during a Temperature TMDL, may be used to evaluate whether or not the water body's temperature is natural high.

Question C: Why is a model that "roughly approximates natural conditions" being relied on to make this important distinction and quantitative determination regarding program compliance?

Ecology response: *See response to Question B.*

Question D: With what data (and from whose monitoring program) was the model populated and calibrated?

Ecology response: *As noted above, this section is a general discussion of how temperature criteria are assessed in the state of Washington and therefore does not refer to the development and calibration of any specific model.*

Question E: How will the model be used to determine interim and final program compliance?

Ecology response: *See response to Question B.*

22. (Page 15, paragraph 3)
Comment: This paragraph provides one of the many references throughout the document mentioning "fine sediment and fines and sand" without distinguishing the quantitative dimensions of what is categorically meant by the term "fine sediment".

Question A: What are the categorical dimensions or particle (grain) size range of "fine sediment"?

Ecology response: *Please refer to the response under Comment 12 above.*

Question B: Is "fine sediment" referring to the fine earth fraction (per USDA NRCS) which includes sand, silt and clay or all particle (grain) sizes less that 2mm in diameter or does "fine sediment" refer to just the silt and clay fraction? Is there another standardized grain size classification or partitioning system being used (e.g. ASTM USCS, AGU, Wentworth) in the report that would change the dimensional assumptions surrounding the words gravel, sand, silt and clay etc.?

Ecology response: *As stated in the comment response for the Pierce Co. cover letter, both excess fine sediment and sand are among the major factors creating conditions in Clarks Creek that harm fish and their supporting habitat. In particular, the deposition of all sediment classes, including sand, during large flow events is an important cause of aggradation which sets the stage for Elodea growth. The general statements made in the TMDL document using the terms sand, fine sand, fine sediment, fines, and other similar terms are not sensitive to a particular standardized grain size classification or partitioning system. The grain size distribution analysis (GSD) was based on specific grain size categories which, as stated earlier for Comment #12, is documented in Appendix C of Brown and Caldwell (2013).*

23. (Page 16, paragraph 3)
Comment: Regarding the statement "…and the dissolved gases criterion is 110 percent of saturation. These targets represent the most protective criteria, and are protective of all designated uses."

Question A: Where, when and how often will the total dissolved gas criterion be measured and re-modeled?

Question B: Whose monitoring program will be responsible for collecting the data that will be used for determining program compliance with the total dissolved gas criterion? Will program compliance be determined through use of the QUAL2Kw or some other model?
NOTE: Please also refer to Question 27 below for related comments and questions regarding the total dissolved gas criterion.

Ecology response: *The TMDL will use monitoring from multiple sources during implementation. As different monitoring programs start in the basin, Ecology will review the plans and associated QAPPs and may recommend monitoring for DO, TDG, sediment or fecal coliform bacteria depending on the overall goal of the program.*

Also as stated earlier, the TMDL will use adaptive management and monitoring to measure success. Beginning in 2020 monitoring will be used to check progress on where Clarks Creek is meeting state water quality standards for dissolved oxygen and sediment.

24. (Page 16, paragraph 4)
Comment: The statement: "The required load reductions is based on the difference between the percentage of sand and fines in Clarks Creek and the 90th percentile of sand and fines in Puget Sound lowland reference systems" does not provide the information necessary to satisfy the County's desire to understand the reference stream calibration developed for sediment Waste Load Allocation .

Question A: How exactly is the sediment load characterization for Clarks Creek being related to a specific or composite condition defined by the Puget Sound lowland reference systems? Are the details of the analysis available for review?

Question B: Which of the reference systems were chosen as the most appropriate analog for establishing the standards for Clarks Creek?

Question C: How were the spatial comparisons made by channel reach?

Ecology response: *See response to Attachment 1, comment 11.*

25. (Page 21, paragraph 4)
Comment: Soils are classified into Hydrologic Soil Groups (HSG's) to indicate the equilibrated minimum rate of infiltration for a soil after prolonged wetting (i.e. internal water transmission rate under saturated conditions). The Hydrologic Soil Groups are referred to as A, B, C, and D. HSG is a critical input parameter in determining runoff curve numbers (e.g. Technical Report 55) for soil map units. Saturated Hydraulic Conductivity (Ksat) is primarily controlled by soil conditions in the upper 100 cm of the profile (~40"). HSG assignment indicates the expected average Ksat of a given soil series and phase under natural conditions. The Ksat is the rate at which the water moves into and vertically down through the soil profile when saturated. The Pierce County Soil Survey (whether accessed through the State Soil Geographic Database (STATSGO) and the Soil Survey Geographic Database (SSURGO)) represents Ksat measured in the undisturbed soil profile as associated with the soil series delineated as the major component of a soil map unit. Approximate numerical ranges for Ksat associated with the HSG are relative values. This is due to the variability in texture and differences in the depth of the soil profile; even across small distances. It is important to stress that disturbed soil profiles (displaced and compacted) quickly evolve under the activities associated with development and urban land use, particularly in those areas that have 25 percent or more impervious coverage. The soils in a majority of the watershed are most probably altered (e.g. increases in bulk density) and the HSG assignment found in the Soil Survey may no longer accurately characterize the soils water receiving and storing capabilities. In these circumstances, the HSG found in the Soil Survey should only be used in a rainfall-runoff model when it is known that compaction and displacement have not occurred. The HSPF modeling relied on the Pierce County Soil Survey which exclusively describes the

attributes of undisturbed soils within the study area. That being said, the Soil Survey GIS layer for Clarks Creek indicated that 71 percent of the watershed is assigned to low capability soils, which are native soils with inherently low infiltration rates and water storage capacity (i.e. HSG C and D). It is also important to note that much of the substratum for the upper watershed area is mapped as having a shallow restrictive layer or aquitard due to the parent material being a basal till. Therefore, the HSG's represented by the soil survey and used in the rainfall-runoff modules (processes) of HSPF are most likely significantly more constrained regarding their permeability rates. This consideration was not represented in the data review (QUAP process) conducted for the TMDL modeling operations. It is Pierce County's position that substantive site constraints (i.e. lands inherently unsuitable for stormwater infiltration and treatment) ought to have been considered in the development of the TMDL Waste Load Allocations (WLA). We believe that this issue is a critical design and implementation challenge to the Capital Project Program and it impairs their ability to design feasible, affordable and durably effective projects that will be able to meet the WLA directive to reduce or treat 50 percent of stormwater generated from the upland of the Clarks Creek Watershed.

Question: With what data were the Soils, Land use, Land Practices modules populated in the HSPF model?

Ecology response: *The discussion of soils on page 21, paragraph 4 of the TMDL document is meant to provide a general background of native soils and is appropriate for this portion of the document. This paragraph does not refer to model assumptions. The reader should refer to the HSPF model calibration report in Appendix C for that information.*

The comment commences by confusing the concepts of saturated conductivity and infiltration. As the name implies, Ksat is an estimate of conductivity under fully saturated conditions. Infiltration into the soil generally occurs under partially saturated conditions and involves other factors such as matric potential. Hydrologic Soil Group (HSG) is not solely a function of KSat, but is an indicator of the rate in which water is drained from the surface. The implication that low infiltration rate is always associated with low water storage capacity is also incorrect, as the capacity depends on the void space and depth of the soil profile and is independent of the infiltration rate.

The statement that the "HSPF modeling relied on the Pierce County Soil Survey" is also somewhat misleading. The Hydrologic Response Unit (HRU) boundaries were based on a detailed analysis of geology and soils, land use/land cover, and slopes as described in Section 3 of Tetra Tech (2013). Model parameters relating to soil infiltration rates were set based on a review of a past HSPF model for the area, EPA guidance, and adjustment during calibration as documented on pages 6-1 through 6-3 of Tetra Tech (2012). The soil survey provides the distinction between relative soil characteristics (HSG group) that can then be compared to recommended ranges listed by HSG group and adjusted based on conditions specific to the watershed. As discussed in the model documentation, calibration was sensitive to the HSPF hydrologic parameters, and these parameters were adjusted to provide the best fit to gage data. Hydrologic parameters were varied in a logical manner based on soil information, land cover, and season, as described in Section 6.1 of the model calibration report. INFILT (the nominal infiltration rate parameter) was, in particular, set by Hydrologic Soil Group, with different values used for forest land cover to reflect lack of compaction and development of more root channels in forest soils.

It is certainly true that there are likely to be site constraints on infiltration in many parts of the watershed. That is why the implementation recommendations are framed in more flexible terms, allowing removal (whether by infiltration, evaporation, or diversion) or treatment of stormwater to meet TMDL allocations.

26. (Page 22, paragraph 1)
Comment: Regarding U.S. G.S. Water Report 86-4154: Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington by Ebbert et al, 1987 (prepared in cooperation with the Puyallup Tribe of Indians); the County has the following question.
Question A: The direct sampling of Maplewood Springs was assigned to Aquifer G in the preceding USGS paper and this differs from the Savoca (2010) paper which sites the source as Aquifer A?

Ecology response: *It is unclear what is being asked. It is correct that these two references differ in their assumptions. The more recent reference was chosen as more reliable compared to a study conducted over 20 years prior.*

Question B: Why was the Savoca (2010) paper the lone literature resource for the groundwater characterization?

Ecology response: *This section of the document provides a description of the Clarks Creek watershed; therefore, the text in this paragraph is meant to provide a general background on groundwater conditions. As stated earlier, Savoca (2010) provided the more recent reference. Ecology welcomes additional research documents if available….*

27. Comment: In the document, Clarks Creek Dissolved Oxygen TMDL and Implementation Plan QUAL2Kw Modeling, prepared for the USEPA Region 10 by Tetra Tech (2010), the 3rd bullet point on page 2 states "Exchange with atmosphere…water will attempt to return the saturation concentration of DO, which, as noted below, is a function of water temperature. When DO is below saturation, oxygen will move from the atmosphere to the water (reaeration). The rate of reaeration is a function of the magnitude of the DO deficit and the velocity and turbulence of the water. When DO is present at supersaturation there will be net degassing to the atmosphere. Note that the saturation concentration varies with temperature; thus, changes in temperature can have an important effect on atmospheric exchanges."

Question A: If river systems are mostly self regulating and water columns are always moving toward a state of temperature dependent equilibration for dissolved gas concentration, how will the 110 percent of dissolved gases criterion be measured, monitored and evaluated for compliance?

Question B: Since the County's monitoring program does not currently measure for this dissolved gases criterion, is it Ecology who maintains the monitoring responsibility? If yes, is a model employed to determine compliance with this criterion?

Ecology response: *Also as stated earlier, the TMDL will use adaptive management and monitoring to measure success. Beginning in 2020 monitoring will be used to check progress on where Clarks Creek is meeting state water quality standards for dissolved oxygen and sediment.*

28. (Page 24, paragraph 1)
Comment: Regarding Pollutant Source Categories: TMDL source category analysis is often conducted by compartment. Pierce County requests quantitative distinctions between source categories. We believe it is most appropriate to distinguish and understand the separate loads being generated from the discernible compartments most often cited in the TMDL development literature, such as: 1) Urban upland inputs (areas with 10 to 15 percent connected impervious cover), 2) Forested lands inputs, 3) Groundwater inputs, 4) In-stream channel inputs (bank slope and toe erosion), and 5) Atmospheric inputs.
Question: Can the TMDL modeling analysis generated for the Clarks Creek TMDL provide these quantitative distinctions, and if not, why was the analysis not conducted and presented in this manner?

Ecology response: *The model can and does provide this information. Please examine Table 7-5 (for sediment) in Tetra Tech (2012) and Table 8-3 (for nutrients) in Appendix C to the TMDL document. As* *described in the TMDL, DO deficit arises as a result of direct and indirect effects of sediment and nutrient loads, including organic material associated with sediment loading and the effects of elodea growth exacerbated by nutrient loading. However, allocations are provided by MS4 jurisdiction land area to provide the municipalities flexibility with where and how they implement the TMDL allocations.*

29. (Page 24, paragraph 1)
Comment: The statement "Natural conditions can also cause low DO, turbidity and fluctuations in sediment loading."

Question: What are these natural conditions and how do they relate to the quantitative characterization of the Natural Loads or Natural Background?

Ecology response: *The statement on page 24, paragraph 1 is referring generally to sources of low DO or sediment to any stream, not specifically to Clarks Creek. This introductory text is explaining which potential pollutant sources were considered. The natural background subsection goes on to discuss available information on these conditions within Clarks Creek. A number of natural conditions could cause low DO, turbidity and fluctuations in sediment loading. The natural background subsection discusses the potential for these conditions to occur in Clarks Creek:*

> *Natural background sources of low DO and sediment include surface runoff from undisturbed areas, natural rates of stream bank erosion, and groundwater with low DO concentrations. While DO in groundwater has not been directly measured, DO concentrations could be either low or high depending on the source of groundwater. The definition of groundwater, and what is strictly natural, is ambiguous in the Clarks Creek watershed as much of the stormflow reaches streams through subsurface pathways. The effect of groundwater on Clarks Creek instream DO concentrations also depends on whether groundwater enters the stream through the tributaries, bank seepage, or channel seepage. The net influence of groundwater inflows on instream DO concentrations was estimated during model calibration as discussed in the Relationship between DO and Baseflow section and Appendix B.*

In the TMDL quantitative analysis, natural conditions were generally defined as forested conditions. In the QUAL2kw modeling, natural conditions referred to dissolved oxygen saturation, which is expected to vary diurnally, and this natural diurnal variation was accounted for in the calibration process. For the sediment TMDL, forested conditions were used to represent natural conditions in the "Natural Condition" scenario of the HSPF modeling and geomorphic conditions analysis. The modeling simulates a sediment load from forested conditions, which is consistent with the statement on page 24, paragraph 1 of the TMDL document.

30. (Page 24, paragraph 2)
Comment: Pierce County is concerned over the fair share appropriation and accountability of the WLA and LAs issued among the different jurisdictions and entities identified in the TMDL.

Question: What assurances can Ecology provide as to how there will be a proportional accounting and enforcement of WLAs and LA across all parties identified as contributing to the Clarks Creek impairment?

Ecology response: *Please refer to previous Ecology response under Comment 4 Question B*

31. (Page 24, paragraph 3)
Comment: The closing sentence in the paragraph states "The monitoring data suggest that the average discharge rate is about 6.3 MGD (9.7 cfs)."
Question: Does this sentence mean to imply that 9.7 cfs is the average base flow discharge rate representing the steady state groundwater contribution from Maplewood Springs?

Ecology response: *Comment noted, changed sentence from "The monitoring data suggest that the average discharge rate is about 6.3 MGD (9.7 cfs)." to "The monitoring data suggest that the average discharge rate of the state hatchery is about 6.3 MGD (9.7 cfs)."*

32. (Page 24, paragraph 4)

Comment: The statements "PTI's monitoring data from 2007 and 2008 showed only low levels of TSS and ammonia. Detailed monitoring of pollutant loading from the hatcheries has not been conducted at this time. Using the available TSS and ammonia data as indicators, the hatcheries contribute relatively small amounts of sediment and oxygen demanding substances to Clarks Creek. PTI will collect monitoring data to better characterize the pollutants and loadings to Clarks Creek." Seems irregular for a number of reasons and provokes the following questions.

Question A: Is it appropriate and reasonable for the EPA not to issue a discharge permit to PTI based on monitoring data generated from more than 5 years ago?

Ecology response: *Yes, the Puyallup Tribal Hatchery is currently below the fish production threshold requiring a federal hatchery permit. EPA regulates fish hatcheries that produce more than 20,000 pounds of fish and use more than 5,000 pounds of feed in the month of maximum feed use. The Puyallup Tribal Hatcheries produced 8,457 pounds of fish and fed 10,148 pounds of food at Diru Creek Hatchery over a 5 month period and reared 5,713 pounds of fish and fed 6,857 pounds of fish food over a 5 month period at the Clarks Creek Hatchery. However, the Puyallup tribal hatcheries will receive a load allocation where they are required to monitor nutrients, solids, and flow, use best management practices to reduce solids and nutrients discharged from the Creek, and maintain a record of drugs used to manage the hatcheries. The Tribe will report annually the results of their water quality monitoring, best management practices implemented, and a record log of the drugs.*

Question B: Why is it appropriate for a TMDL analysis that is detailed with identifying and quantifying the loading sources responsible for system wide impairments make the determination that "Detailed monitoring of pollutant loading from the hatcheries has not been conducted at this time" is a suitable programmatic position to maintain into the future?

Ecology response: *As stated above, the tribal hatcheries are currently below the fish production threshold requiring Federal Hatchery NPDES permits and their discharge were considered non-significant. The TMDL establishes the monitoring to quantify the hatcheries influence on Clarks Creek. If needed, the TMDL will use this monitoring data to establish a wasteload allocation for the tribal Hatcheries.*

Question C: Please explain Ecology's 2004, 2008 and 2012 listing decisions: listing was not supported in 2004 and the County still unclear as to what was the basis for 2008 and 2012 listing and why the state accepted ten year old data that should have been available in 2004 and 2008 as a result of the call for ***marine*** waters data in 2012.

Ecology response: *Ecology Policy 1-11: Under Listing Cycles and Call for Data, "Data collected within ten years of the published call-for-data end date for each Assessment will be consolidated and assessed with other data of the same waterbody segment and parameter." The 303(d) list provides remarks and bases for each listing. See http://www.ecy.wa.gov/programs/Wq/303d/currentassessmt.html.*

Question D: Please explain further the dissolved oxygen standard differences applied above and below Tacoma road?

Ecology response: *The aquatic life dissolved oxygen criteria for Core Summer Salmonid Habitat for the entire length of Clarks creek is: 9.5 mg/l*

33. (Page 26, paragraph 3)
Comment: Regarding the control of permitted development projects, the following statements "Land disturbance occurring as part of construction activity can contribute substantial sediment loading to streams and can provide fine sediment for elodea growth. Detailed evaluation of available monitoring from the currently permitted construction sites has not been conducted at this time, and because these sites are regulated it is assumed to contribute relatively small amounts of nutrients and oxygen demanding wastes to Clarks Creek." represents a significant assumption that cannot be corroborated by the available data.

Question: Is this acknowledgment of not monitoring appropriate and are the assumptions of project site compliance based on any current inspection data?

Ecology Response: *The statement above on "Permitted development projects" is taken out of context. The text refers to construction activity in general and if the activity is not permitted or properly managed there is the potential for these projects to contribute sediment.*

During the TMDL process, Ecology evaluated how many NPDES permitted construction sites occurred throughout the watershed during a five year period. This was then used to give this construction activity a Wasteload allocation and this is explained in further detail on page 119 under the Sediment Load and wasteload allocations section. (See reference text from page 119 below):

> *"The construction WLA applies to all current and future permittees in the Clarks Creek watershed covered under Ecology's Construction Stormwater General Permit (CGP). In order to be in compliance with this TMDL, permittees must conduct turbidity sampling in accordance with the CGP Special Condition S8. All discharges to 303(d) or TMDL water bodies must comply with the required 25 NTU effluent limit, or stay in compliance with the surface water quality standard for turbidity as defined in S8.C.2."*

The NPDES Construction Stormwater General permit is used to control sediment from leaving construction sites and is evaluated every 5 years when the permit is open for public comment. Ecology encourages the county to comment when this permit is open for comments if they feel it is not adequately addressing sediment.

If the county feels any of these facilities are operated inappropriately we encourage the county to report this activity to Ecology Southwest Regional Office by phone at 360-407-6300 or by using the following link online: http://www.ecy.wa.gov/programs/spills/forms/nerts_online/SWRO_nerts_online.html.

34. (Page 26, paragraph 4)
Comment: Regarding the control of permitted industrial projects, the following statements "Depending on the type of industrial activity, stormwater discharges have the potential to contain nutrients or other constituents, which can contribute to low oxygen levels in receiving waters. According to Ecology's PARIS database reviewed in June 2012, three (3) industrial permitted facilities and two (2) sand and gravel permitted facilities are located in the Clarks Creek watershed; none of these facilities directly discharge to Clarks Creek, and therefore are not assumed to substantively contribute to the impairment in Clarks Creek" raise two questions from the County.

Question A: Is this acknowledgment of not monitoring appropriate and are the assumptions of project site compliance based on any contemporary inspection data? Just because there is no direct discharge to Clarks Creek, can these permitted activities be potentially contributing to the non-point source loadings (LAs)?

Ecology response A: *These are permitted, and are not considered non-point source discharges because they operate under a NPDES discharge permit. Evaluation of both facilities confirmed that they do not have*

a direct discharge to surface waters of Clarks Creek. Ecology believes these facilities do not substantively contribute to impairments in Clarks Creek. If the County feels these facilities are operated inappropriately we encourage the county to report this activity to Ecology Southwest Regional Office by phone at 360-407-6300 or by using the following link online:
http://www.ecy.wa.gov/programs/spills/forms/nerts_online/SWRO_nerts_online.html

Question B: This determination is also a concern for Pierce County because of its implications for the fair share approach to having TMDL responsibilities applied proportionally across all parties whom contribute to the impairment. It is the County's position that the remedies and solutions to Clarks Creek's water quality impairments be addressed by all contributing entities. Pierce County is of the opinion that every entity and jurisdiction should have skin in the game when working collectively to address the directives associated with the WLAs and LAs. With that being said, why and how would the current approach represented in the TMDL embody a durable programmatic fair share scenario? (…particularly when schools, hospitals and drainage districts are operating without a NPDES permit yet represent significant infrastructures that contribute to the water quality impairments)

The WLA is based upon current point source dischargers under NPDES permits. Should the need arise, the WLA could be reapportioned to adjust to new secondary MS4 permittees such as school districts, hospitals or drainage districts. Additionally, Ecology recommends Pierce County read Ecology's guidance on secondary permittee coverage and the petitioning process for bringing in new MS4 permittees available at, respectively, http://www.ecy.wa.gov/programs/wq/stormwater/municipal/secondaryneedpermit.html and http://www.ecy.wa.gov/programs/wq/stormwater/municipal/PetitionCriteriaRevcontact108.pdf.

35. (Page 27, paragraph 1)
Comment: The statement "Direct surface runoff to Clarks Creek is considered a nonpoint source" is a simple conceptual statement and is clear in its meaning, however we ask for further clarification in the context of comment 4, Page XVii, paragraph 1. Based on conversations with Ecology staff, Pierce County understands that "properties adjacent to the Creek" is referring to parcels located in areas that are "hydrologic intervening areas", meaning they are parcels positioned along channel interfluves and drain directly to in-stream surface waters and not laterally into County stormwater conveyance or infrastructure.

Question A: Is this understanding or definition correct?

Ecology response A: *Yes, "properties adjacent to the creek" refers to those properties that drain directly to the creek and that are not connected to stormwater conveyance infrastructure.*

Question B: Are these nonpoint source properties officially captured under the MS4 NPDES permit even though they are designated as non-point sources? If those nonpoint source properties are the County's NPDES compliance, by what legal authority or code is that inclusion sanctioned?

Question C: If the nonpoint source properties are designated as part of the Load Allocation, is it Ecology or is it the County that has the responsibility for enforcing TMDL compliance and requiring the implementation of BMPs on these properties?

Question D: How will the Load Allocations assigned to the "properties adjacent to the creek" be applied and enforced if Ecology is the legal entity responsible for compliance and enforcement?

Ecology Response a, B, C, and D: *Please refer to previous Ecology response under Comment 4 Question B*

36. (Page 27, paragraph 3)
Comment: The following sentence "Land disturbance, such as construction sites, can contribute substantial sediment loading to streams, providing fine sediment…" seems somewhat contrary to the presumption cited in preceding section of the TMDL (Comment 34 - Page 26, paragraph 3). When this statement is made in the absence of the following sentence "Detailed evaluation of available monitoring from the currently permitted construction sites has not been conducted at this time, and because these sites are regulated it is

assumed to contribute relatively small amounts of nutrients and oxygen demanding wastes to Clarks Creek." It compel

Question: This position represents a significant set of assumptions that cannot be corroborated by a current review of the available data. Please provide the reasoning behind the statement why a "Detailed evaluation of available monitoring from the currently permitted construction sites has not been conducted at this time" should stand as the status quo and an audit of the BMP inspection records and water quality monitoring data could not be conducted to established the veracity of this assumption for this categorical point source?

Ecology response: *As stated above in comment 33, The NPDES Construction Stormwater General permit is used to control sediment from leaving construction sites and is evaluated every 5 years when the permit is open for public comment. Ecology encourages the county to comment when this permit is open for comment if they feel it is not adequately addressing sediment. Furthermore; the TMDL gives a Wasteload allocation to the Construction Stormwater General Permit holders and assumes compliance with the Wasteload allocations based on permit compliance.*

37. (Page 27, paragraph 4)
Comment: The closing sentence in the paragraph states "The monitoring data suggest that the average discharge rate is about 6.3 MGD (9.7 cfs)."

Question: Does this sentence mean to imply that 9.7 cfs is the average base flow discharge rate representing the steady state groundwater contribution from Maplewood Springs?

Ecology response: *Comment noted, changed sentence from "The monitoring data suggest that the average discharge rate is about 6.3 MGD (9.7 cfs)." to "The monitoring data suggest that the average discharge rate of the state hatchery is about 6.3 MGD (9.7 cfs)."*

38. (Page 27, paragraph 5)
Comment: The sentence "Second, poor riparian cover contributes to increased elodea growth and elevated in-stream temperatures. Many portions of Clarks Creek downstream of DeCoursey Park have poor riparian cover; especially where managed lawns associated with single-family residences extend up to the edge of the creek." prompts the following question.

Question A: If "…managed lawns associated with single-family residences extend up to the edge of the creek." are mostly grandfathered uses that have been continually practiced and in-place prior to the adoption Critical Areas Ordinance, how will riparian buffer vegetation be feasibly restored under this type of legal land use scenario?

Ecology response: *Please refer to previous Ecology response under Comment 4 Question B*

Question B: "Elodea nuttallii can be regarded as a low-light adapted plant, under photorespiratory conditions. (Angelstein and Schubert, 2009)" If Elodea nuttallii is identified to be generally tolerant of shade and able to survive even in turbid waters how will the restoration of the riparian buffer (canopy) act to effectively control its nuisance presence in the channel?

Ecology Response B: *The purpose of the Clarks Creek Effective Shade and Elodea project was to develop a relationship specific to Clarks Creek between Elodea density and percent effective shade to determine the required effective shade to limit elodea growth. The relationship was developed through field measurements and system potential effective shade from other Puget Lowland streams in Western Washington. This field work showed a clear relationship between effective shade and Elodea density in Clarks Creek. As shade increased Elodea decreased in Clarks Creek. TMDL wasteload and load allocations are calculated to achieve compliance with the Clean Water Act mandates and Washington State Water Quality Standards.*

While E. nuttallii can grow in low light, reduction of light inputs will result in less nuisance growth and diminish the contribution of Elodea to the DO impairments. Angelstein and Schubert (2009) conducted a *laboratory experiment in Europe that involved varying the irradiance of artificial light exposure at a constant 18 degrees C (64.4 degrees F) under photorespiratory conditions. Angelstein and Schubert (2009) concluded that the optimum irradiance for E. nuttallii under photorespiratory conditions was 51-94 μmol photons m-2s-1, considered to represent relatively low light availability. Below this irradiance, Figure 1c in Angelstein and Schubert (2009) indicates that growth rates decreased and were significantly different from each other for the two lower irradiance levels tested (10-15 μmol photons m-2s-1 and 23-33 μmol photons m-2s-1). While the highest irradiance tested (113-141 μmol photons m-2s-1) resulted in a decreased growth rate, the lowest growth rate occurred at the lowest irradiance tested (10-15 μmol photons m-2s-1). These results showed the E. nuttallii can grow well at a certain range of low irradiance, but below that peak range, the growth rate begins to decrease.*

In a related and more recent study, Zefferman (2014) studied establishment and growth rates of E. nuttallii under different shade conditions in artificial stream channels in California and found that E. nuttallii was able to establish throughout a broad range of light conditions including shade that reduced incident light by 94%. However, growth rates were lowest in the highest shade. This latter conclusion is consistence with trends in Figure 1c of Angelstein and Schubert (2009). Zefferman (2014) concluded that increased shade is unlikely to prevent establishment of E. nuttallii, but increased shade would slow the growth of E. nuttallii.

At a minimum, restoration of the riparian buffer (canopy) will act to slow the growth rate of E. nuttallii, an outcome that is supported by Angelstein and Schubert (2009) and Zefferman (2014). These studies, however, cannot be used to quantify the effective shade necessary to significantly affect growth in Clarks Creek because their experiments were conducted under different climatic conditions. A certain percent effective shade could result in a different irradiance if measured in California versus Washington based on differences in cloud cover, solar radiation, and tree species, among other factors. Angelstein and Schubert (2009) and Zefferman (2014), therefore, provide information on the relationship between growth rate and irradiance and the relative expected trends. Conversely, Brock (2012), Ecology's effective shade study in Appendix D of the TMDL document, provides watershed-specific results that show an inverse relationship between Elodea growth and effective shade and support the use effective shade in reducing Elodea growth. As indicated by Zefferman (2014), increased shade may not prevent the establishment Elodea. However, it is not uncommon for many plant species to establish under extremely low light conditions, and none of these studies have ruled out the possibility of "shading out" established Elodea beds to the point of restoring designated uses.

Another limitation of Angelstein and Schubert (2009) and Zefferman (2014) were that these studies were conducted as short-term experiments. Similarly, Brock (2012) represents snapshots of effective shade and Elodea presence. For implementation planning purposes, it is useful to consider longer term periods of plant growth. Once the 85 percent effective shade target is achieved within a stream reach, the slower growth rates are likely to result in a reduced competitive advantage for Elodea against environmental factors including grazing, disease, and uprooting by high flows. Shading out of Elodea could be achieved along Clarks Creek with these combined effects. The TMDL implementation plan recommends implementation of shading along with harvesting and sediment load reduction to provide certainty of success.

Angelstein, S. & H. Schubert, 2009. Light acclimatization of Elodea nuttallii grown under ambient DIC conditions. Plant Ecology 202: 91–101.

E. Zefferman, 2014. Increasing canopy shading reduces growth but not establishment of Elodea nuttallii and Myriophyllum spicatum in stream channels. Hydrobiologia 734: 159-170. http://tpyoung.ucdavis.edu/publications/2014ZeffermanHydrobiologia.pdf

39. (Page 27, paragraph 6)
Comment: In the context of Comment 38, Page 27, paragraph 4, the sentence "The net influence of groundwater inflows on in-stream DO concentrations was estimated during model calibration as discussed in the Relationship between DO and Baseflow section and Appendix B." still fails to provide clear comprehendible explanation as to how the estimates were generated and how the module was calibrated.

Question: Please clarify and show how existing data was used and how assumptions were reasoned to establish the relationship between groundwater inflows and in-stream DO concentrations as generated (estimated) in the QUAL2Kw model?

Ecology response: *See Response for Comment 20B.*

40. (Page 29, paragraph 2 and 4)
Comment: Bullet Point 2 of the TMDL Project Goals states the intention to "Equitably distribute the TMDL allocations" and Bullet Point 2 of the TMDL Study Objectives also states the responsibility to "Allocate pollutant loads among pollutant sources in an equitable manner". These two bullet points prompt the County to reemphasize its position that there is a need to develop a more "fair share" approach to apportioning the responsibilities for reducing pollutant loads from all contributing entities than what is currently represented in the TMDL.

Question: In the context of comment 36 which refers to the narrative on Page 27, paragraph 1 and comment 35 which refers to the narrative on Page 26, paragraph 4; and comment 4 which refers to narrative on Page XVii, paragraph 1, how will the equitable manner for allocating pollutant loads be calculated and applied across all contributing load sources, particularly those sources outside the authority of the NPDES permit?

Ecology response: *Ecology has identified in the Reasonable Assurance section on Page 125-127 in the Clarks Creek TMDL subsection, Identified programs to achieve the NPS reductions" this section outlines how all non-point source reductions will be achieved.*

41. (Page 29, paragraph 4)
Comment: Bullet 1 of the Study Objectives states "…and actions assumed to meet the allocations." And Bullet 4 states "Develop a WQIR report that includes all of the elements of a TMDL implementation targets assumed to achieve the TMDL allocations and an implementation plan for achieving the TMDL project goals." which prompts the following concern regarding programmatic risk management.

Question: What is the probability of programmatic success that can be confidently reasoned if all the assumed actions (i.e. Pierce County Public Works investing millions of dollars in capital project design and implementation) listed in the TMDL were executed?

Ecology response: *During the development of the Clarks Creek TMDL, Ecology determined the sources of pollutants to Clarks Creek and calculated allocations with the best available science and data. Ecology is confident that if these allocations are achieved Clarks Creek will meet Water Quality Standards.*

As stated on page 138 of the draft Clarks Creek Watershed Dissolved Oxygen and Sediment TMDL. "Natural systems are complex and dynamic. The way a system will respond to human management activities is often unknown and can only be described as probabilities or possibilities. Adaptive management involves testing, monitoring, evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings. In the case of TMDL projects, Ecology uses adaptive management to assess whether the actions identified as necessary to solve the identified pollution problems are the correct ones and whether they are working. As we implement these actions, the system will respond, and it will also change. Adaptive management allows us to fine-tune our actions to make them more effective, and to try new strategies if we have evidence that a new approach could help us to achieve compliance."

42. (Page 31, paragraph 2)
Comment: The sentence "DOD simulations were used to test the sensitivity of DO to variations in source contributions." prompts the following question.

Question: Were the stakeholders ever included or informed at the time when the different simulations and parameter adjustments were being made and the allocations were being developed?

Ecology response: *See response to Attachment 1, comment 1.*

43. (Page 31, paragraph 3)
Comment: The sentence "The analytical approach for sediment involved evaluating the degree to which sediment loading exceed rates or patterns that impair aquatic life." prompts the following policy question.

Question: Since there is no State water quality standard for sediment (whether it be Total Suspended Solids, Suspended Sediment Concentration or NTUs) does this statement summarize the reasoning Ecology is applying to establish the surrogate nexus the state deems necessary to justify listing sediment *as a TMDL pollutant of concern?*

Ecology response: *Ecology has authority to limit deleterious material through narrative criteria to protect, maintain, and restore the designated uses of a water body. Anthropogenic inputs of sediment are direct pollution inputs that are prohibited by RCW 90.48.080. See response to WSDOT comment 5(a).*

44. (Page 31, footnote 2)
Comment: Regarding the verb choice found in the second sentence of footnote 2, "DO patterns observed in the investigation indicated that anthropogenic sources contributed to the DO excursions." prompts the following concerns from the County regarding the robustness of the TMDL analysis.

Question A: Did the results indicate or statistically determine that anthropogenic sources contributed to the DO excursions?

Ecology response: *"Although the sediment investigation component of the study was limited, the observed low dissolved oxygen concentrations in the lower reaches of the creek helped form the basis for further investigation into the influence of sediment oxygen demand." Pages 46 through 49 of the TMDL document discuss the results of PTI's sampling in 2009-2010. The study provided multiple lines of evidence that anthropogenic sources contributed to the DO excursions. Included within these findings was a statistical relationship between DOD and simulated flow, as illustrated by Figure 16. Figures 14 and 15 also illustrate relationships between anthropogenic sources (using conductivity as an indicator) and DO depletion. The verb "indicated" refers to how the multiple lines of evidence support the determination that anthropogenic sources contribute to the DO excursions.*
These footnotes have also been moved to the study results section under "Effect of Elodea Cutting"
Question B: The verb being offered to establish an important assumption seems less than fully confident; is the interpreted nexus between DO and anthropogenic sources simply indicated or has it been soundly determined as a result of a robust statistical correlation?

Ecology response: *In this statement, "The analyses of the PTI continuous monitoring indicate that there is a strong association with stormflow and decreased ambient DO concentrations in Clarks Creek," the verb "indicate" is used to summarize the results of the PTI study in the statement. The interpreted nexus between DO and anthropogenic sources was determined based on a statistical correlation as well as additional supporting evidence. On page 48, the TMDL states "The analysis shown in Figure 16 concluded that higher flows correlated to higher DODs at Tacoma Road (R2=70%; coefficient p<0.001)."*

Question C: What citations are being relied on to help establish this determination and are they peer reviewed?

Ecology response: *The analysis of the PTI 2009-2010 sampling was based on the data collected within the Clarks Creek watershed. As part of the Clarks Creek DO study for PTI, Brown and Caldwell collected and analyzed data according to the study's quality assurance project plan (QAPP) (see pages 59-88 in Brown and Caldwell (2009) for the QAPP text). Peer-reviewed literature of the relationship between anthropogenic sources and dissolved oxygen depletion specifically within Clarks Creek was not available. There is, however, ample evidence on depletion of DO in stormwater conveyance systems. This may result from decay of organic matter or from oxidation of ferrous iron and sulfide (e.g., Graczyk and Sonzogni, 1991; Stumm and Lee, 1961; Stumm and Morgan, 1996). Regardless of the causes of depleted oxygen in stormwater, TMDL allocations that limit stormwater discharges or treat them in a way such that reaeration can occur will reduce the impact on DO deficit.*

45. (Page 31, paragraph 7 to Page 32, paragraphs 1 and 3)
Comment: The following paragraph and excerpted sentences represent a consortium of seven water quality monitoring entities. "The following agencies sponsor monitoring efforts: city of Puyallup (7 stations,1993), PTI (10 stations, 1998-2012), PTI Stormwater (4 stations, 2011-2012), Pierce County (3 stations, 2008-2010), Ecology (10 stations, 2002-2003), Western Washington Fairgrounds (WWF) (8 stations, 1998-1999), and the USGS (one continuous flow gage, flow 1995-2008, water quality 1983-1984; two field observation flow stations, 2006-2008; four water quality stations, 1983-1984; one additional water quality station, 2006-2007; limited flow observations were also available at the USGS water quality stations)…and from further down page 32 in paragraph 3 it states "Ecology monitored ten stations within the watershed. These stations include five along the Clarks Creek mainstem, two along Meeker Creek, and one each near the mouths of Diru, Rody, and Woodland Creeks. Pierce Conservation District monitors Rody Creek at Pioneer Avenue, Diru Creek at Pioneer Avenue, and Clarks Creek at 56th Street."

Question: Is there integrated coordination among these entities and does this water quality monitoring network represent a data retrieval design suitable and appropriate to the modeling and analysis to which it was applied?

Ecology response: *During the development of the Clarks Creek TMDL, Ecology determined the sources of pollutants to Clarks Creek and calculated allocations with the best available science and data. The data were not collected under a single master plan with coordination among the monitoring entities. Much of the data used in the TMDL came from a variety of earlier monitoring efforts and was not specifically designed to support DO and sediment modeling. While additional data would always be desirable, the available data was sufficient and appropriate to develop the modeling and analyses used to support this TMDL.*

46. (Page 32, footnote 3)
Comment: Regarding the verb choice found in the second sentence of footnote 3, "To what extent are dense growths of submerged macrophytes (such as Elodea) associated with DO impairment in the creek? Elodea appeared to affect dissolved oxygen concentrations in the creek, with daily minimum dissolved oxygen concentrations increasing after removal of the weed in the creek." prompts a concern from the County regarding the robustness of the relationship between water quality metrics and ecological responses being advanced as scientifically established by the TMDL.

Question: The verb being offered to establish an important assumption seems less than fully confident; the verb appeared implies a statistical interpretation that is less then [sic] "beyond a reasonable doubt". What statistical level of confidence does the word appeared signify?

Ecology response: *The question implies that the footnote establishes an assumption for the TMDL, which is incorrect. The footnote is documenting the purpose and summarizing the result of one monitoring study. The word "appear" does not imply that statistical confidence was assessed. Instead, the word "appear" refers to a visual interpretation of data providing evidence that DO increases following Elodea cutting. Table 5 across pages 44-45 shows that average minimum DO and minimum DO saturation increased consistently across the three locations sampled after Elodea cutting.*

These data represent one among several lines of evidence relating Elodea to DO concentrations. This footnote is meant to describe the purpose of a single monitoring study, not the basis for the TMDL, which would not be appropriate for this section. The TMDL document sections "Conclusions and Recommendations" and "TMDL Analysis" summarize the evidence that supports the conceptual model, identification of major stressors and sources, and basis for the TMDL allocations.

The footnote was removed.

47. (Page 32, footnote 4)
Comment: Regarding the verb choices found in the second sentence of footnote 4, "Do bottom sediments appear to be contributing to DO impairment in the creek? Although the sediment investigation component of the study was limited, low dissolved oxygen concentrations in the lower reaches of the creek could be due, in part, to sediment oxygen demand."

Question A: Although the study was admittedly limited, did the final data constraints result in a DO impairment and sediment oxygen demand relationship determination that could not be fully supported by the data and applied analysis?

Ecology response: *This footnote, and the previous three footnotes, refer to one specific study conducted by PTI during 2009-2010, during which continuous DO, turbidity, and conductivity data were collected. The TMDL document as a whole reflects many years of data collection and analysis, and this study represents an interim period where data were collected, relationships were assessed, and further questions were asked so that additional studies could be pursued. The question "Do bottom sediments appear to be contributing to DO impairment in the creek?" represents one of these questions. The 2009-2010 PTI study considered this question using available data, which supported the need for the SOD study conducted in 2011. QUAL2kw modeling provided additional evidence to support the relationship between SOD and DO impairment. For more details, see the Cover Letter response under DO Modeling Concerns.*

Question B: The verb being offered to establish an important assumption seems less than robust or confident; the verb in the sentence fragment could be due, in part, indicates some probabilistic relationship or statistical correlation relating DO impairment and sediment oxygen demand exists, what is it?

Ecology response**:** *See response 47A above. The footnote was removed.*

48. (Page 35, paragraph 2)
Comment: The following sentences, "a watershed model was developed by Tetra Tech (2012a) using EPA's Hydrological Simulation Program FORTRAN (HSPF). This model was developed for PTI as part of a sediment study to support TMDL development and the selection of sediment reduction measures. "prompt the following question.
Question: Were jurisdictional stakeholders involved in the development and selection of the sediment reduction control measures they would be responsible to finance, design and implement?

Ecology response: *The Sediment Reduction Project was funded and led by the Puyallup Tribe of Indians under an EPA grant the Tribe received. An important element of the grant proposal was extensive stakeholder outreach, which the Tribe conducted through regular meetings, phone calls and* *communications with stakeholders. Stakeholders were involved throughout the Tribe's Sediment Reduction Project that was completed on behalf of the Tribe by Brown & Caldwell and other sub-consultants including Tetra Tech. Most of the stakeholder process was specifically about the development and selection of the sediment control measures the County and others would be responsible to finance and implement. To expedite approval from the stakeholders, the Tribe started with the capital improvement projects that were already detailed in Pierce County's basin plan and identified as capital improvement projects in the County's process. Because of the overlap between the Sediment Reduction Project and the Clarks Creek TMDLs, meetings were often held at the same time. Please see response to Attachment 1, comment for more detail on the stakeholder involvement process for the Clarks Creek TMDL.*

49. (Page 35, paragraph 2)
Comment: The following sentence, "The HSPF model outputs provide information on the critical storm conditions and the amount of flow each jurisdiction generates." prompts the following concern.

Question: Since this was a very critical modeling determination that serves as the foundation of much of the WLA development, were the jurisdictional stakeholders involved at any stage in the hydrologic modeling analysis in order to review and corroborate how these important technical results were achieved?

Ecology response: *The jurisdictional stakeholders had significant opportunities to comment on the HSPF hydrologic analysis. The consultants for the Tribe's sediment reduction project presented the watershed modeling approach and results to the stakeholder group on February 13th, 2012 by Jon Butcher. The modeling results were also presented by Brown & Caldwell in other presentations as well. Feedback from stakeholders on GIS data maps as well as modeling assumptions/inputs were sought from County and City staff. A watershed modeling report was also prepared by Tetra Tech (2012) that detailed the hydrologic calibration and validation approach and results. All stakeholders had an opportunity to comment on the draft watershed model report. Also see Ecology response above to Attachment 1, comment 1.*

50. (Page 36, HSPF modeling framework bullet points)
Comment: Pierce County wants to state for the record that the following eleven (11) bullet points detailing the HSPF modeling framework in the left column of page 36 represents eleven potential "stop in, share the update and corroborate the finding" opportunities whereby transparency in the models development could have been practiced by collaborating more openly with the implementing jurisdictions. In particular, this lack of interim involvement and concurrent technical review has undermined the County's confidence in the TMDL line of evidence as currently presented.

- Used simulated flow data throughout watershed to analyze water quality observations.
- Described production and transport of sediment and other pollutants as a function of land use and flow.
- Developed overall sediment balance.
- Estimated upland sediment production rates.
- Simulated existing conditions and build-out conditions.
- Generated flow-duration curve to analyze flow regime of storm events with available data and determine critical conditions.
- Provided a line of evidence for the sediment loading capacity.
- Estimated percent of stormwater flow from sources for DOD
- Determined implementation targets based on stormflow by jurisdiction.
- Development of Allocations.
- Determined implementation targets based on stormflow by jurisdiction.

Ecology response: *See response above and to Attachment 1, comment 1.*

51. (Page 38, paragraph 1)
Comment: In a prior section of the TMDL it was stated that "no direct measurements of SOD were conducted…" however, the following sentences "PTI hired HydrO2, Inc. to conduct SOD measurements in the watershed. During September 19-21, 2011, SOD measurements were attempted at three locations along Clarks Creek by HydrO2, Inc. with assistance from Tetra Tech." prompts the following request for clarification.

Question: Does attempted mean the HydrO2 data and SOD (and CSOD) study did not produce extrapolative results that could be used in the SOD calibration of the QUAL2Kw model?

***Ecology response*:** *The quotation "no direct measurements of SOD were conducted…" cannot be found within the TMDL document. Measurement of SOD occurred in 2011, following other studies that evaluated SOD but did not measure it directly. However, the 2011 SOD sampling by HydrO2 at sites with aquatic vegetation was not feasible because the vegetation made it impossible get a proper seal between the between the chamber and the stream substrate. The methods and results of the HydrO2 data and SOD (and CSOD) study are described above in the response to DO Modeling Concerns, which includes an explanation of SOD considerations during the QUAL2kw model calibration.*

52. (Page 38, paragraph 2)
Comment: The following sentences, "For the Clarks Creek sediment investigation PTI and Brown and Caldwell also conducted a grain size distribution analysis at 20 sites in the Clarks Creek basin in mid-2011, which provides information on substrate characteristics (Brown and Caldwell, 2013)." prompt an additional question consistent with the inquiries of comment 7 (referring to Page XVii, paragraph 2) and comment 13 (referring to Page 5, paragraph 5) which requests the need for a quantified definition of fine sediment.

Question: Did the grain size distribution analysis conducted by Brown and Caldwell result in a more defined characterization of the sediment size classes that represent the real culprit pollutant of concern?

***Ecology response*:** *Yes, the sediment characterization data collected as part of the sediment investigation was included in this TMDL because it provides valuable information regarding the particle size distribution of sediments throughout the Clarks Creek basin. See Figure 33 for additional information. The amount of fines and sands present in Clarks Creek compared to reference sites of similar slopes in Puget Sound lowlands is double to triple of the 90th percentile of percent fines and sands. Additionally, the B-IBI scores measured in Clarks Creek range between poor and fair indicating they are impaired, most likely due to embeddedness from fines and sands.*

53. (Page 38, paragraph 3 and 4)
Comment: The following sentence was stated twice in paragraphs 3 and 4, "As part of the PTI Sediment Reduction Action Plan, Brown and Caldwell (2013) evaluated stream stability and mitigation measures for reducing sediment loadings that originate from degrading stream reaches."

Question: Reading further as to how the stream stability and mitigation measures were evaluated, It appears that a rather approximating set of geometric field measurements were conducted to determine angle of repose slope stability thresholds and in-stream mitigation measures, why wasn't a more appropriate approach such as the Bank Slope and Toe Erosion Model (BSTEM) field protocol not employed to evaluate in-channel sediment loads and physically map those areas targeted for mitigation?

***Ecology response*:** *The field investigations completed for the Tribe's Sediment Reduction Plan was strongly focused on field derived information and built upon existing information available. A comprehensive geomorphology assessment was completed to identify erosional and depositional reaches, identify point sources of sediment, and understand existing geomorphic conditions and processes. Depth of incision, channel width, length and shape of eroded reaches were field verified to estimate dimensions and order of* *magnitude of volume of eroded material. Sediment chemistry and grain size distribution was also completed at 20 locations throughout the watershed including tributaries. Additionally, 36 cross-sections were surveyed to extend an existing HEC-RAS model built by NW Hydraulic Consultants in the upper reaches where sediment sources and inflows enter the channel. The model was then used to simulate hydraulic conditions and calculate in-channel depths and shear stresses for a range of flow rates. The range, frequency and duration of these flows were then used to calibrate the HSPF model. The simulated hydraulic results along with the sediment particle size data were used to perform incipient flow analyses to determine relative sediment mobility and in-stream flow rates required to erode channel boundaries. The emphasis was placed on actual field derived information rather than additional model created data. In general, models are used to supplement, not replace, empirical data about the environments we study.*

Ecology removed the duplicate sentences.

54. (Page 39, paragraph 2)
Comment: The following statement "Brown and Caldwell conducted a sediment study from 2010-2012 to evaluate the sources of sediment loading into the system. The study shows that current sediment loading is approximately sixteen times the loading compared to natural levels of sediment loading." prompts the question as to how the "sixteen times the loading compared to natural levels" conclusion was determined.

Question A: Does this statement mean that the sediment characterization representing the channel bed and substrate was found to be 16 times greater when compared to erosion rates generated by running the USLE module populated with NRCS Order 3 soil survey map unit data or does it mean that the composite TSS data, bed sediment characterization, cross-channel survey, and B-IBI data was then compared to an individual B-IBI reference stream (defining natural levels) as listed on page 84, paragraph 1 and was found to be 16 times greater?

Ecology response**:** *The existing loads were found to be sixteen times that of natural loads by comparing existing sediment load to the modeled natural load. The existing loading was calculated by looking at two sources: upland sources and in-channel sources. Upland sources were calculated using HSPF models that accounted for rainfall and sediment loading from different land uses called hydrologic response units. Brown & Caldwell determined the in-channel sources using historical information regarding channel geometry and bank elevations to quantify total sediment loss from instream channel erosion over the last 100 or so years, and assumptions were made regarding how that erosion was distributed chronologically and spatially. To determine natural erosion rates, a fully forested scenario was run in HSPF to generate natural flows. The Magnitude Frequency Analysis Tool was then used to determine the associated effective work corresponding to those natural flows, and the resulting modeled natural sediment load that would result. This modeled natural load was compared to existing load estimates to result in the "16-times greater" than natural load estimates.*

Question B: If neither of the preceding explanations is fully accurate, how were the current erosion rate and the natural erosion rate determined?

Ecology response**:** *See 54a above*

Question C: If the sediment loading to Clarks Creek was determined to be 16 times greater than a reference condition then which individual reference stream was Clarks Creek being compared too?

Ecology response**:** *The reference streams are not used to derive the 16 times number. The reference streams were used to determine the allocation of a 64% reduction in sediment. This analysis was used to compare current conditions to natural conditions and a fully forested system. Also refer to previous Ecology Response under comment 11.*

55. (Page 39, paragraphs 3 and 4)
Comment: The following statements refer to the QUAP "As part of the Clarks Creek DO study for PTI, Brown and Caldwell collected and analyzed data according to the study's quality assurance project plan (QAPP) (Brown and Caldwell, 2009). Stormwater data from the oxygen-demanding sources investigation for PTI was collected and analyzed according to the study's quality assurance project plan (Tetra Tech, 2011b). Field data collection and hydraulic modeling for the Clarks Creek Sediment Action Plan was completed according to the QAPP designed for the project (Brown and Caldwell, 2011). See Appendix B for a summary of the Model QAPPs for the HSPF and QUAL2Kw modeling." and "Data collection and quality assurance methods are explained in detail in the corresponding appendices." prompts some important concerns regarding stakeholder collaboration and the TMDL process.

County Position-Comment A: Pierce County wants to state for the record that the QAPP process provides for one of the most important initial opportunities to "stop in, share the update and corroborate the data preparation and approach" for the modeling that will represent the next phase of the TMDL development. The County received the *draft final* QAPP as a completed document in its totality with only one opportunity to review and comment. It is the County's position that it would have been more appropriate for Ecology to provide a limited number of incremental opportunities for Pierce County and the other six (6) monitoring entities to meet with their consultants, EPA and PTI in order to concur as to which data will be assembled and how it will prepared for populating the models and used in the forthcoming analysis. This was particularly germane in this circumstance because there was no guiding framework or consistent organization between the seven (7) water quality monitoring entities collecting data in Clarks Creek. Since all the available water quality data was being assembled ad hoc and then screened to serve the development of the waste load allocations, it could have represented a reassuring start to a more transparent process of collaborating more openly with the implementing jurisdictions regarding quality control and TMDL development. In particular, from the County's' perspective, this lack of interim involvement and concurrent technical review undermined the confidence that the modeling was appropriately using data that was originally retrieved for status and trends and permit compliance monitoring but was then applied to develop and calibrate a regulatory watershed model.

Ecology response: *The Tribe's dissolved oxygen monitoring project that was completed in 2009 pre-dated the TMDL. All stakeholders in the TMDL and the Sediment Project had extensive opportunity to provide comment on the quality assurance plans for stormwater monitoring, field data collection and modeling. In fact, several years of regularly scheduled meetings to discuss both projects were held with all stakeholders in order to obtain input early and often. Ecology and EPA held regularly scheduled meetings throughout the TMDL project. The Tribe also held regularly scheduled meetings throughout the Sediment Reduction project. The meetings included reviewing scopes of work and formal kick-off meetings, presentations detailing project approaches and methods, discussions of results and implementation. Alternatives analyses and criteria for ranking projects were discussed at length in the Sediment Reduction project process. Consultants augmented regularly scheduled meetings by contacting technical stakeholder staff to get input on key elements, including modeling inputs/assumptions and planned sediment reduction projects, modeling results, field investigation results, alternatives analysis, criteria for ranking, presenting project approaches, presentations to discuss methods and results, and frequent and ongoing meetings for both these multi-year projects to discuss status and progress throughout the process.*

County Position-Comment B: RCW 90.48.585 states, "The department shall develop policy: subparagraph b) Describing the specific criteria that determine data credibility." Ecology cites Policy 1-11 as establishing the statutory requirements for credible data, yet states "when the credible data policy was developed there was a conscious decision to not specify QA/QC procedures since those policy and guidance documents already exist separately." Pierce County is unable to find specific data quality objectives and resulting assessment criteria, with accompanying use qualifiers for data used in the development of the TMDL. Pierce County's position is that the policy alone does not ensure that TMDL decisions are based on a sufficient quantity and quality of baseline data. In terms of utilizing credible data, the policy should establish a minimum number of samples and quality of data to support TMDL listing and TMDL modeling. TheQUAL2Kw model for Clarks Creek was calibrated based on three summer dry season baseflow samples from 2009, then checked against 2002 and 2003 dry season samples. However, the model was then applied to a 2003 storm/high flow event. The modeling would be more credible if it was based on data across a range of months and flow events.

Ecology response: *The Clarks Creek Modeling QAPP provided the following quality control measures in Section 2.3.6 Quality Control for Nondirect Measurements:*

The majority of the nondirect measurements will be obtained from quality assured sources. Tetra Tech will assume that data obtained from USGS, Washington Ecology, or EPA documents and databases have been screened and meet specified measurement performance criteria. These criteria might not be reported for the parameters of interest in the documents or databases. Tetra Tech will determine how much effort should be made to find reports or metadata that might contain that information. Tetra Tech will perform general quality checks on the transfer of data from any source databases to another database, spreadsheet, or document.

Where data are obtained from sources lacking an associated quality report, Tetra Tech will evaluate data quality of such secondary data before use. Additional methods that might be used to determine the quality of secondary data include:

> *Verifying values and extracting statements of data quality from the raw data, metadata, or original final report*
> *Comparing data to a checklist of required factors (e.g., analyzed by an approved laboratory, used a specific method, met specified DQOs, validated)*

If it is determined that such searches are not necessary or that no quality requirements exist or can be established, however these data must be used in the task, Tetra Tech will add a disclaimer to the deliverable indicating that the quality of the secondary data is unknown.

The Clarks Creek model was calibrated with data gathered from secondary sources for 4 baseflow events, not 3 baseflow samples. QUAL2Kw was calibrated and verified to conditions on four dates representing baseflow or slightly elevated flow conditions. Management scenarios were evaluated for each of these dates to meet both the DO and dissolved gasses criteria:

7/10/09: Represents the system at baseflow conditions before elodea cutting.

7/20/09: Represents the system at baseflow conditions when elodea cutting had proceeded only up to Tacoma Road.

8/6/09: Represents the system at a date after full elodea cutting with baseflow conditions.

8/20/02: Represents the system near baseflow conditions, assuming no elodea cutting.

Two calibrated QUAL2Kw model applications are also available for stormflow conditions (for September 12, 2003 and October 21, 2003). The October event was selected to represent critical conditions for achieving the DO criterion as it represents the greatest measured impact to DO during stormflow conditions which results in DO impairment (Tetra Tech 2011a & 2012c).

Tetra Tech, 2011a. Clarks Creek Dissolved Oxygen TMDL and Implementation Plan QUAL2Kw Modeling. Prepared for USEPA Region 10. Prepared by Tetra Tech, Inc.

Tetra Tech, 2012c. Clarks Creek Storm Flows (revised). Prepared for USEPA Region 10. Prepared by Tetra Tech, Inc.

Question: Why was the Clarks Creek TMDL QAPP process not inclusive or collaborative with the jurisdictions that are both providing the water quality data and having to implement the TMDL models findings? The County received the QAPP as a draft final document, and was then issued a limited (inadequate) time to review it. The County would have preferred to be a partner in the development process for assembling the QAAP rather than just being an endpoint reviewer. Additionally, the County diligently (and repeatedly) assembles its comments and concerns and submits them in a timely way to Ecology and they are never responded too or observably integrated into the document revisions.

Ecology response: *We appreciate Pierce County's comments and extensive involvement in the development of the Clarks Creek TMDL. Ecology took into account several of Pierce County's concerns during TMDL development. Examples include postponing the issuance of the TMDL for 1-2 years until additional stormwater data were collected, including watershed-wide wasteload allocations, and modeling the quantified benefits from specific projects that stakeholders requested the contractor model. However, in areas where we respectfully disagree with Pierce County, Ecology has met with the County several times and discussed and replied to concerns verbally and in writing. Ecology continues to encourage continued dialogue on the Clarks Creek TMDL with stakeholders.*

56. Page 40, Paragraph 3
Comment: The following statement: " . . . 3. comprehensive monitoring of storm drains and instream locations during storm events," instigates the question.

Question: What entity was responsible for the "comprehensive monitoring of storm drains and in-stream locations during storm events"?

Ecology response: *This bullet is referring to the stormwater sampling conducted by Tetra Tech for PTI in 2011-2012. The summary of this study's results begins on page 49.*

57. (Page 41, paragraph 3)
Comment: The following paragraph states "Further analysis of data variability and central tendency indicates a small decline in DO below the state hatchery, followed by a gradual recovery downstream to Diru Creek, then a decline below Rody Creek. The decline below the hatchery is not necessarily associated with the hatchery itself but could instead reflect lower velocities and greater macrophyte growth in this reach." which prompts two questions from the County.

Question A: How did the "analysis of data variability and central tendency" illustrate the correct interpretation of the DO data?

Ecology response: *On average there is a small decline in DO below the state hatchery. This decline could be a result of inputs from the hatchery, other inputs of water depleted in DO, or stream conditions. Because the hatchery discharge occurs at about the point where the stream velocity decreases due to lower gradient on the alluvial plain and near the upstream occurrence of Elodea growth, both of which affect the DO balance, the data alone are not sufficient to distinguish between these potential sources. That is why we use a model.*

Question B: How did the previously referred to analysis result in the following noncommittal determination as represented in following excerpted sentence "The decline below the hatchery is not necessarily associated with the hatchery itself but could instead reflect lower velocities and greater macrophyte growth in this reach"?

Ecology response: *See Response 57A.*

58. (Page 41, paragraph 4)
Comment: The following paragraph states "Though limited data were collected, DO concentrations in Meeker Creek violated water quality standards with a minimum of 5 mg/L DO Data in Rody Creek, Diru Creek, and Woodland Creek were above DO water quality standards." which prompts the following question.

Question: Can the County assume that because Rody Creek, Diru Creek, and Woodland Creek are in compliance with applicable water quality standards that the dissolved oxygen Waste Load Allocation does not apply to these tributaries?

Ecology response: *No, the Waste Load Allocations are for the entire watershed. The reductions in the tributaries are also needed for Clarks Creek to meet the dissolved oxygen standard and are explained in the compliance with Standard Section pages (94-101).*

59. (Page 42, Figure 11)
County Position-Comment: The County is of the opinion that the depiction of the DO concentrations data illustrated in Figure 11 (titled *DO concentrations measured in Clarks Creek 1992-2010*) is very cluttered and so difficult to discern that it has become rather meaningless in its ability to impart useful information to the audience.

Ecology response: *Comment noted and Ecology recognizes that the graph represents a lot of data; this graph however does show a general overall picture of dissolved oxygen concentrations throughout the basin in comparison to water quality standards and is necessary to depict this comparison. This figured was not created by Ecology or TetraTech; therefore, it cannot be edited.*

60. (Page 43, paragraph 1)
Comment: The following statement "From 1991-2012, the city of Puyallup and Pierce County have cut elodea within Clarks Creek as a temporary means to reduce elodea in the system." prompts the question.

Question: How will water quality improvement projects that were implemented in the recent past be credited for their pollutant abating actions and how many years back will Ecology credit these completed water quality improvement projects for their program compliance applicability (i.e. direct contributions to satisfying TMDL target actions)?

Ecology response: *As discussed in stakeholder meetings and described in Appendix H, "Allocation Accounting," appropriate projects completed after October 21, 2003 may receive "credit" towards meeting wasteload allocations.*

61. (Page 43, paragraph 2)
Comment: The statement "The mechanical harvesting of the dense elodea mats has long been a problem for operations at the Tribe's Chinook hatchery near river mile 1.0. The cuttings and fine bed sediments, which were re-suspended during the cutting, clogged the hatchery intake, sometimes necessitating the early release of juvenile salmon from rearing ponds which likely reduced their survival rates." instigates the following comment.

County Position-Comment: On behalf of the hatchery, the scenario as described above could be explained as a lack of coordination, communication and in general, represents an operational failure to successfully anticipate and mitigate a seasonally temporary activity (i.e. potential operational conflict).

Ecology response*: Comment noted - Ecology can't speak on behalf of the tribal hatchery. During the development of the TMDL the Elodea task force was formed. Ultimately, Ecology believes that planting trees and creating shade is the best solution for reducing Elodea densities in Clarks Creek.*

62. (Page 43, paragraph 2)
Comment: The statement "The re-suspended bed sediments also posed a potential barrier for returning adult salmon to the hatchery as well." requires further clarification.

Question: How did the *re-suspended bed sediments create a potential barrier for returning adult salmon*, was this due to a persistent turbidity curtain being created that the adult fish were avoiding or was it because of the formation of a summer depositional berm at the hatchery intake, please clarify?

Ecology response: *Sediment levels are too high, clogging up gravel in stream beds, creating turbidity, and harming the habitat which fish use for spawning, rearing, and migrating. The Marine Environment and Habitat Sciences Division of Fisheries and Oceans Canada reports there are at least five ways in which excessive sediments may be harmful to a fishery; 1) by acting directly on fish swimming, either killing them (i.e. gill trauma) or reducing their growth rate, resistance to disease and other immunological and physiological responses, 2) by preventing successful development of fish eggs and larvae, 3) by modifying natural movements and migrations of fish (i.e. displacement, avoidance), 4) by reducing the abundance of food available to the fish, and 5) by decreasing the efficiency of catching fish (Birtwell 1999). In all these ways, excess sediment profoundly affects the productivity of a salmon (or trout) stream (Cordone and Kelly, 1961; McNeil and Ahnell, 1964; McHenry et al., 1994). Importantly, excess sediment cause smothering of bottom invertebrates reducing organism density (Tebo, 1955) and types of invertebrates that salmonids often prey upon (i.e. caddis, stoneflies, and mayflies) thereby limiting the food base. Bedload sediment also adversely affects invertebrates by filling up their crevice homes, muddying over their attachment surfaces, and eliminating interstitial spaces which act as a storehouse for organic silt on which many other invertebrates feed (Hynes 1973).*

Birtwell, I.K. 1999. The effects of sediment on fish and their habitat. DFO Can. Pacific Science Advice and Review Committee Habitat Subcommittee Res. Doc. Canadian

Cordone, A.J. and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. Reprint from California Fish and Game. Vol. 47, No. 2. California Department of Fish and Game, Inland Fisheries Branch. Sacramento, CA. 41 pp. [155k]

Hynes, H.B.N. 1973. The effects of sediment on the biota in running water. Pages 653-663 in Fluvial Processes and Sedimentation, Proceedings of a Hydrology Symposium, Univ. of Alberta, Edmonton. National Research Council, Environment Canada.

McHenry, M.L., D.C. Morrill and E. Currence. 1994 . Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in Five North Olympic Peninsula Watersheds. Lower Elwha S'Klallam Tribe, Port Angeles, WA. and Makah Tribe, Neah Bay, WA. Funded by Washington State Dept. of Ecology (205J grant).

McNeil, W. J. and W.H. Ahnell. 1964. Success of Pink Spawning Relative to Size of Spawning Bed Material. U.S. Fish and Wildlife Service, Special Scientific Report - Fisheries No. 469. Washington, D.C. 17 pp.

63. (Page 43, paragraph 2 and Page 44, paragraph 1)
Comment: The statement "The elodea re-colonizes quickly after harvesting, as hormones are stimulated and the stems take hold in the fine sediment substrate, which is a preferred habitat of elodea. Thus, the previous methods used to harvest elodea in the creek increased its rate of growth, compounding the problems in the creek." requires further clarification.

Question: In response to footnote 3 "The Task Force concluded that DASH would be a more effective, long-term solution to removing elodea, compared to annual cutting which did not remove the roots of the elodea", is it the position of Ecology that the described deleterious effects attributed to Elodea removal are still problematic even with DASH?

Ecology response: *According to the Elodea Task Force, DASH captures the entire elodea plant and results in localized sediment disturbance. Based on DASH operations performed in other streams, such as the Chehalis, it is very successful and minimizes deleterious effects on the system.*

64. (Page 44, paragraph 2)
Comment: The statement "The study concluded that "Elodea appeared to affect DO concentrations in the creek. Daily minimum DO concentrations appeared to increase after the City removed Elodea from the creek" (Brown and Caldwell, 2009)." instigates the following question.

Question A: The use of the verb appear is confusing when it is used to represent the findings of a study. Did the study statistically determine that Elodea did affect DO concentrations in the creek?

Ecology response: *See response to Comment #46.*

Question B: Did DO increase or did it not increase as a post abatement response to removal? 25Please clarify and confirm the most accurate characterization of what was correlated, what does appear mean statistically?

Ecology response: *See response to Comment #46.*

65. (Page 45, paragraph 2)
Comment: The statement, "Shallow groundwater in the alluvial plain further downstream has been noted as having low DO (Jones et al., 1999; Brown and Caldwell, 2009). Apparently, this is due to low permeability and incorporated organic peat and muck deposits, although DO concentrations in discharging groundwater in this region have not been directly measured." requires further clarification.
Question: This pair of sentences appears contradictory, how does shallow groundwater in the alluvial plain get represented as having low DO without DO concentrations in discharging groundwater having been directly measured?

Ecology response: *The quoted sentence says nothing about how DO concentrations are represented in the model. The fact that discharge groundwater concentrations have not been directly measured merely notes an absence of data and does not present any contradiction with the prior sentence. The DO data reported in Jones et al. (1999) were measured from groundwater wells, which is not directly representative of groundwater discharging to surface waters. The TMDL was edited to clarify this distinction, adding the text "based on monitoring data from groundwater wells" after "Shallow groundwater in the alluvial plain further downstream has been noted as having low DO . . ."*

66. (Page 45, paragraph 2) Please also refer to Comment 21 (referring to Page 10, bullet point 1) and Comment 27 (referring to Page 22, paragraph 1)
Comment: The statement, "Calibration of the QUAL2Kw model found that a good fit was obtained by setting the DO concentration in diffuse inflows direct to Clarks Creek downstream of Maplewood Springs to 8 mg/L during summer baseflow conditions." requires further clarification. County Position-Comment: In the U.S. G.S. Water Report 86-4154 Water Quality in the Lower Puyallup River Valley And Adjacent Uplands, Pierce County, Washington by J. C. Ebbert, Bortleson, Fuste and Prych, 1987 (prepared in cooperation with the Puyallup Tribe of Indians) direct sampling of Maplewood Springs was reporting pH ranging from 6.3 to 8.2 and dissolved oxygen at 8.7 mg/L (at 9.1o C).

Question: Given the absence of any direct measurements or any real-time data for dissolved oxygen or flow discharge volumes originating from Maplewood Springs, why was theQUAL2Kw model being best fit calibrated to 8.0 mg/L downstream of Maplewood Springs instead of 8.7 mg/L which was a reading produced from a direct measurement conducted by the USGS at Maplewood Springs?

Ecology response: *See response previous Ecology response to Comment 20B.*

67. (Page 45, paragraph 2)
Comment: The statement, "Urban and alluvial plain groundwater may in part account for reduced DO concentrations in water discharged from Meeker Creek and other conveyances." prompts the following concern.

Question: Is Ecology not certain or confident enough in its modeling to reliably characterize and accurately account for reduced DO concentrations in water discharged from Meeker Creek and other conveyances without defaulting to statements like "Urban and alluvial plain groundwater may in part account for"?

Ecology response: *The QUAL2Kw modeling tool simulates the DO balance in the Clarks Creek mainstem. It does not simulate the DO mass balance within the tributaries, groundwater system, or in stormwater conveyances.*

68. (Page 46, paragraph 1)
Comment: The statement, "…as well as acute contributions of low DO concentrations" prompts the following question.

Question: What are acute contributions referring to?

Ecology response: *"Acute" here is meant in the sense of definition 2b for acute in the Merriam-Webster dictionary: "having a sudden onset, sharp rise, and short course." It refers to stormwater conditions in which pulse loads may cause a sudden change in DO concentrations. As stated in the next paragraph, monitoring indicates that stormwater, especially in the lower watershed, is low in DO and contributes to low DO concentrations instream during storm events. It is important for the reader to understand the complex timing and interactions between stressors leading to DO the impairment. The first paragraph in this section is used as a general introduction of these concepts, and the second paragraph defines the chronic and acute contributions more specifically.*

69. (Page 46, paragraph 2)
Comment: The statement, "Monitoring indicates that stormwater, especially in the lower watershed, is low in DO and contributes to low DO concentrations in-stream during storm events" prompts the following question.

Question: The use of the verb indicates is confusing when it is used to represent the statistical correlation that supposedly supports the findings of a pivotal TMDL study. Did the study statistically determine that stormwater discharging to Clarks Creek is low in DO and that it does contribute to low DO concentrations in-stream during storm events or did the study not find a robust correlation for this relationship?

Ecology response: *"Monitoring" refers to observed data. Low DO in stormwater discharges is evident in many different sampling events, as is discussed in the report. Statement changed from "Monitoring indicates that stormwater, especially in the lower watershed, is low in DO and contributes to low DO concentrations instream during storm events." to "Monitoring shows that stormwater, especially in the lower watershed, is low in DO and contributes to low DO concentrations instream during storm events."*

70. (Page 47, paragraph 3)
Comment: The sentence, "Lower conductivity (associated with higher surface flow) appears to correlate with consistently elevated DOD, confirming the need to control low DO in stormwater." prompts the following concern.

Question: The use of the verb appears is confusing when it is used to represent the findings of a study. Did lower conductivities as associated with higher surface flow robustly correlate with consistently elevated DOD levels or did they not?

Ecology response: *The verb "appear" is used to communicate that the statement is based on a visual interpretation of the relationships illustrated in Figures 14 and 15 in the TMDL document. Figure 16 shows the relationship between DOD and flow, including a linear regression line with R2 = 0.704, as is acknowledged in the next comment.*

71. (Page 48, paragraph 2)
County Position-Comment: The sentence, "The analysis shown in Figure 16 concluded that higher flows correlated to higher DODs at Tacoma Road (R2=70%; coefficient p<0.001) (Tetra Tech, 2012a)." reveals a moderate strength or less than predictive correlation between higher flows and higher DODs at Tacoma Road with a R2 of 70%; coefficient p<0.001.

Ecology response: *The goal of this analysis was to determine whether there was statistically significant correlation. The p-value of less than 0.001 indicates that there is an extremely low probability that the positive correlation shown in Figure 16 between flow and DOD is untrue. The R2 value indicates that 70 percent of the variability in DOD is explained by flow. Both statistics firmly support the statement on page 48 quoted in this comment. The goal of this analysis was not to assess predictive power, which would require different statistical tests than those presented on page 48. Furthermore, these data and the equation in Figure 16 were not used for predicting DOD.*

72. (Page 49, paragraph 6)
Comment: The statements, "The same pattern for depression of DO concentrations occurred in the outfalls at SW-3 (Meeker Creek; 6.7 mg/L) and SW-1 (West Pioneer Way; 6.4 mg/L). During both events, these low DO concentrations did not appear to have a noticeable effect on DO concentrations in the downstream receiving water." prompts the following questions.

Question: The use of the verb appears is confusing when it is used to represent the findings or interpretations resulting from important analysis. What does the preceding statement specifically mean; please clarify further the interpretation being advanced? Did DO concentrations associated with the SW-1 and SW-3 outfalls recover to above criterion thresholds in the downstream reaches from West Pioneer to the mouth or did they not?

Ecology response: *It can be clearly seen in Figure 18 that the DO concentrations in SW-1 (West Pioneer Way) and SW-3 (Meeker Creek) did not recover to above criterion thresholds. The mouth was not monitored during this particular study as noted in earlier paragraphs in this section. The verb "appear" is used to communicate that the statement is based on a visual interpretation of the data. Statement changed from "The same pattern for depression of DO concentrations occurred in the outfalls at SW-3 (Meeker Creek; 6.7 mg/L) and SW-1 (West Pioneer Way; 6.4 mg/L). During both events, these low DO concentrations did not appear to have a noticeable effect on DO concentrations in the downstream receiving water." to "The same pattern for depression of DO concentrations occurred in the outfalls at SW-3 (Meeker Creek; 6.7 mg/L) and SW-1 (West Pioneer Way; 6.4 mg/L). During both events, these low DO concentrations did not have a noticeable effect on DO concentrations in the downstream receiving water."*

73. (Page 50, paragraph 6)
Comment: The statements, "The cause of the low DO concentrations is unclear at this location. Much of the upstream watershed is within the park, which is not expected to be a major source of stormwater; however, other stormwater inputs near SW-4 may have influenced the DO concentrations. The site is also downstream of the state hatchery discharge and could be influenced by groundwater input." prompts the following questions.

Question A: Was the forested watershed positioned above this location modeled for its sediment load delivery?

Ecology response: *Yes.*

Question B: What does, other stormwater inputs near SW-4 mean or refer too specifically?

Ecology response: *This refers to small stormwater conveyances that have not been monitored and are not explicitly represented in the model.*

Question C: The use of the terms is not expected, may have and could be imply a less than confident set of interpretations regarding the data and modeling analysis, please explain why these less than definitive terms were chosen to represent Ecology's current level of understanding regarding the inputs influencing and relationships between DO, specific pollutants and in-stream flow volumes?

Ecology response: *The choice of wording reflects the fact that the cause of the low DO concentrations is unclear at this specific location, as is stated in the quoted text. It does not imply any lack of confidence regarding the relationships between DO, specific pollutants, and in-stream flow volumes in Clarks Creek in general.*

74. (Page 53, paragraph 6)
Comment: The statements, "For the locations studied in 2011 through 2012, PTI found that the long-term, cumulative effects of stormwater on in-stream DO were evident because of increasing levels of pollutants during each storm event." prompts the following questions.

Question A: How was this determination made, what data was used and how did it provide the analytical evidence to support a cumulative effects analysis?

Ecology response: *This refers to the following statement found on p. 2 of the sampling study: "Diminished dissolved oxygen concentrations during higher flows indicate that a combination of pollutants transported into the creek has a measurable effect and may be cumulative over time." Statement changed from ""For the locations studied in 2011 through 2012, PTI found that the long-term, cumulative effects of stormwater on in-stream DO were evident because of increasing levels of pollutants during each storm event." To "For the locations studied in 2011 through 2012, PTI found that the long-term, cumulative effects of stormwater on in-stream DO were evident because of decreasing levels of DO over time."*

Question B: Where is the citation for PTI's findings or is there a reference as to where this cumulative effects analysis can be reviewed?

Ecology response: *The report in question is Stormwater Sampling in Clarks Creek, Puyallup River Drainage (WRIA 10): Measuring Oxygen-Demanding Sources, FINAL, June 2012. Submitted to: Puyallup Tribe of Indians, Tacoma, WA by Tetra Tech, Inc. Surface Water Group, Seattle, WA. This was provided as Appendix E to the TMDL report.*

75. (Page 53, paragraph 6)
Comment: The statements, "Modeling found that decreases in nitrate loads in Maplewood Springs and other groundwater sources did not reduce the number of predicted DO excursions under baseflow conditions because nitrate levels in the stream are sufficiently high that it is unlikely that nitrogen limitation on Elodea growth can be established." prompts the following concerns.

Question: Please clarify and explain further the preceding statements, it is unclear what the assumptions were and how the modeling found "…it is unlikely that nitrogen limitation on Elodea growth can be established." How were baseline nitrate loads at Maplewood Springs originally calibrated for the QUAL2Kw model?

Ecology response: *As is noted immediately prior to the sentence that is cited, "A full write-up of the modeling process and results is available in Tetra Tech (2012a)." The nitrogen sensitivity analysis is described in Section 3.1 of that report.*

76. (Page 53, paragraph 6)
Comment: The statements, "The most conclusive effect was shown for SOD: a decrease in SOD resulted in a strong increase in DO concentrations under baseflow conditions. While these results do not preclude the direct influence of nitrate, flow withdrawals, and riparian shading, they provide evidence that SOD is an important contributor to DO impairment." prompts the following question.

Question: How did this deductive modeling exercise ultimately relate to the final calibration of SOD given the absence of direct SOD measurements (other than the two locations by HydrO2)?

Ecology response: *This modeling exercise, which is specified as a sensitivity analysis in the TMDL document and model documentation, was conducted after the calibration and corroboration exercises documented in Tetra Tech (2011). See the Cover Letter response under DO Modeling Concerns for an explanation of the SOD parameterization in the model. The sensitivity analysis indicates that simulated DO concentrations are sensitive to a change in SOD.*

77. (Page 55, paragraph 6)
Comment: The statements, "The majority of the samples collected were below detection limits of 2 mg/L. BOD-5 concentrations were consistently below 10 mg/L for the February 17, 2012, March 13, 2012, and March 29, 2012 rainfall events and did not show any distinctive patterns. The November 16, 2011 rainfall event resulted in much higher BOD-5 concentrations at SW-3. This rainfall event was a low intensity, short duration event which resulted in peak BOD-5 concentrations at SW-3 of 129 mg/L in the outfall discharge and 348 mg/L downstream of the outfall. BOD-5 concentrations were also elevated above the SW-3 outfall at a peak concentration of 28.1 mg/L. An elevated BOD-5 concentration at SW-4 was also measured at the outfall (10.8 mg/L); however there were no measurable effects in the stream downstream of the outfall." prompts the following questions.

Question: Does this preceding statement interpret the November 16, 2011 data as a potentially anomalous event that can be explained by a reasonable alternative explanation other than what is being considered (and apparently affirmed) with the current models working hypothesis?

Ecology response: *The data collected on November 16, 2011 show that elevated BOD concentrations can occur during storm events at multiple locations in the Clarks Creek watershed. However, the residence time in Clarks Creek during storm events is so brief that elevations in BOD concentration of this order of magnitude will have essentially no impact on predicted instream DO. Since BOD-5 concentrations were consistently below 10 mg/L during the other sampling events, the data suggest that loading of inflow DOD during storm events has a stronger overall influence on downstream DOD than loading of BOD-5. This is consistent with modeling assumptions and results, as shown later in the document in Figure 50.*

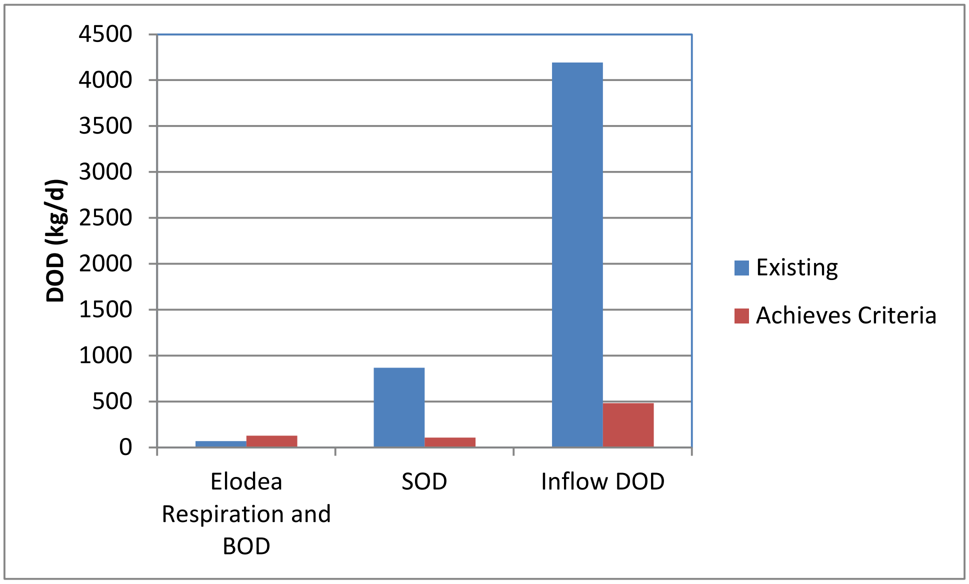


Figure 50. ***DOD Loads That Would Achieve DO and Dissolved Gases Criteria | under Wet Conditions (event of 10/21/2003).***

78. (Page 59, paragraph 1)
Comment: The statements, "At the one sample site with no elodea growth, the effective shade was 78%. Using the regression equation in Figure 26, an elodea density of 0% corresponds with an effective shade of 95.9%. Temperature TMDL studies for other Puget lowland streams, such as Bear-Evans and Green-Newaukum, *suggest* that based on Clarks Creek's width and vegetation characteristics, an effective shade of 85% is plausible and *would* "*shade out*" elodea." prompts the following concern.

Question: Please consider the use of verb in the statement "*would shade out Elodea*". Although the County agrees that increasing riparian buffer and canopy is incontestably beneficial to stream health, adopting and implementing a management strategy of "shading out" a rather shade tolerant species such as Elodea will probably not be achieved given the grandfathered land uses that preclude its implementation. The County is not convinced that this infeasible TMDL objective will result in the eventual eradication or significantly diminished presence of Elodea in Clarks Creek. How can this TMDL target goal be reasonably implemented if there are no coercive regulatory mechanisms available to the County to impose the reestablishment of riparian buffers along streamside properties that have incompatible grandfathered uses up to the channel edge?

Ecology response: *The purpose of the Clarks Creek Effective Shade and Elodea project was to develop a relationship specific to Clarks Creek between elodea density and percent effective shade to determine the required effective shade to limit elodea growth. The relationship was developed through field measurements and system potential effective shade from other Puget Lowland streams in Western Washington. TMDL wasteload and load allocations are calculated to achieve compliance with the Clean Water Act mandates and Washington State Water Quality Standards. Achieving 85% effective shade will not be easy, but it is plausible. See other responses concerning nonpoint jurisdiction.*

79. (Page 59, paragraph2)
Comment: The statements, "Water temperatures in Clarks Creek typically range between about 8 and 14 ºC throughout the year and therefore are in compliance with Washington water quality standards. However, *they are believed* to be elevated over natural conditions due to a lack of riparian shade." prompts the following question.

Question: The use of the verb in the statement "*they are believed*" implies a less than confident interpretation regarding the data and modeling analysis, please explain why this less than definitive term were chosen to represent Ecology's position (current level of understanding) regarding the correlative relationship between riparian shade and in-stream temperatures?

County Position-Comment: TMDL studies have not utilized a consistent approach to defining critical periods. The temperature parameter defines the critical period as summer, however the defined months and specific dates are difficult to predict based on a consistent methodical approach or as it should apply (integrate with) to the aquatic life criteria cited in WAC.

Ecology response: *Changed the text from "However, they are believed to be elevated over natural conditions due to a lack of riparian shade." to "However, they are elevated over natural conditions due to a lack of riparian shade."*

<u>General response</u>:
Each TMDL study takes the same general approach although each study may have different inputs, variables, and data resolution necessary to determine what it will take to improve water quality in each watershed.

Determination of critical period and what is cited in WAC*:*
WAC 173-201A-200(1) indicates several designated uses and associated criteria for temperature. For example, the core summer salmonid habitat temperature criterion may be the use that is addressed in a TMDL. The description of this designate use is as follows:

> ***Core summer salmonid habitat****. The key identifying characteristics of this use are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids.*

The date range included is in this description is a general characteristic and does not limit the numeric criteria to this season. The 16° 7-day average daily maximum (7-DADMax) criterion applies to any consecutive 7 days in the year and is not limited to summer months. The critical period determined in the TMDL must meet this standard regardless of season. The standards allow only one exceedance of the 7DADMax within a 10 year period.

A critical period is defined in a TMDL with an estimate of conditions such as lowest flows and highest temperature to determine when excursions of the temperature criterion is most likely to occur and when the excursions are most extreme. If implementation actions are required to protect the water bodies most vulnerable event(s) for the parameter, then it is assumed that the standards will be met during other periods. The water body, during those seasons outside the critical period, may demonstrate temperatures cooler than the criteria. These cooler conditions are also required to be maintained by the antidegradation conditions in the standards which describe allowable incremental warming for waters cooler than the criteria. The determination of implementation actions are based on meeting the standards during the critical period, unless there is evidence that the incremental temperature increase is also not being met.

80. (Page 63, paragraph 1)
Comment: The sentence, "For the Clarks Creek Sediment Reduction Action Plan, Brown and Caldwell (2013) estimated volumes and annual loading for the two general categories of sediment sources in Clarks Creek basin: in-channel and upland sources." prompts the following question.

Question A: Pierce County expects that all the different source categories be properly identified and numerically distinguished in order to track and corroborate the load accounting being reported the TMDL document. Why was the “in-stream channel sediment load” not quantitatively distinguished and reported separately from the upland sediment load in the Waste Load Allocations and TMDL report?

Question B: This is the first time the TMDL report that separately calculated sediment source categories have been discussed. Can the sediment loads and concurrent Waste Load Allocations be reported and treated separately for each source category?

Ecology response: *The loading capacity, load and wasteload allocations for the sediment TMDL are derived from three different studies; therefore, only one categorical percent reduction is provided for the final wasteload allocation. However, the Sediment Reduction Plan should be referenced for details on sources of instream and upland sediment and projects to abate and reduce them. Additionally, Ecology provided one numeric wasteload allocation to provide municipalities with flexibility with where and how it would implement projects to reduce the instream and upland sources of sediment in the Clarks Creek Basin.*

81. (Page 63, paragraph 1)
Comment: The following statements “The estimates were calculated based on the efforts listed previously and were developed specifically to support identification and development of sediment control measures. While the estimates include model output for the upland sources, additional assumptions were made and further calculations completed to reach the final in-channel and upland loading estimates for the Sediment Reduction Action Plan. These estimates vary from the model output, but are within an order of magnitude and thus complement the model estimates.” Prompt these questions.

Question: Are these additional assumptions and model estimates provide the foundation of the calculations used for quantifying the in-channel sediment load portion of the sediment waste load allocation?

Ecology response: *We changed the text on page 65 of the TMDL to read “The model estimated that upland sources of sediment contribute about 462 tons of sediment per year.”*

82. (Page 63, paragraph 2)
Comment: The statements “The volume of sediment from in-channel sources were field-approximated based on visual indicators of the eroded cross-section height and width multiplied by the length of the eroded segment. This volume was converted to an annual erosion rate by assuming that the period over which the erosion occurred…” prompt the following concern.

Question: Why was the in-channel sediment load category generated through a field-approximated approach based on visual indicators when a more appropriate TMDL protocol for identifying, delineating and quantifiably characterizing in-channel sediment loads (source category) such as the Bank Slope and Toe Erosion Model (BSTEM) was available to be employed?

Ecology response: *See response to comment 53 above. Both approaches are approximations, and to make the statement that the BSTEM is more appropriate, more accurate, or more realistic than actual field measurements of environmental changes over time is incorrect.*

83. (Page 63, paragraph 3)
Comment: The statements “Sediment deposition has occurred in the low gradient reaches of Clarks, Rody, Woodland, and Silver creeks in the form of primarily sands with some silts. The lower reaches of Clarks Creek near the PTI’s Clarks Creek hatchery contain larger amounts of silts and finer materials.” prompts the question.

Question: This part of on-going and continuous comments requesting a more clearly stated quantitative definition of the sediment load than what is described in narrative by use of the term fine sediment. What sediment particle or grain size classes will in-channel CIP projects design BMPs to address? Particularly when the in-channel load is described as being predominantly comprised of silts and finer materials that represent grain size classes that are less than 0.05 mm? (According to the U.S. D.A. Soil Texture Classification system)

Ecology response: *The CIP projects identified in the Sediment Investigation utilize various techniques and are designed to achieve different environmental outcomes, not all of which are to entrap or reduce sedimentation. For example, a wet pond is designed primarily to attenuate runoff flows while bank stabilization projects have the goal of reducing geomorphological changes to the stream channel and eliminate an ongoing source of sediment to the system. The purpose of the Sediment Investigation was not to quantify the specific impacts of sediment reduction for multiple particle size classes; rather its intent was to quantify overall impacts to sediment reduction that would result from project implementation. Please also refer to comment previous Ecology responses under comment 12, 52, and 53.*

84. (Page 64, paragraph 1)
Comment: The statements "Upland loads of sediment are generated from pervious land surfaces through soil erosion and from impervious surfaces through the buildup and wash-off of accumulated solids. Brown and Caldwell (2013) used the HSPF hydrologic model to estimate upland sediment production rates. The model uses a variety of input parameters to represent pervious and impervious land surfaces, accounting for slope, soil properties, and land cover conditions." prompts the following questions.

Question: Has the fine sediment and pulverized road grit that comprises the majority of the impervious coverage wash-off load been proportionally characterized for its part of the upland sediment load?

Ecology response: *The HSPF model does include separate modeling for three particle sizes: sand, silt, and clay. Each of the three particle classifications were parameterized separately and therefore each was accounted for in the upland buildup and wash-off module in HSPF.*

85. (Page 64, paragraph 2)
Comment: The statements "Brown and Caldwell (2013) used the HSPF hydrologic model to estimate upland sediment production rates. The model uses a variety of input parameters to represent pervious and impervious land surfaces, accounting for slope, soil properties, and land cover conditions." prompts the following comments and question.

County Position-Comment: The County would have been most interested to witness and have a limited participatory engagement regarding the input parameter selection for populating certain HSPF model simulations at the time the model was being developed. For example, the County would have appreciated an opportunity to technically review or concur with at least three different soil related modules under Pervious Land Segments (e.g. PWATER, SEDMNT, and PQUAL). This is an example where Ecology facilitates a process of public notification but provides no public collaboration or partnership with the Permittees that must acknowledge and accept the findings generated from such model runs.

Question A: The word stakeholder implies a participant with standing and interest in the process outcome. If the word Stakeholder infers a collaborative role, why does Ecology facilitate a "TMDL program development and roll out process" that solicits comments after the fact (i.e. the draft final has been completed) and rarely acknowledges the critical and constructive input from a stakeholder in a timely enough fashion to influence the final outcome of the process?

Ecology response: *See response to Attachment 1, comments 1, 48 and 55.*

Question B: Please explain why HSPF was selected as the chosen watershed model and not LSPC++ (which Tetratech is most familiar with)? Why was LSPC++ not used to develop the sediment budget and load reduction scenarios instead of HSPF?

Ecology response: *HSPF and LSPC are based on the same algorithms. LSPC is essentially a recompilation of HSPF in the C++ language that differs primarily in the way parameter and input/output files are handled, although LSPC does have a few added components and does not implement some of the newer code from HSPF 12. Tetra Tech frequently uses both HSPF and LSPC as appropriate for different circumstances. For Clarks Creek, HSPF was chosen primarily due to Ecology's desire to use a model that was fully in the public domain with stable code available on an open source archive. In addition, HSPF provides a more convenient platform for detailed specification of channel hydraulic responses derived from HEC-RAS, SWMM, and other models.*

Question C: Why was SWM 5.0 or XPSWM not employed to characterize the hydrology, hydraulics and sediment loads of those urban areas in the Clarks Creek watershed with significant connected impervious coverage (including commercial and industrial land uses)?

Ecology response: *We assume the comment refers to SWMM 5.0 (not SWM 5.). The comment is incorrect in that SWMM was indeed used to characterize the hydraulics of the watershed, as is described in Section 4.2.2 of the HSPF model calibration report (Appendix C to the TMDL). SWMM was not used for continuous hydrology because its strength is in simulating storm response and HSPF generally provides superior results for simulation of dry weather flows. The Clarks Creek SWMM model has not been calibrated for sediment loading, and, as with continuous hydrology, it is Tetra Tech's experience that more realistic and reliable results can be obtained with HSPF.*

As noted in the response to Comment #3, previous HSPF model applications were developed separately for the Clarks Creek watershed, one by Pierce County in 2006 for the Clear/Clarks Creek Basin Plan (Pierce County, 2006) and one by USGS in 1994 (Mastin, 1996).

86. (Page 65, paragraph 1)
Comment: The statements "Based on the available evidence, the performance of the sediment model is acceptable and high average relative errors reported for some stations appear to be due to anomalous outliers and small sample sizes." prompts the question.

Question: Why was this model adequacy determination not shared with the jurisdictional Permittees to a gain their corroboration at the time the model was being developed and producing these results?

Ecology response: *See response to Attachment 1, comments 1 and 55.*

87. (Page 65, paragraph 1)
Comment: The statements in the following paragraph "The model estimated that upland sources of sediment contribute about *460 tons* of sediment per year. The model output also provided an annual sediment loading rate by sub-area and thus, "hot spots" could be identified. To ground-truth the modeled hot spots, Brown and Caldwell used GIS data and aerial photography to verify the reasonableness of the hot spots and additional field reconnaissance was performed. Once verified, Brown and Caldwell estimated that the total amount of sediment load from in-channel erosion and upland sources for the Clarks Creek basin under current conditions is *673 tons/year."* prompts the questions.

Question: Correction A: On page 63, paragraph 3, the in-channel sediment load was estimated as being *211 tons/year*. In the above paragraph excerpted from Page 65, paragraph 1, the upland sediment load is being estimated as *460 tons/year*. The result of the combined sediment load estimates is being reported at the end of the paragraph as 673 *tons/year*. This figure is incorrect and the total should be reported as 671 tons/year.

Ecology response: *The upland sediment load should be 462 tons/year. See Response to Comment 81 for correction.*

The term "geomorphically significant flow" was taken from Leopold and generally refers to the flow that is required to mobilize the mean particle size for a particular location. Specific flow limits for what defines a geomorphically significant flow are different for each stream. The geomorphically significant flows were not used in the TMDL allocations.

Question B: How did the GIS and aerial photographic analysis serve to *verify the reasonableness* (i.e. confirm) of the "hot spots" model analysis?

Question C: How did the *additional field reconnaissance* actually ground-truth or verify the "hot spots" model analysis?

Ecology response B & C: *The Brown and Caldwell Memorandum prepared for the Clarks Creek Sediment Reduction Study dated October 24, 2011 provides details on how GIS and aerial maps and photographs were utilized to ground truth areas in the basin where sedimentation, erosion, in-channel incision and deposition are occurring. The document goes into detail on Clarks Creek and each of the tributaries. However, examples are Section 2.1 Background says, "This technical memorandum is a summary of our field observations and understanding of existing geomorphic processes based on our review of existing studies, reports, maps, aerial photos, and field work completed to date." The last sentence in paragraph 3 of Section 2.4.1 Sediment Point Sources and Instability says, "Major sediment source areas within Clarks Creek can be viewed in attached drawings." Finally, the fifth paragraph in Section 2.4.3 General Geomorphic Condition and Observations says, "Field and historical map evidence suggests that channel straightening resulting in head cutting and channel degradation, increases in impervious surface runoff, and large regional floods have possibly combined to destabilize Clarks Creek."*

Question D: How did the "hot spots" model analysis and mapping inform and relate to the Capital Improvement Project list referred to on Page 66, paragraph 2 with the sentence "Twenty-three projects were identified to address in- channel and upland sediment sources utilizing…" and Page 66, paragraph 1 with, "*If all 23 projects were implemented*, a 52% reduction in annual sediment loading *would be accomplished* (Figure 31)…" and Page 66, paragraph 2 with, "A combination of *flow control and capital projects was selected by PTI and the stakeholder group*…"?

Ecology response D: *We are uncertain what this question is referring to exactly. The section explains that the Sediment Reduction Project (the hot spot model analysis and mapping from the project) was used to indentify sediment sources. The section goes on to explain:*

> *Input data for each reach, one page results summaries, and additional tabulated results are provided in Brown and Caldwell (2012).*
>
> *After identifying the prominent sediment loading sources, an evaluation of potential sediment reduction measures was conducted. A combination of flow control and capital projects was selected by PTI and the stakeholder group. Twenty-three projects were identified to address in-channel and upland sediment sources utilizing:*
>
> - *In-channel intervention including channel and bank stabilization.*
> - *Stormwater detention ponds.*
> - *Sediment traps.*
> - *Stormwater diversion.*

- *Stormwater treatment.*
- *Low impact development (LID) practices such as porous pavement and roadway bioretention.*

The suite of projects was modeled to assess the sediment load reduction potential. The HSPF model was modified to represent existing conditions and build-out conditions. The build-out conditions, accounting for future regulatory requirements for on-site mitigation and flow controls, were selected as the baseline for project implementation. If all 23 projects were implemented, a 52% reduction in annual sediment loading would be accomplished (Figure 31), primarily due to reduction of in-channel sources.

88. (Page 65, top half of the page, bullets 1 through 4)
County Position-Comment A: When reviewing the lower estimates of what is being represented as “geomorphically significant flows”, the County has some reservations. For example, the *critical condition* or the *current condition 2 year flow* is identified as the October 21, 2003 precipitation event. This event is calculated as 138 cfs, and if we compute 5 percent of 138 cfs it results in approximately 7 cfs (i.e. 52 gallons / sec.) of in-channel flow. The *predevelopment* or *forested condition 2 year flow* event would calculate to be significantly less and may be as low as half of the *current condition 2 year flow* event. If this assumption is reasonable, it is the County’s contention that 3.5 to 4.5 cfs represents an in-stream flow condition with a very low critical hydraulic shear stress, too low for representing the lower end of what is being called a “geomorphically significant flow“. Having such a low flow volume representing the lower end of what is necessary to entrain and transport in-channel sources of sediment is suspect when discussing the concept of “geomorphically significant flow events” and their relationship to the deleterious effects of hydromodification. This use of the phrase, “geomorphically significant flow“ is confusing in the context of hydromodification because it doesn’t actual define the flow limits associated with channel forming flows that incise or degrade the channel invert elevations. However, it might admittedly represent a hydraulic condition whereby fine sands (~0.15 mm) would be entrained and transported downstream through suspension and saltation.

Ecology response: *The term “geomorphically significant flow” was taken from Leopold and generally refers to the flow that is required to mobilize the mean particle size for a particular location. Specific flow limits for what defines a geomorphically significant flow are different for each stream. Geomorphically significant flows are not part of TMDL allocation.*

Comment B: What is the meaning of this analysis and how can the results be practically applied when summer baseflows are generally in the range of 30 to 40 cfs?

Ecology response: *Brown and Caldwell’s analysis of geomorphically significant flows for various stream reaches within the Clarks Creek Basin was used to evaluate the level of flow control within the system that would be required to reduce channel erosion. The analysis was not used for baseflow conditions, it was used to characterize erosion and sediment transport.*

89. (Page 65, top half of the page, bullets 1 through 4)
Comment: The sentence “The lower flow bound was very low for the steepest, most incised stream reaches. This indicates that even small flows can cause bedload movement in these reaches.”

Question: Does this sentience mean that the lowest flows for the upper reaches, representing just a few cfs, creates enough shear stress/pressure to move gravel that is over ½ inch (D50 is 13.7 mm)in diameter?

Ecology response: *The geomorphically significant flows are not part of the TMDL allocation. The initial intent of the geomorphic analysis that was part of the tribe’s Sediment Reduction Plan was to define the channel forming flows that incise or degrade channel invert elevations, consistent with the Leopold definition. See the magnitude frequency analysis included as an appendix to the Tribe’s Sediment Reduction Plan. The magnitude frequency analysis actually corroborated the minimum requirement #5 for LID on-site* *storm water management to manage flows between 8% and 50% of the 2-year forested discharge. See reach summaries in the MFA analysis. Although these results were NOT used in the TMDL allocations, the practical application of these results in the field is to use the analyses results to inform the selection of capital projects and best management practices where opportunities exist to reduce flows that incise or degrade channel conditions.*

90. (Page 65, paragraph 1)
Comment: The statements in the paragraph "The suite of projects was modeled to assess the sediment load reduction potential. The HSPF model was modified to represent existing conditions and build-out conditions. The build-out conditions, accounting for future regulatory requirements for on-site mitigation and flow controls, were selected as the baseline for project implementation. *If all 23 projects were implemented*, a 52% reduction in annual sediment loading *would be accomplished* (Figure 31), primarily due to reduction of in-channel sources." prompts the following questions.

Question A: Is it being implied that if the County adopts the "approved" CIP list (i.e. the portion of capital projects listed that apply to its jurisdiction) then it will be credited as having fully completed the TMDL requirements and will have attained final Clarks Creek TMDL program compliance?

Question B: Previous conversations with Ecology staff indicated that the County (i.e. Permittees) is expected to develop its own Capital Project oriented TMDL Implementation Plan for Clarks Creek. If this is the case, then what is Ecology's guidance to the County regarding the development of its own Implementation Plan in light of the 23 projects already identified?

Ecology response A & B: *Ecology understands that the projects Pierce County proposed for inclusion in the Accountability Memo were proposals only. The TMDL offers Pierce County the flexibility to meet the TMDL allocations through a variety of stormwater projects that treat and reduce stormwater volume depending on the location. It is up to the jurisdiction to pick and plan projects.*

County Position-Comment: It is the position of Pierce County that HSPF is not the most appropriate model to develop a CIP program list with and that a more suitably scaled and specifically tailored model such as the Pollutant Load Reduction Model (built on a SWM 5.0 platform) would be significantly more accurate in its ability to demonstrate fine sediment load and stormwater flow reductions resulting from stormwater BMP project designs.

Question C: Is Ecology open to the use of a more appropriate sub-catchment scale model (such as PLRM) in the development of the County's TMDL Capital Projects oriented Implementation Plan?

Ecology response C: *Yes, Pierce County is welcome to develop any sub-catchment scale model they want to analyze projects for TMDL implementation as long as it has been reviewed and approved by Ecology and meets the allocation goals of the TMDL, which include 1) provide treatment or reduction of the total stormwater flow volume discharged from portions of the MS4 located within the zones identified in the TMDL as subject to the volume reduction WLA to Clarks Creek and tributaries by 50% relative to the 10/21/2003 storm event, or 2) meeting the Wasteload allocations expressed as DOD (kg/d) based on the jurisdiction's apportionment of flow during the wet weather event on October 21, 2003, and 3) reduce sediment by 66% as required by the WLA.*

91. (Page 66, paragraph 2)
Comment: Statements in the paragraph "After identifying the prominent sediment loading sources, an evaluation of potential sediment reduction measures was conducted. A combination of *flow control and capital projects was selected by PTI and the stakeholder group*." raise the following concerns.

Question: Assuming the phrase *stakeholder group* implies a collaborative process was conducted (that included Pierce County) which generated an *approved* list of improvement projects and control measures designed to address Clarks Creek's water quality impairments? Pierce County staff does not concur with the final flow control measures and capital project list generated by PTI. County staff participated in the process and issued many critical comments and requests for adjustments that were not acknowledged or integrated into the final set of recommendations. The County takes exception to the representation that a collaborative process with PTI and other stakeholder entities generated a collectively endorsed or approved list of Capital Improvement Projects designed to address the pollution generating "hot spots" identified through the HSPF modeling effort.

Ecology response: *See response to Attachment 1, comment 1, and 55.*

92. (Page 67, paragraph 2)
Comment A: Statements in the paragraph "Pollutants such as phosphorus, organic nitrogen, or fecal coliform can attach to sediment particles. When erosion occurs and fine sediments are transported downstream, the pollutants attached to them can also be transported in lower reaches of Clarks Creek. As a result, part of PTI's grants included analyzing sediment samples for certain parameters. Soil type and grain size distribution is also very important, because it affects the mobility of sediment and how erodible an area may be. As part of PTI's grant focusing on creating a sediment reduction action plan, Brown and Caldwell and PTI staff collected samples at 20 locations" raise the following concerns."

County Position: Pierce County disagrees with the statement "Pollutants such as phosphorus, organic nitrogen, or fecal coliform can attach to sediment particles…". It is true that fecal coliform can readily attach to the surfaces of fine sands and silts; however it is not generally true that phosphorus and organic nitrogen will physico-chemically sorb or attach to the surfaces of silts or sands, which are commonly inert. P sorption is primarily inorganic. The four main inorganic phosphorus reactions are precipitation with Al, Fe, Mn, Ca, or Mg; anion exchange; reaction with hydrous oxides; and fixation by phyllosilicate clays. Generally speaking, sands will not sorb phosphorus (anion) unless they are coated with these (cation) oxide precipitates.

Ecology response: *The term "attach" is a general term that can mean chemical sorption or the general association of organic material, such as leaf detritus, with mixed sediment particles. The purpose of this sentence is to introduce the general concept of pollutant movement occurring in conjunction with particle movement. Typical bed sediment analysis for pollutant content does not separate the sediment first into particle size, and such is the case with PTI sampling mentioned in the subject paragraph. The results for pollutant content in sediment were analyzed and reported for the total sediment sample. Bed sediments represent a diverse matrix of sediment particles. This particular statement considers the matrix of sediment particles and the collective potential for pollutants to sorb to that matrix. Clay may provide the best sorption potential for most pollutants, but clay tends to stick to other sediment particles, regardless of grain size. Thus, it is important to consider the pollutant content of the bed sediment as a whole.*

Comment B: Pierce County has questions with the statement "…included analyzing sediment samples for certain parameters. Soil type and grain size distribution is also very important, because it affects the mobility of sediment and how erodible an area may be."

Question B: The soil types (soils series and soil map units) are analyzed and reported based on the USDA textural or particle size classification system and the in-stream sediment samples were analyzed for their fluvial hydraulic mobility and classified based on the AGU sediment classification system. Therefore, how did the data for soil types as represented by the soil texture (i.e. USDA particle size classification) data in the Pierce County Soil Survey get analytically related to the sediment measured for their mobility in the channels and therefore characterized by the AGU sediment classification system?

Ecology response: *The text was edited to clarify the difference between soil and sediment grain size. The text "Soil type and grain size distribution is also very important, because it affects the mobility of sediment* *and how erodible an area may be" was changed to "Grain size distribution is also very important, because it affects the mobility of sediment and how erodible bed sediment may be."*

93. (Page 67, paragraph 2)
Comment: Pierce County has questions with the statement "…As part of PTI's grant focusing on creating a sediment reduction action plan, Brown and Caldwell and PTI staff collected samples at 20 locations within the Clarks Creek watershed during a one-week period in late July/early August 2011. The sampling was conducted shortly after the city of Puyallup and Pierce Count completed their annual cutting of elodea in Clarks Creek downstream of sampling site Clarks-04."

Question A: Brown and Caldwell eliminated 6 outliers resulting in a sample size of 14 samples. Why and how were the 6 outlier samples "visually deemed" not to be suitable representations of the substrate sediment for the channel reaches in which they were located?

Question B: The fourteen (14) sample collections were distributed to characterize three separate slope channel classes or categories as delineated for the watershed (Class 3: < 1 % / Class 2: >1 % to <6 % / Class 3: >6 %). Two (2) composite samples were collected to characterize the Class 1 slope channel category, and 7 were collected for Class 2 and 5 collected to characterize Class 3 channels. Pierce County is of the opinion that the sample size is not particularly robust for the determination and applications to which it was applied. Fourteen (14) samples are not enough data to adequately characterize the substrate sediment throughout the watershed. Please provide the experimental design line of evidence for sample size suitability, particularly for generating critical substrate characterizations that informed multiple modeling applications?

Ecology response: *The studies conducted by the Tribe and Brown and Caldwell used the data collected from all 20 sites within the depositional areas to understand the dynamics in Clarks Creek and tributaries. Sediment source volumes were direct measurements during the field survey and geomorphic analysis. The study also analyzed surficial sediments for total organic carbon and nutrients as well as grain size distribution. The conclusions using the whole set of data is reported in the field investigations report that is an appendix in the Sediment Reduction Plan. It appears the county is referring to the magnitude frequency analysis which was completed to estimate geomorphically significant flows at multiple cross-sections throughout the Clarks Creek watershed. Brown and Caldwell used a linear regression model based on the grain size distribution data to obtain the relationship between median particle size and channel gradient. Six outliers were identified in this process by plotting stream channel slope against median particle size (D50). See Figure 7 on p.8 of Appendix D. The model fit the data well with an R-squared of 0.97 and could be applied more broadly to the network. The model was used to classify the bed sediment classes, calculate the sediment transport rates, and ultimately obtain the geomorphically significant flows.*

94. (Page 70, paragraph 1)
Comment: Pierce County has questions with the statement "…majority of sediment was classified as fine sand and very coarse silt. … Also at Clarks-05 there is an increase in silt and clay content. This is likely attributed to the change in hydraulic characteristics. …In addition, Elodea growth starts approximately 200 feet upstream of this site. Clarks-05 and Clarks-08 were two of the three sites where percent fines were greater than 25% of the grain size distribution."

County Position: The County wants to stress again, after making many similar prior comments, that to this point in the TMDL report; multiple references have been made using terms such as fine sand, sand, fine sediment, fines, fine-grained material, silt, coarse silt, clay, mud, gravel, cobble, particle size distribution, particle size of suspended sediment, grain size distribution etc.

The document never identifies which dimensional scale or grain size classification was being used to provide the necessary quantitative definition for these terms. Unless one refers to technical documents such as the Geomorphic Magnitude-Frequency Analysis technical memorandum and/or the Clarks Creek Sediment Study; one would not know that it's the American Geophysical Union Sediment Classification System that is providing the quantitative size class definitions behind the categorical terms being used? Having this information as a footnote or citation would have removed confusion from the TMDL analyses narrative story the document is trying to impart. It would have been very helpful to the audience if they were informed as to which classification system was being used so they could figuratively apply quantitative size limits (categorical dimensions) to each of the narrative terms found in the text. It should be noted that confusion also arises because the NRCS Soil Survey data uses the USDA textural soil separate partitions (particle size classification system) which represents some very different quantitative thresholds for defining particle size class terms such as clay, silt, sand and gravel etc.

Ecology response: *See Response to Comments #12 and #22 Question B.*

95. (Page 70, paragraph 2)
Comment: The statement "…in Puget Sound lowland reference streams supporting healthy aquatic life (37%)" prompts the question.

Question A: Is, Puget Sound lowland reference streams supporting healthy aquatic life, referring to an official document or report? If it is, where is the citation?

***Ecology response**: The citation is Hayslip, 2013. Reference sites had B-IBI scores between 38 and 46 with a median of 40, which translates to "good" or "excellent" quality waters under the Puget Sound Stream Benthos guidelines.*

Question B: Does this document represent Ecology's official regulatory index reference standard for this region of western Washington State? Has it been formally adopted by the state of Washington as Ecology's official regulatory index reference standard for the Puget Sound lowlands?

***Ecology response**: The Hayslip memo is a list of reference areas in the Puget Sound lowlands which have high biotic quality. Reference streams are frequently used in TMDLs to develop targets. They do not need to be formally adopted into State standards to be used in TMDLs.*

96. (Page 70, paragraph 3)
Comment: The sentence, "In general, concentrations of TP, TN, BOD, and TOC appeared to be higher in samples with higher percentages of fine-grained material." prompts the question.

Question: The use of the verb appeared is confusing when representing a finding and it suggests a lack of confidence in the interpretation being advanced. Were the concentrations of TP, TN, BOD, and TOC statistically determined to be well correlated with samples that had higher percentages of fine-grained material or were they not?

Ecology response: *Consistent with responses to Comments 46, 70, and 72, the word "appear" does not imply that statistical confidence or correlation were assessed. Instead, the word "appear" refers to a visual interpretation of data.*

97. (Page 75, paragraph)
Comment: The sentence, "Newcombe and Jensen (1996) analyzed 80 published documented reports on fish responses to suspended sediment in streams and estuaries to yield a predictive model for six data groups that relate biological response to duration and exposure and *suspended sediment concentration.*" prompts the following comment.

County Comment: *Total Suspended Solids* (TSS) has been the sediment sampling protocol term used exclusively to this point in the TMDL document. When introducing a new and historically competing sediment sampling protocol term such as *Suspended Sediment Concentration* (SSC) it warrants being defined (even if it's located in the glossary) so the differences can be clarified for the audience and they can effectively relate the terms and understand the references and relationships being advanced in the narrative.

Ecology response: *Added the following text, "Newcombe and Jensen (1996) analyzed 80 published documented reports on fish responses to suspended sediment in streams and estuaries to yield a predictive model for six data groups that relate biological response to duration and exposure and suspended sediment concentration (equivalent to total suspended solids)."*

98. (Page 76, paragraph 2)
Comment: The two sentences, "The assessment illustrates that the severity scores are not extremely sensitive to load reductions. However, the results are highly uncertain." prompts the following request for a response.

Question: Can Ecology please further explain the previously cited sentence; County staff is unclear as to its implications? Do these two sentences mean the relationships being staged on the preceding page between suspended fine sediment and the severity of its impact on fish at various life stages is not reliably applicable to Clarks Creek because the sediment load reduction modeling runs did not correlate TSS and the severity scores adequately to support the interpretation?

Ecology response: *The text was edited to clarify this statement by replacing the sentence "However, the results are highly uncertain" with "The calculation of severity scores is a semi-quantitative method based on streams outside of the watershed and a high degree of uncertainty is associated with these methods." The statement refers to the fact that the calculation of severity scores is a semi-quantitative method based on streams outside of the watershed and a high degree of uncertainty is associated with such methods.*

99. (Page 76, paragraph 3 to Page 77, paragraph 1)
Comment: The paragraph, "In Clarks Creek, there are limited suspended sediment data in the watershed. To fit the observed data during baseflow, a default of 2 mg/L TSS was used for spring discharges. This assumption results in a prediction of persistent concentrations at or above 2 mg/L, which in turn, influences the predicted severity scores by increasing them as the Newcombe and Jensen equations are sensitive to low TSS values when they persist over a long period of time." prompts the following questions.

Question A: Table 4 from the Clarks Creek Watershed Fecal Coliform TMDL cites an average TSS value of 0.6 mg/L for water diverted from Maplewood Springs and into the fish raceways of the WDFW Hatchery. Why was a default "best fit to surface water baseflow" TSS value of 2 mg/L used to represent spring discharge TSS instead of a direct Maplewood Spring TSS average value of 0.6 mg/L.?

Question B: If an average TSS value of 0.6 mg/L were used, how would it affect the statement, "…influences the predicted severity scores by increasing them as the Newcombe and Jensen equations are sensitive to low TSS values when they persist over a long period of time."? Would the severity score be different than the predicted score of 6 to 7 if the chronic TSS value were set at 0.6 mg/L instead of 2 mg/L?

Ecology response: *The 2 mg/L concentration is appropriate for representing baseflow conditions downstream of the hatchery. It is associated with the spring discharge, but actually represents net condition downstream of the spring, including channel exchanges that occur in the outflow channel. In addition, Maplewood is only one of a number of springs in this reach. Water withdrawn from the central part of the pool at Maplewood Springs to the hatchery is not the same as water downstream in this reach.*

If the chronic TSS value was set to 0.6 mg/L the severity score would decline; however, 0.6 mg/L is an appropriate representation of baseflow concentrations in Clarks Creek.

100. (Page 77, paragraph 2)
Comment: The paragraph "While suspended sediment data are limited in the watershed, the analysis indicates that a reduction in TSS and sediment load would reduce the adverse impacts of sediment on salmonids. A reduction of the severity scores below 6 would change the effects from moderate to minor, so the analysis does suggest that beneficial improvements occur with a 50% to 75% sediment load reduction.

Question: The use of the verbs indicates and suggest are confusing when representing an important finding based on the data and modeling analysis. These words suggest a lack of certitude or confidence in the interpretation being advanced. Did the data and the modeling analysis statistically determine that a reduction in TSS and sediment load would reduce the adverse impacts of suspended sediment on salmonids or did they not? Are these suspended sediment metrics well correlated with fish severity scores or are they not?

Ecology response: *The inference is based on the interpretation of the data according to the guidelines in the peer-reviewed and cited reference (Newcombe and Jensen, 1996). Ecology did not undertake any independent reanalysis of stressor-response relationships between fish and TSS because this is already well documented in previous studies.*

101. (Page 78, paragraph 2 to Page 79, paragraph 1)
Comment: The paragraph "A study to quantify sediment oxygen demand (SOD) was conducted in 2011 by PTI and HydrO2, Inc. The preferred chamber method of direct measurement of SOD was possible only on open patches of sand/mud or sand/gravel without significant amounts of submerged aquatic vegetation, so these measurements do not include the full SOD that may be exerted underneath Elodea mats. According to the data collected at two sites without significant macrophyte coverage, average SOD ranged from 1.58 to 1.99 gm-O2/m2/day. These measurements likely underestimate the SOD that is present in areas of fine organic sediments that are typically covered with Elodea." prompts the following questions.
Question A: Were only two sites within the Clarks Creek Watershed successfully measured for SOD by PTI and HydrO2, Inc.?

Question B: Were these two SOD measurements used to inform the calibration of the QUAL2Kw Model? If they were not, why were they not?

Question C: The statement, "These measurements likely underestimate the SOD that is present in areas of fine organic sediments that are typically covered with Elodea." sounds somewhat reasonable but it shows an interpretive prejudice when offered in the absence of a citation to support the interpretation or conclusive statement. Is there an applicable scientific citation available to support this statement?

Ecology response: *Only two sites were successfully measured for SOD and neither site was located within the Elodea mats. Direct measurement of SOD using the preferred chamber method requires that the bottom of the chamber have contiguous contact with the bed sediment and no transfer of water or other substances occur between the inside of the chamber and the surrounding water column. Since aquatic vegetation creates an uneven surface and precludes these conditions, the chambers must be placed in areas absent aquatic vegetation. SOD is expected to be higher within aquatic vegetation beds compared to open areas because of senescence and decomposition of organic matter, and, therefore, the SOD measurements were expected to underestimate effective SOD concentrations in the stream. The total community substrate oxygen demand (CSOD) measurements were also highly uncertain, as stated in the TMDL report, both because they were not directly measured within the Elodea beds and because they are based on the net effects of oxygen demand and reaeration, but no direct measurements of reaeration were obtained. When the model is run with SOD set equal to the rate reported for open areas only, the observed instream DO concentrations cannot be replicated with reasonable assumptions for reaeration. In contrast to the high uncertainty in the measured estimates, Tetra Tech (2011) states that the SOD rate of 8 g-O2/m2/d resulted in a close fit to the observed DO daily range and longitudinal profile and SOD is within the range of values cited in Tables A-24 and A-25 in USEPA (1997).*

102. (Page 79, paragraph 1)
Comment: The paragraph "HydrO2 also conducted total community substrate oxygen demand (CSOD) measurements. Re-aeration was estimated as a function of flow using the method of Langbein and Durum (1967). The resulting CSOD estimates at 3 sites on Clarks Creek ranged from about 2.5 to 4.7 gm-O2/m2/day. The estimates do not provide a full measurement of the oxygen demand exerted by the combination of sediment and decaying organic material within Elodea mats, and because re-aeration was not directly measured, they are also highly uncertain. However, these measurements confirmed the importance of both SOD and CSOD in the system and indicated that water column respiration is relatively small, about 0.5 gm-O2/m2/day" prompts the following request for a response.

Question: The statement "The estimates do not provide a full measurement of the oxygen demand exerted by the combination of sediment and decaying organic material within Elodea mats, and because re-aeration was not directly measured, they are also highly uncertain" uses language that implies the data and analysis are not probative or compelling yet these statements are followed with the following declaration, "However, these measurements confirmed the importance of both SOD and CSOD in the system and indicated that water column respiration is relatively small, about 0.5 gm-O2/m2/day". Pierce County requests further substantiation that these conclusions are scientifically reasonable (i.e. defendable) and the County would like to know how was this determination was soundly supported by the provided data and analysis?

Ecology response: *While only two direct SOD measurements are available and these are from bare sediment areas only, the observations do confirm that significant SOD is present (even outside Elodea growth areas) and that the respiration within the water column (outside the Elodea mats) is relatively small. In the QUAL2Kw model, the effective SOD represents bacterial and fungal respiration that occurs on the sediment surface and also the decay and consumption of non-living organic matter that is trapped within the Elodea mats. Direct respiration at the sediment surface is likely to be greater in Elodea growth areas due to the preference of the plant for fine-grained organic sediments as well as root growth within the sediment. An additional contribution comes from the consumption of organic material trapped within the Elodea mats, whether derived from external loads or from dead Elodea detritus. This source of oxygen depletion must be represented as part of effective SOD in the QUAL2Kw model as the model assumes that decay of detritus occurs primarily at the sediment interface. Therefore, it is scientifically reasonable that higher rates of effective SOD apply within the Elodea mats than in the bare sediment areas where measurements were taken.*

103. (Page 83, paragraph 2 to Page 84, paragraph 1)
Comment: The paragraph "Numerous bioassessment studies have been conducted in Puget Sound lowland streams. EPA selected eight of these streams with B-IBI data with similar geological conditions to Clarks Creek that could provide a comparison as a reference condition. Assessing the sites as a group provides more data and accounts for variations even within reference streams. Between 2009 and 2011, 13 B-IBI surveys were conducted on Big Beef, Chuckanut, Coal, Griffin, Surveyor, Dewatto, and Candall Creeks in addition to a Coulter Creek tributary (Hayslip, 2013)." prompts the following question.

Question: Is the Hayslip, 2013 report the document that describes how the EPA selected the eight (8) streams with B-IBI data with similar geological conditions to Clarks Creek and generated a comparison to develop the reference condition? If it is not the document that describes this process, then where would that EPA process be described?

Ecology response: *The Hayslip, 2013 memo describes the reference streams in the Puget Sound lowlands ecoregion where B-IBI scores were in the "good" to "excellent" water quality range, according to the Puget Sound Stream Benthos guidelines. Ecoregions are areas with similar ecosystems based on soils,* *geology, elevation, and other factors. Classification of waterbodies by ecoregion allows comparison of waterbodies with similar biological expectations. The Clarks Creek is in the Puget Sound lowlands ecoregion like the reference streams in the TMDL.*

104. (Page 84, paragraph 1)
Comment: The sentence "The average percentage of urban land uses in the watersheds selected is 2%." prompts the following question.

Question A: Why was the average percentage threshold of 2 percent urban land use selected as a criteria?
Question B: Is this value being used to represent the difference between urban and rural land uses?
Question C: Is 2 percent urban land use being used synonymously with 2 percent impervious coverage?

Ecology response A, B, & C: *We did not use 2% urban land use alone to select reference sites. We used multiple factors to assess whether or not a site represented minimal human disturbance. We reported on the percent urban (2% was the average of the reference sites we used) as just one piece of information that was relevant to deciding whether a site had minimal human disturbance. The percent urban was derived by using land use/landcover data (from the National Land Cover Database, NLCD) in the watershed upstream of the sampling point. We did not use impervious coverage data.*

105. (Page 85, paragraph 6)
Comment: The sentence "Ortho-phosphorus (PO4-P) represents the fraction of total phosphorus that is directly available to plants." prompts the following question.
Question: Please expand on and clarify as a point of reference, "Ortho-phosphorus (PO4-P) represents the fraction of total phosphorus that is directly available to plants" and distinguish it from the concept of Biologically Available Phosphorus (BAP) which is composed of Soluble Reactive Phosphorus, fractions of Soluble Un -Reactive Phosphorus and labile P.

Ecology response: *The section in question refers to water column concentrations. The concept of BAP is generally applied to soils and lentic water bodies where there is sufficient residence time for biological action to make organic and soluble un-reactive phosphorus available. In streams, much of these fractions are washed through the system. In such systems, PO4-P is a good approximation of the bioavailable fraction. However, we acknowledge that it is an approximation and that the wording is imprecise. To clarify, the text "in the water column" was added after this statement in the TMDL.*

106. (Page 88, bullet and 1)
County Comment: Please clarify just how the USLE module of HSPF was populated and assisted with these final calculations?

Ecology response: *HSPF does not contain a "USLE module"; however, some parameters used in USLE calculations may be used to inform parameter assignments in HSPF. This is discussed in detail in Sections 7.1-7.2 of the HSPF model calibration report (Appendix C to the TMDL).*

107. (Page 88, bullet and 5)
County Comment: The statement "the percentage of fine sediment (silt and clay only)" states definitively for the first time in this report that fine sediment means just the silt and clay fraction of the sediment sample (i.e. grains or particles less that 62 microns in diameter in the American Geophysical Union Sediment Classification System (sedimentology / fluvial hydraulics) and soil separates partitioning under 50 microns in the USDA NRCS Soil Survey system (terrestrial). (…this issue also referred to in Comment 96)

Ecology response: *Comment noted. See response to Comment 96.*

108. (Page 88, bullet and 6)
County Comment: The paragraph "Benthic invertebrate assessments of Clarks Creek indicate stream health that is "poor" to "fair." Clarks Creek B-IBI scores range between 26 (poor) to 34 (fair), indicating that macroinvertebrates are impaired. In contrast, some reference streams in the Puget Sound lowlands ecoregion, which support a healthy aquatic habitat, have B-IBI scores that range from 38 (good) to 46 (excellent)."prompts the question.

Question A: This statement is confusing and it gives the impression that only some of the applicable reference streams were chosen in the comparison because they provided contrastingly higher B-IBI scores than those generated in Clarks Creek. In a previous question (Comment 105), the County requested a more clear explanation as to how and by what criteria the reference streams were chosen.
Question B: Please describe and clarify how geomorphically comparable reaches within those geologically similar streams had their B-IBI scorecard assessments statistically compared to B-IBI assessments generated on geomorphically similar reaches within Clarks Creek?

Ecology response A & B: *A biological assessment is an evaluation of the condition of a water body by sampling organisms, in this case benthic macroinvertebrates, that spend all or part of their lives in that water body. Multiple metrics are then combined into an index, such as the Puget Lowland ecoregion Benthic Index of Biotic Integrity (B-IBI), and are used to assess the structure and function of these biological communities. When the B-IBI was developed, it established scoring criteria (poor, fair, good, excellent, etc.) based on the set of reference sites that were used to develop the B-IBI. These reference sites were all in the Puget Lowland ecoregion and represented minimal human disturbance. So when a site has a B-IBI score of 34, it is determined to be in "fair" condition as compared to reference sites in the Puget Lowland ecoregion. It would have been perfectly acceptable to just score Clarks Creek using the Puget Lowland ecoregion B-IBI.*

However since we wanted to also assess percent sands and fines (for which there is no benchmark, criteria or index available), we took this a step further and selected additional reference sites in the Puget Lowland ecoregion to use for comparison to Clarks Creek. We wanted to use the same reference sites to compare B-IBI scores and percent sand and fines. Therefore, we selected these additional reference sites based on 3 criteria: same ecoregion as Clarks Creek (Puget Lowland ecoregion), minimal human disturbance and consistent data set for B-IBI, and percent sand/fines. The reference sites we selected for our analysis scored, on average, a 40 which is good/excellent using the Puget Lowland B-IBI (which was developed using a separate set of reference sites). Then we scored Clarks creek using the Puget Lowland B-IBI and the scores ranged between 26 (poor) to 34 (fair).

There is no need for any further statistical analysis to use the Puget Lowlands B-IBI. Taxonomic data from each site is used to calculate a B-IBI score. Then the B-IBI score is put in a category from poor to excellent, which is based on the reference sites used to develop the index.

109. (Page 89, paragraph 1)
Comment: The paragraph "The conceptual model diagrams show the linkage between stressor sources (at the top), instream processes (middle), and impacts (at the bottom). Each pathway through the diagrams can be regarded as a risk hypothesis that *describes a cause and effect relationship*." prompts the following response.

County Comment: To this point some 90 pages into the TMDL report, the County has generated 111 comments with scores of corresponding questions. The overarching impression is that the technical analysis and the narrative that describes it, fails to create a compelling picture or describe a convincing process that portrays a comprehensive understanding of the Clarks Creek water quality impairments. In many cases the County reads language and repeatedly hesitates over recurring word choices that seemingly undermine the confidence (i.e. strength of conviction) behind the correlations being offered to support the ”line of evidence” conclusions being advanced. It is the County’s position that Ecology has been unsuccessful in proving its multi-parameter relationship hypothesis and it has failed to establish a clear and convincing case for the cause and effect interactions linking stream ecosystem functional impairments to water quality parameters in Clarks Creek.

Ecology response: *Comment noted. Ecology is confident with its analyses and -believes the complex relationship between DO, sediment, elodea, stormwater, and shade is established for the Clarks Creek TMDL.*

110. (Page 89, paragraph 3)
Comment: The following statement “For sediment, the key stressor source is hydromodification, especially increased impervious surfaces on the landscape which increase stormwater velocity and discharge volume. This causes both increased upland sediment washoff and in-channel and streambank erosion.” prompts the County to inquire about the potential to develop the following programmatic alternatives.

Question: Outside of a Implementation Plan that identifies and details a capital and LID retrofit projects list, are there operations and maintenance BMPs that could effectively (i.e. measurably) interdict readably transportable fine sediment and wash-off grit from county owned impervious surfaces before it enters a stormwater conveyance to be concentrated at some interim settling or endpoint treatment facility? For example, will Ecology award TMDL credit for sediment load reductions (i.e. approved WLA target attainment actions/activities) that result from a dedicated increased programmatic commitment *to mobile sweeping and vacuuming of county roads?*

Ecology response: *The Clarks Creek Implementation and Accountability memo provides the following guidance:*

Evaluating the tradeoffs between volume reduction and treatment requires a definition of “treatment” and a method to convert between treatment and volume. For Clarks Creek, the reduction in untreated stormwater volume is intended to achieve a variety of benefits, including reductions in sediment loads, reductions in phosphorus loads that support elodea growth, and reductions in organic matter loads that contribute to SOD. Both phosphorus and organic matter loading are strongly associated with the washoff of particulate matter in stormwater. Therefore, it makes sense to account for treatment in terms of reductions in solids load.

A basis for conversion between volume reduction and treatment can then be established by specifying the solids reduction efficiency that constitutes adequate treatment. The draft Western Washington Hydrology Manual (Volume 5, Section 3.5) presents a Basic Treatment Menu (BTM) that applies to most projects and presents a variety of BMP facility designs.

The BTM provides a baseline for evaluating whether a stormwater BMP performs well enough to achieve the desired “reduction in the volume of untreated stormwater.”

Facilities that are designed consistent with the BTM are automatically assumed to meet the TMDL volume reduction or treatment allocation requirement. Stormwater that is treated by such a facility is accounted the same as if the stormwater had been removed from the system. Designs that are not in the BTM but can be demonstrated to achieve comparable levels of removal would also receive full credit (but not more than a 1:1 match).

Other retrofit or stream improvement projects may not achieve the performance targets of the BTM, but should still receive partial credit toward the volume reduction goal. The accounting can be done on the basis of suspended solids removal. For example, consider a channel restoration project that is anticipated to achieve a 20 percent removal of solids on a storm flow (for the 10/21/03 event) of 100 MG. The credit toward the needed “reduction in the volume of untreated stormwater” can be calculated by comparing the *design removal rate of 20 percent to the target removal rate of 80 percent. That is, the project would be accounted as meeting 100 MG x 20%/80% = 25 MG.*

This approach will allow the comparison and crediting of all types of BMPs and improvements that may contribute to the overall load reductions and water quality improvement goals. In addition to flexibility, it provides a common metric that can be used in cost-benefit comparisons between different projects. A library of modeled unit area (per-acre) flows by HRU is available and can be used to evaluate any candidate project.

Street sweeping removes sediment, but it's not clear how to calculate the sediment reduction from the practice using the BTM. The implementation projects that address the TMDL must demonstrate that they will achieve the DOD wasteload allocation or the 50% reduction in stormwater flow volume or untreated stormflow and the 66% sediment reduction. The Implementation and Accountability memo provides guidance on evaluating these projects for effectiveness and removal rates.

111. (Page 96, paragraph 3)
Comment: The following statement "Water quality standards for Clarks Creek also contain criterion for total dissolved gases, which "shall not exceed 110% saturation." Daytime DO monitoring of Clarks Creek shows occasional high DO saturation levels that violate applicable water quality standards during the day when elodea and other plants undergo photosynthesis. Although low DO levels cause problems in Clarks Creek, DO saturation that is too high can also be harmful to aquatic life. As a result, elodea density levels must be reduced to address both occasional exceedances of the DO saturation water quality standards and DO levels that are too low, both of which harm aquatic life." prompts the question.

Question A: Does the previous paragraph mean to imply that the Elodea abatement DASH projects currently being implemented during the summer in Clarks Creek are inadequate at achieving the necessary population reductions required to address the total dissolved gas criterion?

Ecology response: *No, the TMDL is not evaluating the practices currently in place in Clarks Creek. Elodea densities and the effectiveness of this practice will need to be determined with monitoring. The allocation for Elodea density needs to be "…reduced to a maximum of 33% of existing (pre-TMDL) coverage between the state hatchery and Tacoma Road and to a maximum of 25% of existing coverage between Tacoma Road and the mouth of Clarks Creek to meet both the DO and the total dissolved gas criteria." This statement does not imply how the responsible parties will achieve these reductions.*

Question B: If riparian buffer and canopy restoration is deemed not to be a practically feasible goal (please refer back to Comments 80 and 81) then would an increase in DASH abatement projects be the appropriate programmatic response to reducing Elodea densities and growth rates by 67 to 75 percent from their existing (pre-TMDL) levels? How will the preexisting Elodea densities be measured and how will the post DASH treatment densities be calculated in order to award the Elodea reduction credits necessary to achieve this TMDL directive?

Ecology response: *Riparian shade is the best long term strategy for elodea control and abatement. The Elodea and Shade Report found a strong relationship between effective shade and elodea substrate coverage along Clarks Creek. Riparian vegetation is also important for erosion control, habitat restoration, and pollutant runoff control.*

The Elodea and Shade Report categorized the elodea density and substrate coverage at approximately 20 sites along Clarks Creek. This may be a good starting point for characterization of pre-TMDL coverage. This accounting system for elodea should be set up by the Clarks Creek Team through the Implementation plan and follow-up monitoring (as suggested by the Shade Report).

112. (Page 99, paragraph 2)
Comment: The following sentence "Baseflow conditions were estimated using the steady-state (diurnal) QUAL2Kw models developed for four well- monitored summer dry weather events in Clarks Creek with flows around 50 cfs at Tacoma Road." prompts the question.
Question: Please define a summer dry weather event? What are the climatic/meteorological qualifiers or criteria?

Ecology response: *Because only a limited number of synoptic modeling events were available it was not necessary to formulate an exact operational definition of "summer dry weather" events. Instead, summer monitoring events during which there was no rainfall and for which flows in Clarks Creek remained close to the steady-state spring-supported discharge of around 50 cfs at Tacoma Road are referred to as dry weather events.*

113. (Page 100, paragraph 3)
Comment: The following sentence "…and low DO was especially pronounced on October 21, 2003, which was approximately a 2-year rainfall event." prompts the question.

Question: Additional USGS and nearby meteorological station data analysis conducted by Pierce County demonstrates that the October 21, 2003 event was a 1 year recurrence event for stream discharge and a 23 year return interval for precipitation. This disagreement in the hydrologic and meteorological analysis supports the County's contention that this event does not represent an appropriate critical condition storm event for TMDL modeling analysis.

Ecology response: *We agree that the October 21, 2003 flow peak was in the 1-2 year recurrence range. The quoted statement was corrected in the TMDL document, changing "2-year rainfall event" to "2-year runoff event." Precipitation measured on October 20 was in the 23-25 year recurrence range, but is only a measurement at one specific point in the watershed. The QUAL2Kw modeling used for the TMDL is based on instream flow measurements, not the precipitation data. The October 21, 2003 runoff event was selected to represent the critical condition for TMDL because, among the documented events it is the one requiring the largest reduction in mass of DO deficit (DOD). The low recurrence frequency is appropriate for calculation of the TMDL and allocations which require reasonable assurances that water quality standards will be achieved. Reference to the recurrence interval of the BMP design storm is not relevant to the calculation of the TMDL, but is relevant to the interpretation of the TMDL into implementation planning. It should be noted, however, that the proposed implementation plan allows credit for "treatment" if stormwater is routed through a BMP designed according to the standards described in the permit, regardless of the actual amount of rainfall. See also the response under "DO Modeling Concerns" in the Pierce County cover letter.*

114. (Page 100, bullets 2 and 3)
Comment: The following two bullet points…
• Diffuse inflows achieve a DO concentration of 9.5 mg/L.
• SOD is held to 2.5 mg/m2/day.
…prompt the subsequent comments from the County.

County Comment: Please refer to Comment 68 and Comment 103 respectively for the issues the County is recording regarding the substantiation behind these assumptions.

Ecology response: *Comments 68 and 103 do not appear to refer to these issues. As stated in the text, there are assumptions that were made "to determine the loading capacity for DOD during stormflow conditions…" This means that we assumed a reduction in SOD and assumed a healthy DO input from diffuse inflows and then calculated the additional reduction in influent DOD necessary to achieve water* *quality standards. These two assumptions are applied to the wet weather analysis because they were previously determined to represent conditions needed to achieve water quality criteria during dry weather flow (see Appendix B).*

115. (Page 101, paragraph 1)

Comment: The following sentence "Note that net Elodea respiration increases slightly under this scenario, despite reduced Elodea coverage, due to the greater water velocity that occurs with the reduction of Elodea biomass." prompts a request for further clarification from Ecology.

Question: This preceding statement requires some additional clarification to be fully understood, please provide a more thorough description as to what is being attempted to be explained by the preceding sentence?

Ecology response: *The reduction in biomass allows for an increase in stream velocity; the increased velocity, in turn, introduces additional dissolved oxygen to the aquatic beds, which explains the slight increase in Elodea respiration.*

116. (Page 103, paragraph 1)

Comment: The following sentence "On pervious and impervious upland areas the model simulates the build-up and wash- off of sediment resulting from human influences and rainfall."prompts the comment.

County Comment: This statement represents one of those opportunities that prompted the County to register a similar complaint as previously described by Comments 52, 57 and 87.

Ecology response: *This statement was edited so that it clearly states that the model addresses both natural background and human influences. After "human influences," the text "naturally occurring land cover" was added. Comments 52 and 57 are not related to the HSPF model. See response for Comment 87.*

117. (Page 103, paragraph 4)

Comment: The following paragraph "In addition to a current conditions simulation, a natural conditions and a build-out scenario were simulated utilizing the model. The natural conditions model scenario demonstrated that current sediment loads are much larger than would be expected under natural conditions. Both upland loads and channel erosion are predicted to have increased. However, some erosion of the channel in the steepest segments of the glacial till would be expected even under natural conditions (Tetra Tech, 2012a)." prompts the question.

Question A: Please refer to Comment 56 (Page 39, paragraph 2) for County Question. Does this statement mean that the sediment characterization representing the channel bed and substrate was found to be 16 times greater when compared to erosion rates generated by running the USLE module populated with NRCS Order 3 soil survey map unit data or does it mean that the composite TSS data, bed sediment characterization, cross-channel survey, and B-IBI data was then compared to an individual B-IBI reference stream (defining natural levels) as listed on page 84, paragraph 1 and was found to be 16 times greater?

Ecology response: *As stated on page 103, the sediment loads are estimated from the HSPF model. Also, as has been previously noted, there is no "USLE module" in the models used for this project.*

Question B: If neither of the preceding explanations is fully accurate, how were the current erosion rate and the natural erosion rate determined?

Ecology response: *These rates were determined through use of the calibrated HSPF model.*

Question C: If the sediment loading to Clarks Creek was determined to be 16 times greater than a reference condition then which individual reference stream was Clarks Creek being compared too?

Ecology response: *The reference to "16 times greater" appears on page 88. It is based on comparison of HSPF runs for current and natural conditions, and does not refer to any reference stream. Note that the sediment loading comparisons on page 88 are for upland load as determined in the sediment reduction project and differ from the sediment loading comparisons on page 103, which is for instream loads at 66th Avenue.*

118. (Page 104, paragraph 1)
Comment: The following paragraph "The current and build-out scenarios show similar loads due to the simulation of future BMPs that will be required under the proposed general permit." prompts the question.

Question: What spatial assumptions by parcel and what kind of distribution of impervious coverage did the model fabricate to simulate the build-out scenario? Were the land use and the potential permitting eligibility by parcel informed by data provided Pierce County Planning Department?

Ecology response: *Land use assumptions for the build-out scenario are described in Section 9.2 of Appendix C: "The buildout scenario examines the potential impacts of full buildout in the watershed. The land use for this case is obtained by converting existing undeveloped land uses to zoned land uses except where protected from development (e.g., parks). This reveals the maximum amount of development and impervious surfaces that could occur in the watershed under current land use plans." The analysis does not look at other issues affecting individual parcel eligibility.*

119. (Page 104, paragraph 2)
Comment: The following paragraph "Model runs suggest that the total effective SOD (representing demand from both the sediment surface and from within the Elodea mats) needed to be reduced by approximately 60%, while the density of Elodea (below Tacoma Rd.) needed to be reduced to 25 percent of the current density compared to 2003 levels (Tetra Tech, 2011a). The stormwater load reduction required to meet these scenarios is utilized as a line of evidence in the determination of the loading capacity for sediment." prompts the question.

Question A: Does Ecology have reliable aerial-spatial calculations as to how much Elodea there is as a current base line value in which to measure the reduction from?

Question B: How will Ecology measure and monitor the reduction of Elodea and credit that decrease in population density toward TMDL target achievement?

Ecology response A & B: *The Elodea and Shade Report categorized the elodea density and substrate coverage at approximately 20 sites along Clarks Creek in 2012. This may be a good starting point for characterization of pre-TMDL coverage. The monitoring plan (as suggested by the Shade Report) with goals specific to tracking elodea reduction should be established by the Clarks Creek Team during the Implementation Phase of the TMDL.*

120. (Page 104, paragraph 2)
Comment: The following paragraph "Clarks Creek-09, the sediment sampling site closest to 66th Avenue, has the highest percentage of fine sediments and sands (100%) likely due to physical features that cause high amounts of sediment deposition. In contrast, the 90th percentile of Puget Sound lowland reference stream values, which reflect a healthy stream habitat, for percentage of fine sediments and sands is 36%. Therefore, the percentage of sands and fines that would need to be reduced from current conditions is 64%." prompts the question.

Ecology response: *Many TMDLs use reference sites as a basis for determining allocations in TMDLs. Reference sites are areas where there is little pollution and water quality standards are met or the biological organisms are healthy. The Clarks Creek sediment TMDL uses Puget Sound lowland reference sites with high biological integrity scores to determine a healthy level of percent silts and sands. The 64% reduction in the TMDL allocation is the amount of sediment in Clarks Creek that would need to be reduced to be at the same level as percent silts and sands in reference streams. During the TMDL development process, we explored other methods such as reducing existing sediment loads to the natural sediment load and determining geomorphically significant flows. We chose the reference streams approach since it used regional site-specific reference data and used the same metric from the Sediment Reduction Project that quantified the amount of sediment that needed to be reduced from projects selected by stakeholders. These projects are optional, and stakeholders may choose other projects to meet their wasteload allocations.*

121. (Page 107, paragraph 3)
Comment: The following paragraph "As discussed in the Model Application section, the HSPF model also provided sediment loading results based on current, natural, and build-out scenarios. The average annual sediment loading from the model represents both the in-channel and suspended bedload transport in the basin." prompts the position from the County.

County Comment: A Bank Stability and Toe Erosion Model (BSTEM) spreadsheets should have been set up for a continuous simulation to evaluate bank stability and toe erosion on each of the reaches and tributaries of Clarks Creek. Dynamic BSTEM is a public-domain model developed by the USDA National Sedimentation Laboratory (USDA, 2009) and widely used for generating TMDL sediment loads originating from stream channels. Additionally, the channel characterizations for Clarks Creek should have resulted from a Rapid Geomorphic Assessment (RGA) including a modified Wolman pebble count conducted at each site (Simon and Klimetz, 2008). Detailed soil and vegetation characterization should have also been performed at each sampling site. Soils at each of the Clarks Creek sampling locations should have been characterized from in-situ shear strength testing with Torvane testers, and corroborated by field samples utilizing geotechnical laboratory analyses (e.g., bulk weight, particle size distribution, internal angle of friction, vane shear) Additionally, submerged jet devices to measure in-situ critical shear and erosion rates for cohesive material should have been used to measure shear stress thresholds. In the absence of this more precise analysis, the County has little confidence that the in-channel sediment load that was generated (and consequently the load reduction targets) for that very significant contributing compartment of the watersheds overall sediment load balance.

Ecology response: *Loads predicted by the HSPF model are consistent with the geomorphic analyses conducted for the Clarks Creek Sediment Reduction Action Plan (Brown and Caldwell, 2013), lending confidence to the results. However, as with all models, further refinement may be possible. The types of additional analyses described in the comment could be useful for further refining the TMDL implementation plans.*

The analyses conducted for the Sediment Reduction Plan incorporated both modeling and field observations and found good agreement between the two. The ultimate purpose of the Sediment Reduction Plan was to identify "a range of projects aimed at reducing sediment loads to Clarks Creek. Reducing sediment loads (and the pollutants commonly associated with sediment) should help improve habitat for Endangered Species Act (ESA)-listed salmonids, protect Tribal and state hatchery operations, meet dissolved oxygen (DO) and bacteria total maximum daily load (TMDL) objectives, and control elodea growth in the creek." The analyses conducted by Brown and Caldwell identified and ranked upland and in-channel sediment sources based on geomorphological assessment of the Clarks Creek basin, sampling and analysis of channel bottom sediments, HSPF modeling, GIS analysis of the factors affecting sediment loads, field reconnaissance to ground-truth HSPF results, and sediment transport magnitude-frequency analysis. This provides the most comprehensive study to date on specific opportunities to reduce sediment loading and achieve that objective from the TMDL.

Question A: Citing the sampling site assessment as having 100 percent fines and sands does not necessarily translate to characterizing the whole reach; especially when stating the reach as being comprised of 100 percent fines and sands.

Question B: Where and how was the substrate characterization and comparison conducted along the longitudinal profile of the reference stream?

Question C: In the statement "…due to physical features that cause high amounts of sediment deposition" do this mean to infer that this setting is a naturally unconfined, low gradient channel reach that is alluvial in its depositional function?

Question D: The statement "In contrast, the 90th percentile of Puget Sound lowland reference stream values, which reflect a healthy stream habitat, for percentage of fine sediments and sands is 36%. Therefore, the percentage of sands and fines that would need to be reduced from current conditions is 64%." prompts the following concern from the County. Does this mean a 64 percent reduction in deposited sediment when compared to the low gradient alluvial reach of (an as yet unrevealed stream name and comparable reach of the reference condition?

Question E: After all the analysis and modeling provided in the TMDL Report, is the Waste Load Allocation and/or TMDL reduction target for sediment derived from a rather limited and simple characterization of the substrate and comparing it to, what appears to be a marginally suitable reference condition?

Ecology response A-E: *The 64% reduction is based on three lines of evidence, including the Newcombe and Jensen assessment that identified a 50-75% reduction in suspended sediment was necessary to reduce impacts to aquatic life, the Sediment Reduction Study HSPF model which would require a 76% reduction in sediment to return to natural forested conditions at the 66th Avenue site, and 64% reduction in sediment loading necessary to meet Puget sound lowland stream reference conditions that support a healthy aquatic environment. Hayslip (2013) evaluated eight Puget Sound Lowland reference streams to determine the percent silt and fines present at reference locations in streams with similar elevations, gradients, and geology as the Clarks Creek basin. "This loading capacity is expected to meet designated uses because 1) it is equivalent to the reduction necessary in percent sand and fines to meet reference conditions; 2) it is expected that aquatic life will respond beneficially to the sediment reductions (Newcombe, 1996); and 3) the reduction will result in a long-term average flow weighted TSS concentration of about 2 mg/L, which is similar to TSS concentrations in reference Puget lowland systems." Finally, Ecology must develop the loading capacity to achieve water quality standards under all conditions; in this case, those were where the highest reductions were needed.*

Attachment Two

Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL
Additional Course Level Comments

Comment 1: Has Department of Ecology/EPA/Puyallup Tribe of Indians put in enough efforts to write this TMDL that requires costly projects to comply?

Ecology response*: Yes, we believe the TMDL meets the necessary requirements.*

a. This TMDL is poorly written and poorly structured. The document contains many ambiguous and unprofessional terms, as well as irrelevant information in its introduction (see p1–28). Results and discussion section of the document reads like introduction and methods (see p40–41). Conclusion is mixed with materials for introduction and results (see p87–91).

Ecology response*: Comment noted. However, Ecology has clarified wording when needed but respectfully disagrees with commentator's conclusions. See previous comments. We have made a number of changes based on public comments that should improve the readability of the TMDL.*

b. Assumptions are used for important factors due to insufficient data.

> i. p24, "Detailed monitoring of pollutant loading from the hatcheries has not been conducted at this time. Using the available TSS and ammonia data as indicators, the hatcheries contribute relatively small amounts of sediment and oxygen demanding substances to Clarks Creek. PTI will collect monitoring data to better characterize the pollutants and loadings to Clarks Creek."
>
> ii. p26, "Detailed evaluation of available monitoring from the currently permitted construction sites has not been conducted at this time, and because these sites are regulated it is assumed to contribute relatively small amounts of nutrients and oxygen demanding wastes to Clarks Creek."

Ecology response*: The hatcheries (state and tribal) and the General Construction Site Permit were given allocations under the TMDL. Also, the TMDL is requiring that the tribal hatcheries monitor and based on the monitoring data may calculate a different wasteload allocation in the future.*

c. Conflicting information is presented.

> i. p26, "According to Ecology's PARIS database reviewed in June 2012, three (3) industrial permitted facilities and two (2) sand and gravel permitted facilities are located in the Clarks Creek watershed; none of these facilities directly discharge to Clarks Creek, and therefore are not assumed to substantively contribute to the impairment in Clarks Creek." However, it is said on p27, "Land disturbance, such as construction sites, can contribute substantial sediment loading to streams, providing fine sediment for elodea growth."
>
> ii. Properties adjacent to Clarks Creek directly discharges to the creek, however, are given a pretty high load allocation for relatively small areas. Should not the TMDL regulate these properties better since they are critical areas?

Ecology response*: The Industrial Facilities and the Sand and Gravel facilities were reviewed and evaluated and none of them directly discharge to or adversely impact Clarks Creek. Land disturbance activities not following permit requirements can cause significant pollution. If the county feels these facilities, or others, are operated inappropriately we encourage the county to report this activity to Ecology Southwest Regional Office by phone at 360-407-6300 or by using the following link online:*
http://www.ecy.wa.gov/programs/spills/forms/nerts_online/SWRO_nerts_online.html

Please also refer to previous Ecology Response under Comment 10.

d. Without presenting or citing statistical analysis results, some conclusion statements sound subjective.

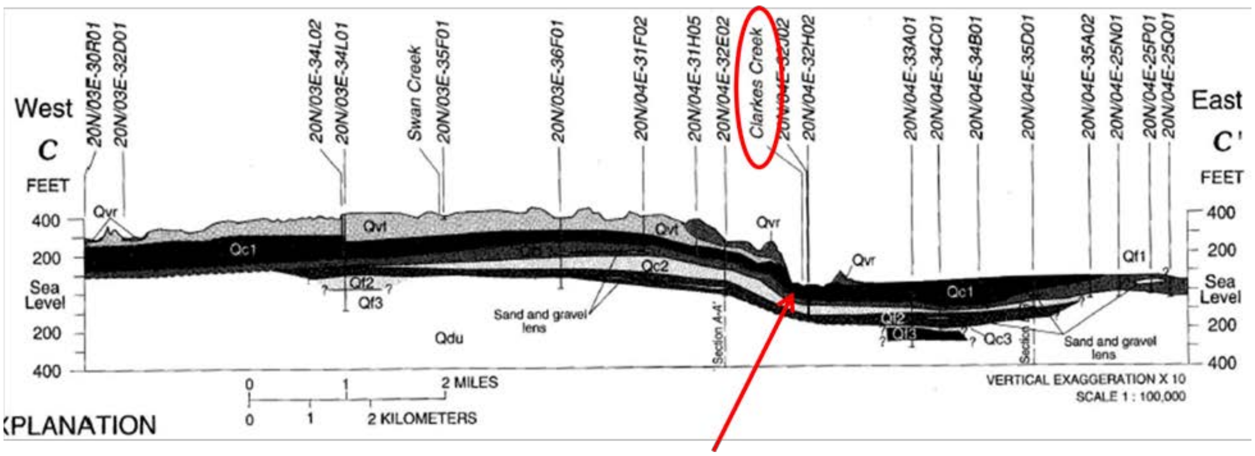
> i. p41, "Further analysis of data variability and central tendency indicates a small decline in DO below the state hatchery, followed by a gradual recovery downstream to Diru Creek, then a decline below Rody Creek. The decline below the hatchery is not necessarily associated with the hatchery itself but could instead reflect lower velocities and greater macrophyte growth in this reach. (see Fig. 11)"
>
> ii. From data collected from only four storm events during 2011–2012, do we have enough degree of freedom to draw major conclusions on p53 and on p48? On p53, "PTI found that the long-term, cumulative effects of stormwater on instream DO were evident because of increasing levels of pollutants during each storm event"; on p48, "Tetra Tech also evaluated simulated flows in Clarks Creek with DOD to see if higher flows corresponded to higher DO depletion. The Tacoma Road flow gauge in Clarks Creek was not operational from 2009-2010. Therefore, Tetra Tech used precipitation, climate data, and existing flow data in Clarks Creek to create a 70-year simulation of flows using the HSPF watershed model. The analysis shown in Figure 16 concluded that higher flows correlated to higher DODs at Tacoma Road (R2=70%; coefficient $p<0.001$) (Tetra Tech, 2012a)."

***Ecology response**: The paragraph in (di) was referring to a series of box plots that were inadvertently omitted from the draft. These have now been added to the document. Statistical results are shown for (dii) and indeed are cited in the comment.*

Comment 2. What are the natural stream bed sediments of Clarks Creek?

> a. p24, "In Clarks Creek and its tributaries, excessive sediment accumulates in streams and promotes the growth of aquatic vegetation."
>
> b. Where the fine sediments accumulate in the Clarks Creek is at the alluvial sediment area of the Puyallup River Valley. If we were able to dredge the creek, would we be able to reach a layer of desired stream bed materials at the alluvial deposition area?

***Ecology response:** Information regarding Clarks Creek bed sediments is found in a study on groundwater hydrology by USGS from 1999. It states, "The Puyallup River Valley ranges in altitude from sea level near Tacoma to 150ft near Orting …. The valley floor is composed of coarse- to fine-grained deposits that include alluvial, marine, and mudflow deposits (Walters and Kimmel, 1968; Dragovich and others, 1994)….The area is transected by several creeks whose headwaters originate within the study area, and the area is bordered on the east by the Puyallup River, which originates at Mount Rainier in the Cascade Range. The creeks include Swan, Clear, and Clarks Creeks, which flow northward into the Puyallup River and out to Commencement Bay…" The figure below (inserted from USGS, 1999) shows Clarks Creek sitting on the Qc1 aquifer, which is classified as unconfined, consisting largely of sand and gravel deposits but containing clay and silt within the sand and gravel matrix (Jones et al., 1999).*



The TMDL based the excessive sediment and corresponding reduction on three lines of evidence. The Sediment Reduction Study and HSPF model which identified areas of instream erosion, deposition, and upload loads of sediment and calculated that a 76% reduction in sediment is needed to return to natural forested conditions at the 66th Avenue site. The Newcombe and Jensen assessment that identified a 50-75% reduction in suspended sediment was necessary to reduce impacts to aquatic life. Finally, Hayslip, 2013 evaluated eight Puget Sound Lowland reference streams to determine the percent silt and fines present at reference locations in streams with similar elevations, gradients, and geology as the Clarks Creek basin. This evaluation found a 64% reduction in sediment loading necessary to meet Puget Sound lowland stream reference conditions that support a healthy aquatic environment. "This loading capacity is expected to meet designated uses because 1) it is equivalent to the reduction necessary in percent sand and fines to meet reference conditions; 2) it is expected that aquatic life will respond beneficially to the sediment reductions (Newcombe, 1996); and 3) the reduction will result in a long-term average flow weighted TSS concentration of about 2 mg/L, which is similar to TSS concentrations in reference Puget lowland systems." Finally, Ecology must develop the loading capacity to achieve water quality standards under all conditions; in this case, those were where the highest reductions were needed.

Dredging the creek would not restore natural conditions and dredged reaches would soon be overwhelmed by new deposition unless instability in upstream channels was first addressed.

Comment 3: Do we really understand the contributing source of the SOD assumed in the DO model?

a. pB169, "Decreases in nitrate concentration or flow withdrawals did not predict fewer DO excursions. Increased riparian shading indicated a partial but inconclusive effect on DO as the exact light requirements of elodea (e.g., Elodea nuttalli) are not well established. A decrease in SOD did result in a strong increase in DO concentrations, supporting the control of SOD as a promising management measure."
b. p53, "they provide evidence that SOD is an important contributor to DO impairment." The average in situ chamber SOD measurements and CSOD (Community Substrate Oxygen Demand) measurements in Appendix C on p49 has an average of 2.89 g O2/m2/D with a range of 1.58–4.71 g O2/m2/D, which is much smaller than the assumed value (8 g O2/m2/D) in the QUAL2Kw modeling.
c. The QUAL2Kw simulation for the event on 10/21/2003 is used for DOD allocation, however, modeling results for the event seem highly uncertain. The 2010 draft QUAL2Kw Modeling Report from Tetra Tech to USEPA Region 10 reported that simulated dissolved oxygen is markedly over-estimated for the 10/21/2003 event with the assumption of 8 g O2/m2/D SOD and concluded that additional sources of DO deficit appears to exist.

d. Sediment load is not equal to SOD. Bank erosion is the major sediment source of the Clarks Creek sediment load, but, we do not expect high nutrient-laden materials from bank erosion. We do not have SOD values for the bank erosion materials yet.

Ecology response: *See the Cover Letter response under DO Modeling Concerns for an explanation of the SOD parameterization in the model. Ecology does not contend that sediment load is equal to SOD. However, stormwater that causes bank erosion is also likely to contribute pollutants. Bank erosion is primarily a concern because of its role in aggrading the stream and promoting Elodea growth.*

Comment 4: Can we use other means for elodea and DO control instead of running against natural geomophological processes of erosion and sedimentation?

a. Geomorphological studies for Rody Creek and Swan Creek show that creeks of this region are at unstable stage due to development of the past century. Instead of running against naturally occurring geomorphological processes for stream incision and bank erosion, can we use other approaches like eliminating nutrient inputs (especially phosphorus input) to the watershed for SOD control? If we do plan on applying the suggested instream erosion and sediment control, do we know the confident level of winning?

Ecology response: *We agree that portions of these creeks are unstable "due to development of the past century." However, it is not appropriate to attribute the effects of development as "naturally occurring geomorphological processes." Indeed, the risk of instability can be lessened by returning hydrology closer to natural conditions. Addressing impairments associated with elodea and DO will likely require multi-pronged strategies that address hydrology, geomorphology, and nutrient loads simultaneously. Unfortunately, it is not possible to "eliminate" phosphorus input, although it can certainly be reduced. The TMDL implementation focuses on control or treatment of stormwater as an integrative measure that both controls hydraulic stresses from impervious surface runoff and reduces loading of nutrients and organic matter. As to confidence in the results, please see the "Margin of Safety" and "Reasonable Assurances" sections of the TMDL.*

b. p88, "Even low flows can cause bedload movement, particularly in the steepest, most incised stream reaches."

Ecology response: *Movement of bedload of non-cohesive sediments (e.g., sand) will occur only at low flows. However, cohesive organic sediments will be of greater concern for SOD, elodea growth, and the transport of nutrients. Such cohesive sediments are typically characterized by a critical shear stress and threshold of incipient motion below which erosion of bedded sediments does not occur.*

c. p85, "As a result, a more effective way to limit plant growth would be to restrict phosphorus."

Ecology response: *Ecology agrees that restricting phosphorus is an important part of the strategy for limiting elodea growth. That is why the implementation focuses in part on the treatment of stormwater, which will remove both sediment and sediment-associated phosphorus loads.*

Comment 5: Do we really understand the DOD sources of the Clarks Creek?

a. p52, "PTI found that the accumulation of oxygen-demanding conditions in the creek increased over the winter storm season indicating that factors like community substrate oxygen demand (CSOD; including both SOD and demand generated within the Elodea mats) and the volume of other oxygen-stripping pollutants have increasing effects." What are those oxygen-stripping pollutants? What is the impact of Elodea growth and decay? Does groundwater discharge to streams increase during storm season?

Ecology response: *The use of the term "oxygen stripping pollutants" is imprecise. This text was replaced with the sentence "Through the winter season sampling, PTI found that diminished dissolved oxygen concentrations during higher flows indicate that a combination of pollutants transported into the creek has a measurable effect and may be cumulative over time."*

b. p53**,** "Low DO occurred at the upstream SW-4 location consistently across the four storm events, and instream DO concentrations were generally lower or similar to DO concentrations in the stormwater output. This location is downstream of a park at 12th Avenue approximately where the stream meets the alluvial plain. The cause of the low DO concentrations is unclear at this location. Much of the

c. Correlation between high flow and high DOD is found (Fig. 16), but what are the causes for this relationship? Is that because high oxygen depletion, low oxygen inflow stormwater and groundwater or a relatively low reaeration area due to large amount of water flowing through the channel?

Ecology response: *The relationship between high flow and high DOD is evaluated based on flow simulated for the same date as the DOD measurements. Groundwater effects are expected to be comparatively low during high flow events and would likely not affect this relationship. It is unclear what the commenter means by "high oxygen depletion." Reaeration rates are higher instream during energetic flow events, but are expected to be much less within closed storm drains compared to open channels, and high flows are associated with flow contributed by storm drains. Elodea growth in the channel reduces re-aeration capacity; however, this reduction in re-aeration capacity from Elodea is not exclusive to high flow events. Overall, the relationship between high flow and high DOD is attributed to high DOD in stormwater inflow and the accumulation of oxygen demanding substances instream during the wet season.*

d. p35, "For the locations studied in 2011 through 2012, PTI found that the long-term, cumulative effects of stormwater on instream DO were evident because of increasing levels of pollutants during each storm event." Have not we related the low DO to high flow already? Applying multiple regression techniques on time and flow may be necessary.

Ecology response: *The relationship between DO and flow has been demonstrated in several ways, including through the calibrated QUAL2Kw models and in the analysis of continuous DO monitoring by PTI. Additional multiple regression analyses might be of interest, but would generally provide evidence of correlation, not causation.*

e. p35, "In contrast, individual outfalls with relatively low DO concentrations did not appear to strongly impact instream DO concentrations during storm events, apparently because the incremental flow from individual outfalls was small relative to total flow in the creek. Since only four locations were sampled, it is possible that acute impacts may occur at other locations in the watershed." Would not we need further study to find the possible acute impacts before we uniformly treat all the stormwater?

Ecology response: *This paragraph goes on to explain: "these findings suggest that management of the long-term effects of stormwater could be more effective at addressing DO impairments. The monitoring data from 2010 combined with this more recent study provide clear evidence that DO concentrations are consistently low during storm events and a general decline occurs as flows increase throughout the wet season, indicating that stormwater has a cumulative effect on DO concentrations during the winter."*

f. What would be the reason for the spikes mentions on p55, "The majority of the samples collected were below detection limits of 2 mg/L. BOD-5 concentrations were consistently below 10 mg/L for the February 17, 2012, March 13, 2012, and March 29, 2012 rainfall events and did not show any distinctive patterns. The November 16, 2011 rainfall event resulted in much higher BOD-5 concentrations at SW-3. This rainfall event was a low intensity, short duration event which resulted in peak BOD-5 concentrations at SW-3 of 129 mg/L in the outfall discharge and 348 mg/L downstream of the outfall. BOD-5 concentrations were also elevated above the SW-3 outfall at a peak concentration of 28.1 mg/L. An elevated BOD-5 concentration at SW-4 was also measured at the outfall (10.8 mg/L); however there were no measurable effects in the stream downstream of the outfall."

Ecology response: *The spikes in BOD-5 associated with SW-3 might be the result of stagnant water being pumped from the holding tank that discharges to Meeker Ditch when full. The BOD-5 spike at SW-4 was much less pronounced and could be due to flushing of accumulated materials and stagnant water in storm drains, catch basins, etc.*

Comment 6: Both the DOD and sediment loads are allocated based on the proportion of stormflow generated from the HSPF model. Does the model really reflect the proportion of stormwater generated?

a. P35**,** "First, a watershed model was developed by Tetra Tech (2012a) using EPA's Hydrological Simulation Program FORTRAN (HSPF). This model was developed for PTI as part of a sediment study to support TMDL development and the selection of sediment reduction measures. The HSPF model was used to predict flow and sediment loading to quantify the sediment loading capacity. The HSPF model outputs provide information on the critical storm conditions and the amount of flow each jurisdiction generates. The HSPF model output was also used to allocate both the DOD and sediment loading capacity by jurisdiction based on the proportion of stormflow generated."

b. On p6-17 of Appendix C, "The model appears to over predict the results from the gage, which had a daily average flow of only 138 cfs and a peak of 165 cfs on 10/21. However, instantaneous flow measurements made downstream at 56th Street during water quality sampling reported 279 cfs on this day, in line with the model predictions." Obviously, the model was not able to capture the dramatic flow increase between Tacoma Road USGS gauging station and 56th Av. observation point for the 10/21/2003 event.

c. Does the model really reflect groundwater impact on stream flow in Clarks Creek? Preliminary study of the USGS MODFLOW model (USGS 2010) showed that about 1/3 of the increase flow between Tacoma Road USGS Gauging Station to 56th Av. observation point were from groundwater.

Ecology response: *These issues are discussed in more detail in Attachment 3. Please refer to the response to Attachment 3.*

Comment 7: Reference conditions set the bar for the TMDL. Documents showing analysis for the reference conditions need to be available and reviewed. Where can we find the published document for it?

a. p82, "Figure 43 also provides the 90th percentile percentage of fines and percentages of fines and sands in reference streams, which support aquatic life use. The TMDL study used the 90th percentile as a conservative statistic to represent the lower end of sediment values in a reference stream to account for uncertainties and variability in reference sites"

b. p83–84, "EPA selected eight of these streams with B-IBI data with similar geological conditions to Clarks Creek that could provide a comparison as a reference condition …. Between 2009 and 2011, 13 B-IBI surveys were conducted on Big Beef, Chuckanut, Coal, Griffin, Surveyor, Dewatto, and Candall Creeks in addition to a Coulter Creek tributary (Hayslip, 2013)."

c. Where can we find Hayslip, G. 2013 (Memo from Gretchen Hayslip, EPA, to Jennifer Wu, EPA, re: Puget Sound Lowlands Reference Sites)?

Ecology response: *We have made this available on the Clarks Creek TMDL website.*

Comment 8: What is the logic behind the 64% reduction of the fines and sands?

a. p105, "Clarks Creek-09, the sediment sampling site closest to 66th Avenue, has the highest percentage of fine sediments and sands (100%) likely due to physical features that cause high amounts of sediment deposition. In contrast, the 90th percentile of Puget Sound lowland reference stream values, which reflect a healthy stream habitat, for percentage of fine sediments and sands is 36%. Therefore, the percentage of sands and fines that would need to be reduced from current conditions is 64%."
b. Comments for a, without higher stream flow than current conditions, it is not possible for the stream to carry gravels to the Clarks Creek-09 site. Event we did reduce 64% of the fines and sand from stormwater that cloud flow into Clarks Creek, sediment deposited at the Clarks Creek-09 site would still be 100% fines and sand if we would not allow higher stream flow going through the stream.
c. p106, "In the mainstem of the Clarks Creek, sediment composition averages roughly 65% fines and sands at 10 sites. Tributaries to Clarks Creek have fines and sands that range from 28%-48%." "Since fines and sands comprise the bulk of the sediment composition, particularly in the mainstem Clarks Creek, and since fines and sands are the primary sediment size that harms fish and aquatic life use, reducing 64% of the sediment load will also reduce 64% of fines and sand."
d. Comments on a and c, it seems that we are seeking to change the composition of stream bed sediments. However, without higher flows flushing out the fine deposits from the stream bed, we may have excessive fines on more sites. The proposed implementation target of this TMDL (pxii, "Reduce 50% of stormflow volume or treat 50% of untreated stormwater") would reduce high flows at Clarks Creek and may cause less desirable sediment composition at stream beds.

Ecology response: *See attachment 1, comment 120.*

Comment 9: Does not the uncertainty of the DOD sources render this TMDL high risk associate with high cost? It seems we need further study or some pilot projects to better understand the mechanism of the low DO in Clarks Creek before we jump into the costly remediation projects.

a. If we are to change current hydrological regime of the Clarks Creek by infiltrating 50% stormwater, do we have knowledge for the targeted hydrological regime? Do we know the consequences of this change to the habitat and biota of the streams and the water quality implications for groundwater?

Ecology response: *The reduction in streamflow would return Clarks Creek closer to natural, pre-development hydrologic conditions, which would not be a cause of biological impairment.*

b. Without high flows flushing out the fine sediments, would not fine sediments deposit on the other areas and cause further degradation of the stream beds?

Ecology response: *Such degradation would occur if excess sediment loads are not mitigated. Implementation is expected to include significant amounts of stormwater treatment that will reduce external sediment loads, while reduction in peak flows will lower rates of bank erosion.*

Attachment Three

Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL
Flaws with Basing Model on October 21, 2003 Storm Event and Failure of Lack of Quantifying Groundwater

The storm event on October 21, 2003

The storm event on 10/21/2003 is used as critical DO depletion conditions for DOD load and wasteload allocations. The event is a countywide heavy rain event that left a record in NOAA Storm Events Database with about $800,000 property damage (http://www.ncdc.noaa.gov/stormevents/).

The following are "Episode Narrative" for the event from the database (http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5371177):

"An all time daily record rainfall total was set at SeaTac Airport with 5.02 inches. Other daily records were set at Shelton with 7.20", Hoquaim with 5.39" and Olympia with 4.12". Almost all reporting stations had at least 2 inches of rain in the 24 hour period from midnight to midnight. Two sinkholes, one in Clallam and one in Mason County, damaged roads and cut off access to homes. In all, nearly 50 homes suffered damage from minor flooding especially in basements and garages. Traffic snarls were common as many roads throughout the region were temporarily closed. The national parks and forests suffered fairly extensive damage to several bridges and many trails or the roads that leading to the trails."

During the storm, daily average stream flow of the Clarks Creek at the USGS Gauge at Tacoma Road near Puyallup was 138 cfs (Fig. 1, 2) with a peak flow of 173 cfs (Fig. 3). Instantaneous flow measurements during water quality sampling made downstream at 56th Street, Puyallup (Fig. 1) reported 279 cfs on that day. Field measured DO concentrations declined steadily downstream, with a minimum of 4.83 mg/L below the Puyallup Tribal Hatchery.

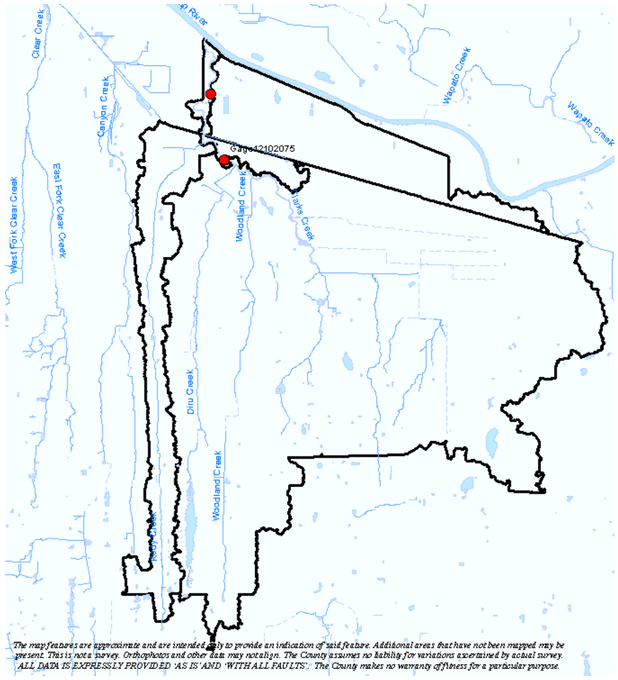


Figure 1. Clarks Creek Watershed and the two stream flow measurement locations for the event on
October 21

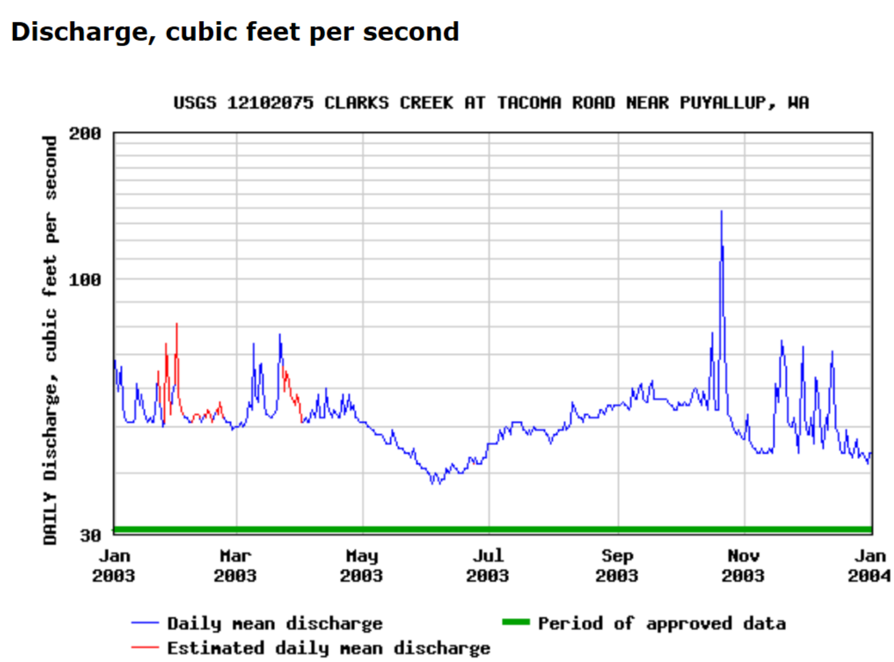


Figure 2. Clarks Creek daily average stream flow at the USGS gauging station

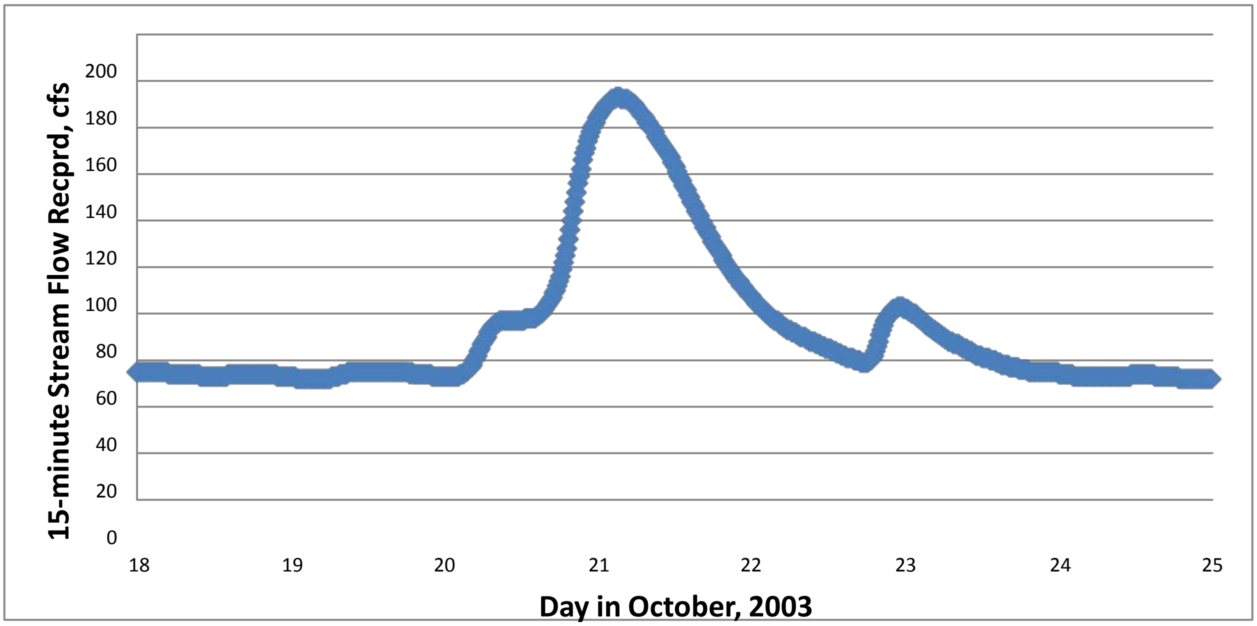


Figure 3. Clarks Creek instantaneous Stream Flow at 15-minute interval at the USGS gauging station

In the Clarks Creek TMDL study, the HSPF model (Tetra Tech, 2012a) was used to simulate storm events over a 50-year period from January 1960 to March 2010. Based on the flow-duration curve created using the daily output from the HSPF model, the 138 cfs flow of 10/21/03 is predicted to be an event of a recurrence interval of 2 years. According to 17 years USGS stream flow gauging station data available for the Tacoma road station, the flow on 10/21/03 has a recurrence interval of 1 year based on annual maximum series analysis (Table 1).

Table 1. Stream Flow Annual Maximum Series at USGS Gauging Station at Tacoma Road

Water Year	Maximum Daily Avg. Flow (cfs)	Max. Flow Date	Records Count	Annual Daily Avg. Flow (cfs)	Rank	Recurrence Interval
2007	272	11/7/2006	365	66	1	18.0
1996	190	2/9/1996	366	60	2	9.0
2014	170	2/17/2014	265	63	3	5.7
1997	168	12/30/1996	365	74	4	4.0
2008	165	12/3/2007	366	56	5	3.0
2002	152	11/14/2001	365	55	6	2.3
1999	150	11/26/1998	365	67	7	1.9
2013	142	11/19/2012	365	65	8	1.5
2005	140	1/18/2005	365	46	9	1.2
2004	138	10/21/2003	366	46	10	1.0
2006	136	1/11/2006	365	49	11	0.8
2000	134	11/12/1999	366	63	12	0.7
2011	125	5/15/2011	365	37	13	0.5
1998	116	10/30/1997	365	68	14	0.4
2012	113	1/21/2012	366	63	15	0.3
2001	82	11/8/2000	365	53	16	0.3
2003	81	1/31/2003	365	52	17	0.2

Though the daily average stream flow (138 cfs) on 10/21/2003 is a two- or one-year recurrence flow, the rainfall event for the flow is an extreme event. According to the 71 years observation records from the McMillin Reservoir Climate Station, the 24-hour precipitation on 10/21/2003 has a recurrence interval of 23 years based on annual maximum series analysis (Table 2). Considering that the recurrence frequency of the 24-hour precipitation of the event is much smaller than two-year occurrence events, most likely the event would not be representative for the DO and sediment load condition at the watershed scale. Using this event as the critical event for TMDL allocation may lead to insufficient understanding of the contributing sources for setting TMDL target.

Table 2. Daily Precipitation Annual Maximum Series at McMillin Climate Station

Water Year	Maximum Precipitation Daily (in)	Max. Precip. Date	Records Count	Annual Precipitation (in)	Rank	Recurrence Interval
2007	3.59	20061107	365	52.5	1	72.0
1987	3.52	19861124	365	39.2	2	35.5
2004	3.07	20031021	366	44.0	3	23.3
1960	3.06	19591121	366	46.1	4	17.3
1996	2.72	19960208	366	56.7	5	13.6
1999	2.71	19981126	365	54.2	6	11.2
1975	2.67	19741227	365	44.8	7	9.4
1991	2.60	19910405	365	48.3	8	8.1
2009	2.50	20090107	361	45.2	9	7.1
1990	2.40	19900109	365	46.5	10	6.3
2005	2.37	20050118	365	38.6	11	5.6
2002	2.35	20011114	365	45.4	12	5.1
1942	2.22	19411219	365	29.9	13	4.6
1951	2.20	19510209	365	46.0	14	4.2
2008	2.09	20071203	366	37.2	15	3.9
1963	2.00	19621120	365	40.8	16	3.6
1995	2.00	19941227	334	44.3	17	3.3
1964	1.99	19640125	366	43.3	18	3.1
1954	1.95	19540122	365	48.0	19	2.8
1983	1.95	19830830	365	48.4	20	2.7
2000	1.95	19991112	366	47.4	21	2.5
1961	1.94	19601120	365	46.8	22	2.3
1968	1.94	19680602	366	44.4	23	2.2
2011	1.94	20110515	365	51.8	24	2.0
1947	1.93	19461118	365	37.2	25	1.9
1980	1.93	19791202	366	42.5	26	1.8
1984	1.90	19840125	366	44.2	27	1.7
1993	1.87	19930323	365	37.8	28	1.6
1948	1.86	19480322	366	47.7	29	1.5
1965	1.86	19641124	365	40.8	30	1.4
1950	1.83	19500120	365	47.2	31	1.4
1997	1.82	19961229	365	60.4	32	1.3
1978	1.81	19780923	365	43.7	33	1.2
1982	1.80	19811006	365	46.0	34	1.1
1946	1.78	19460709	365	41.7	35	1.1
1959	1.75	19581019	365	48.0	36	1.0
2006	1.75	20060130	365	44.1	37	1.0
1971	1.72	19701206	365	46.3	38	0.9
1998	1.65	19971030	365	36.7	39	0.9
2012	1.63	20111123	365	46.0	40	0.8
1956	1.61	19551211	366	49.8	41	0.8

Water Year	Maximum Precipitation Daily (in)	Max. Precip. Date	Records Count	Annual Precipitation (in)	Rank	Recurrence Interval
1986	1.60	19860119	365	41.6	42	0.7
1988	1.60	19871210	366	37.3	43	0.7
1979	1.53	19781103	365	34.6	44	0.7
1967	1.51	19670622	365	40.3	45	0.6
1972	1.51	19720305	366	53.2	46	0.6
1981	1.50	19801107	365	44.7	47	0.6
1992	1.48	19920128	366	35.1	48	0.5
1969	1.46	19690918	365	43.3	49	0.5
1949	1.44	19490210	365	33.4	50	0.5
1977	1.44	19770824	365	28.1	51	0.4
1976	1.42	19760808	366	49.7	52	0.4
2010	1.42	20091117	365	50.5	53	0.4
1945	1.39	19450904	365	32.8	54	0.4
1955	1.38	19550208	365	34.4	55	0.3
1958	1.38	19580124	365	36.8	56	0.3
1943	1.35	19421123	359	33.2	57	0.3
1985	1.35	19850607	365	31.9	58	0.3
1974	1.32	19731109	365	50.7	59	0.2
1957	1.31	19561117	365	40.0	60	0.2
1973	1.29	19721226	365	31.3	61	0.2
1994	1.27	19940303	365	31.3	62	0.2
2001	1.22	20010411	365	34.5	63	0.2
1989	1.20	19881123	365	39.3	64	0.1
1970	1.18	19700216	365	34.7	65	0.1
1962	1.17	19611122	365	34.3	66	0.1
2003	1.17	20030131	365	31.6	67	0.1
1953	1.14	19530117	365	37.2	68	0.1
1952	1.09	19520204	366	28.9	69	0.1
1966	1.08	19651005	365	38.8	70	0.0
1944	0.98	19431011	365	25.1	71	0.0

TMDL Modeling

The TMDL p35 states "The HSPF model was used to predict flow and sediment loading to quantify the sediment loading capacity. The HSPF model outputs provide information on the critical storm conditions and the amount of flow each jurisdiction generates." The event on 10/21/2003 was selected to represent critical conditions for achieving the DO criterion. However, the HSPF modeling study for the TMDL overpredicted the stream flow at Tacoma Road gauging station and did not capture the observed dramatic flow increase between the USGS gauging station at Tacoma Road and the observation point at 56th Ave.

On p6-17 of Appendix C, figure 6-20 of the document (Fig. 4) shows the HSPF predicted peak flow around 340 cfs and it is reported: "In Pierce County, 5.7 inches of precipitation was recorded at McMillin Reservoir on this date and 3.7 inches at WSU, with approximately another 0.5 inches on the following day. The model appears to overpredict the results from the gage, which had a daily average flow of only 138 cfs and a peak of 165 cfs on 10/21. However, instantaneous flow measurements made downstream at 56th Street during water quality sampling reported 279 cfs on this day, in line with the model predictions. If both gage records are accurate this storm may have been spatially heterogeneous, with more intense rainfall on the downstream portions of Clarks Creek."

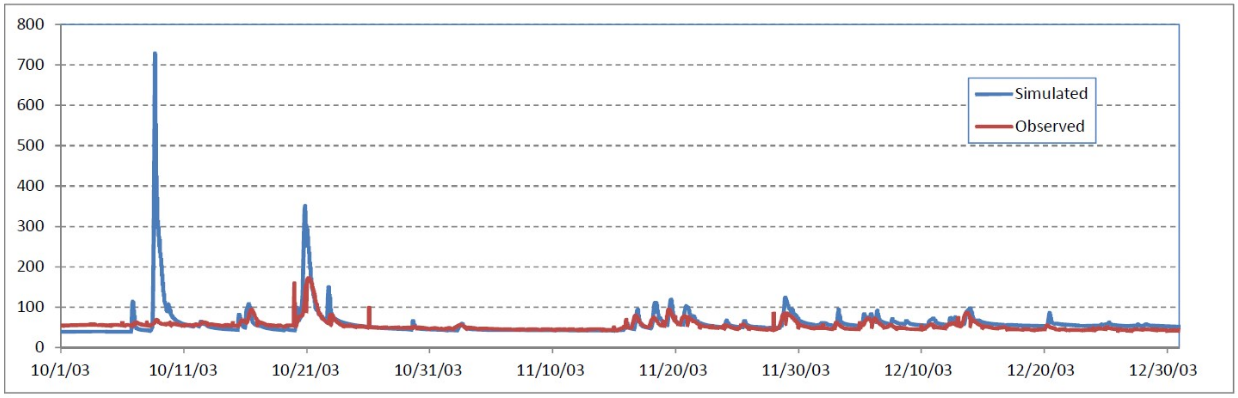


Figure 6-20.   Hourly Flow Prediction for Clarks Creek at Tacoma Rd., Fall 2003

Figure 4. Figure 6-20 in Appendix C of the TMDL

According to the climate records downloaded from NOAA National Climate Data Center (http://www.ncdc.noaa.gov/cdo-web/datatools/findstation) and WSU AgWeatherNet (http://weather.wsu.edu/awn.php?page=historicData) Total precipitation observed during October 20–22 (the event period observed from the stream flow at the USGS gauging station, Fig. 3) were 4.70 in at WSU Puyallup weather station and 3.67 in at Mc Million Reservoir weather station (Fig. 5). Figure 6 shows the 15-minute observation data collected from WSU Puyallup Climate Station around the event. The TMDL modeling study used precipitation values from WSU weather station during the event.

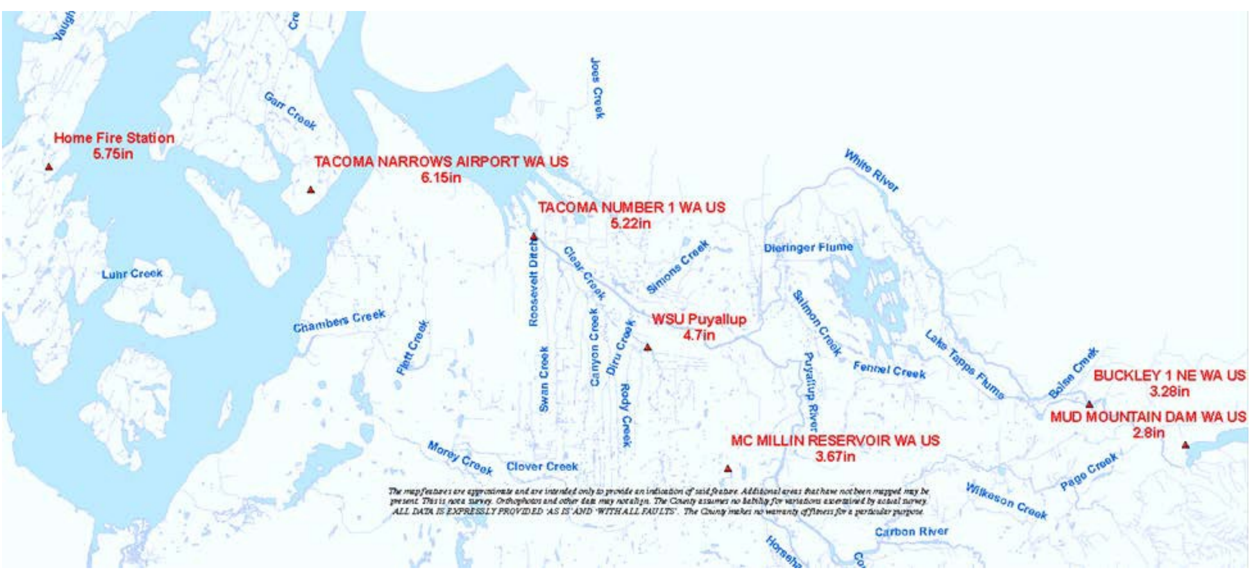


Figure 5. Precipitation observed at the weather stations within and around Clarks Creek watershed during October 20–22

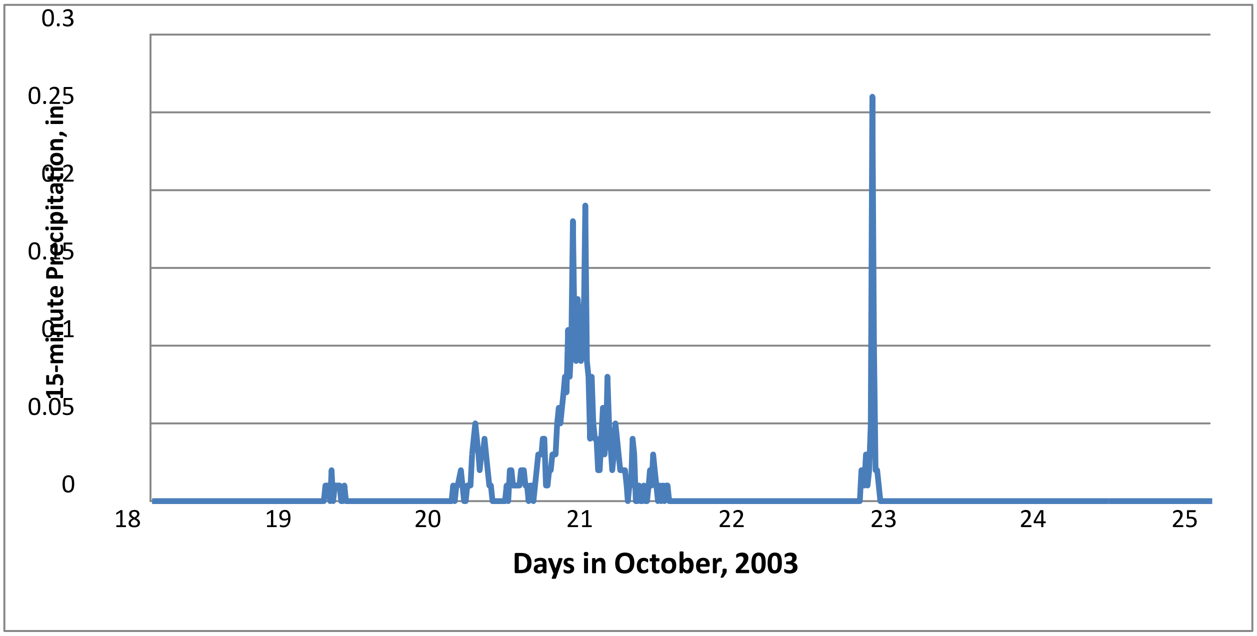


Figure 6. Precipitation at 15-minute interval measured at WSU Puyallup Climate Station

The hydrograph above the base flow line during the event can be simplified as a triangular shape with duration of 2.5 days and a height of peak flow minus base flow. If we assume base flow would not change during the event on 10/21/2003, and the single observation (279 cfs) at 56th Street, Puyallup was the peak flow, the stream flow increase between the two monitoring points can be calculated using eq. 1. The increased flow volume for the whole event is 11.4 million cubic ft, on average flow rate increases 53 cfs from Tacoma Road gauging station to 56th Ave. The increased stream flow value is more than 1/3 of the daily average flow observed at the Tacoma Road gauging station and this value would be greater if the observed value at the 56th Street, Puyallup is not the peak flow as assumed.

$$\Delta V = \frac{1}{2} * 2.5d * \frac{86400s}{d} * \frac{(279-173)ft^3}{s} = 11.4 \times 10^6 ft^3 \qquad (1)$$

For DO TMDL allocation, QUAL2Kw modeling results for 10/21/2003 were used. However, QUAL2Kw model simulation was conducted with high uncertainty. On pB-168, it states that the significant unknown factor for the DO balance is sediment oxygen demand (SOD), and a calibrated SOD rate of 8 g- O^2/m^2/d is used for the model. SOD data collected later (Appendix E) shows that field measured SOD and CSOD have a range of 1.58–4.71 g-O^2/m^2/d, which is much smaller than 8 g-O^2/m^2/d used in the model. A SOD value of 8 g-O^2/m^2/d is roughly corresponding to 3.24 mg/l DO for a flow of 50 cfs.

In addition, the 2010 draft QUAL2Kw Modeling Report from Tetra Tech to USEPA Region 10 reported that dissolved oxygen is markedly over-estimated for the 10/21/2003 event and concluded that additional sources of DO deficit appears to exist. Sensitivity analysis of the QUAL2Kw model for 10/21/2003 showed that an equivalent CBOD5 concentration of about 190 mg/L to the diffuse flows as well as to the flow from the State Hatchery and Meeker Ditch would be required to replicate observations However, the range of 100 – 300 mg/L CBOD5 is expected in raw sewage.

Groundwater discharge to the stream

Surface water and groundwater interaction plays an important role in the Clarks Creek Watershed, however, the impact of groundwater on stream water DO is not explicitly quantified in the TMDL study. The following are hydrogeology description from "Water quality in the lower Puyallup River valley and adjacent uplands, Pierce County, Washington" (USGS, 1987).

"*The aquifers in the alluvium are separated by discontinuous confining beds of silt, or silt and clay. Some recharge of the shallow, unconfined aquifer occurs by upward leakage from underlying confined aquifers (Fig. 7). Some of the highest yielding wells in the valley penetrate through the alluvial sediments and tap sand-and-gravel glacial sediment. In the alluvial sediments, the water table remains at shallow depths throughout the year. During periods of high river stage, some water moves from the river into alluvial sediments, but during lower river stages, ground water discharges into the river. The deeper aquifers generally have heads slightly higher than shallow alluvial aquifers. Shallow water not discharged to the river moves down valley. The deeper artesian aquifers discharge into the alluvial sediments and into Puget Sound at the mouth of the Puyallup River valley.*"

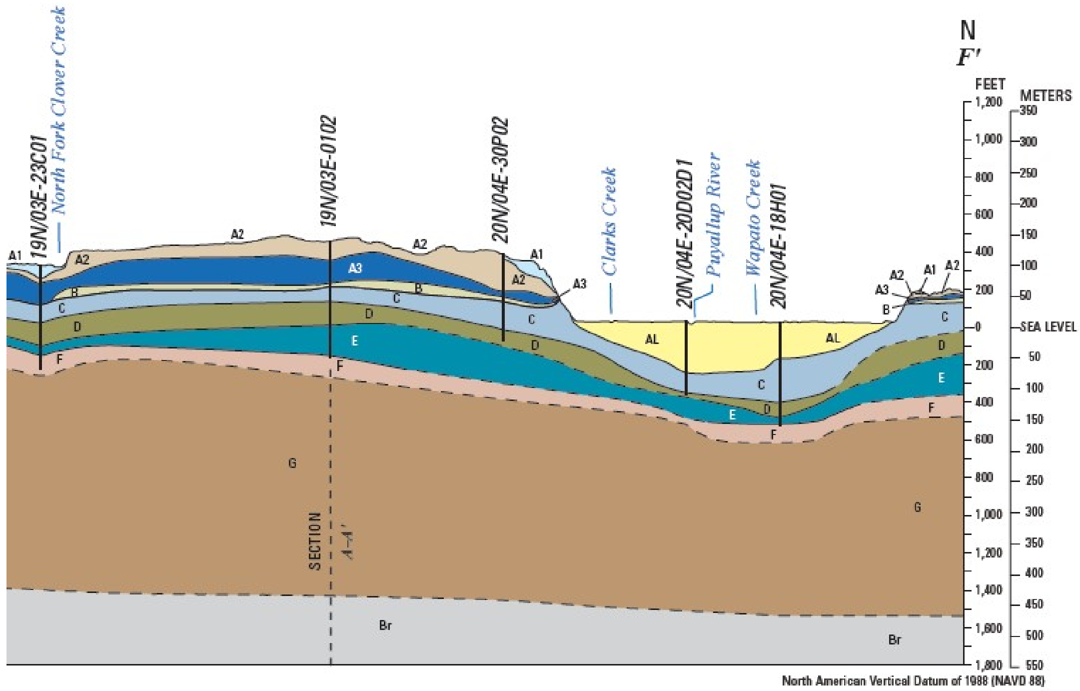


Figure 7. South-North cross section of hydrogeologic units from USGS 2010 "Hydrogeologic framework, groundwater movement, and water budget in the Chambers-Clover Creek Watershed and vicinity, Pierce County, Washington"

Groundwater table along the Clarks Creek at the Puyallup River valley (25.1–28.8 ft, Fig. 8) is higher than the water level in the stream (around 22 ft, Fig. 9). Preliminary water balance estimation using Modflow Zone Budget based on the USGS groundwater model for the Chambers-Clover Creek Watershed and vicinity showed that groundwater discharge to the main stream of the Clarks Creek below the USGS station and discharge to the Rody Creek near its confluence to Clarks Creek amount up to 17.4 cfs, about 1/3 of the increased stream flow (53 cfs) between the two monitoring points during the event on 10/21/2003.

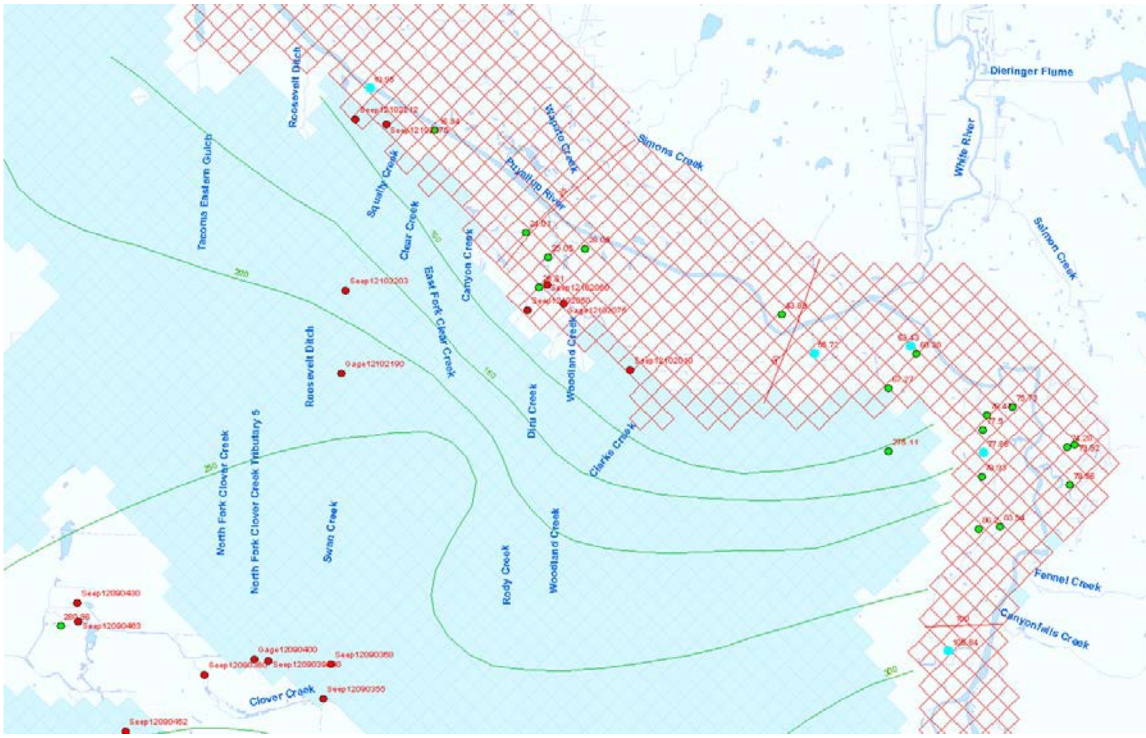


Figure 8. Groundwater contour for the C aquifer and AL aquifer

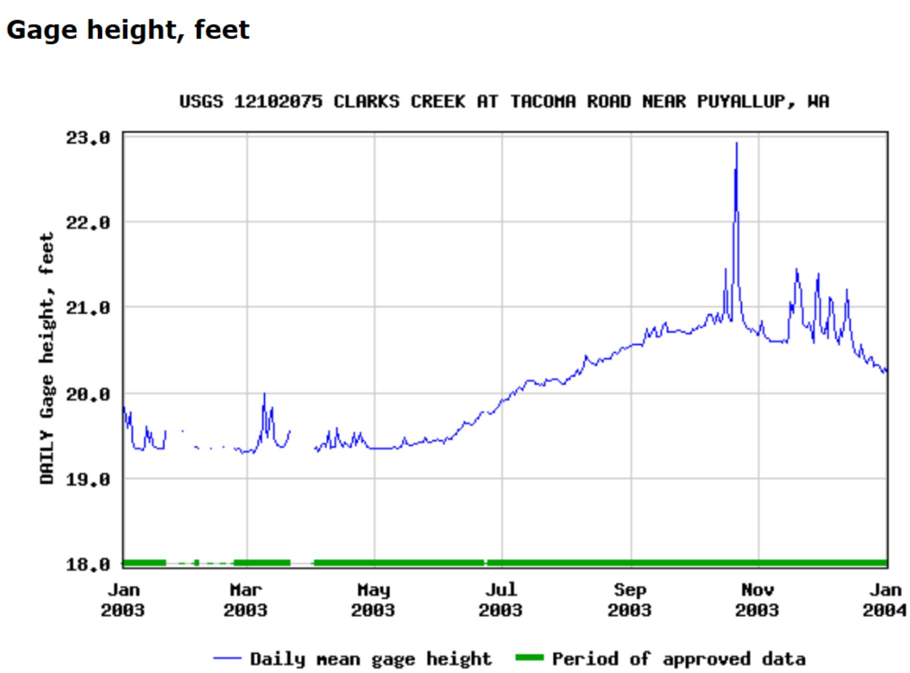


Figure 9. Clarks Creek daily mean gaging height at the USGS gauging station

Fig. 10 shows the USGS 2011 MODFLOW model river cells and zones for Rody Creek and Clarks Creek main stem between the USGS Gauging station at Tacoma Road and the monitoring point at 56th ST, Puyallup that are used for Zone budget estimation, and Fig. 11 shows Zone budget results from MODFLOW run for steady state of the USGS model. Groundwater discharge to the river is $(0.718+0.787)*10^6$ ft^3/D, which is about 17.4 cfs.

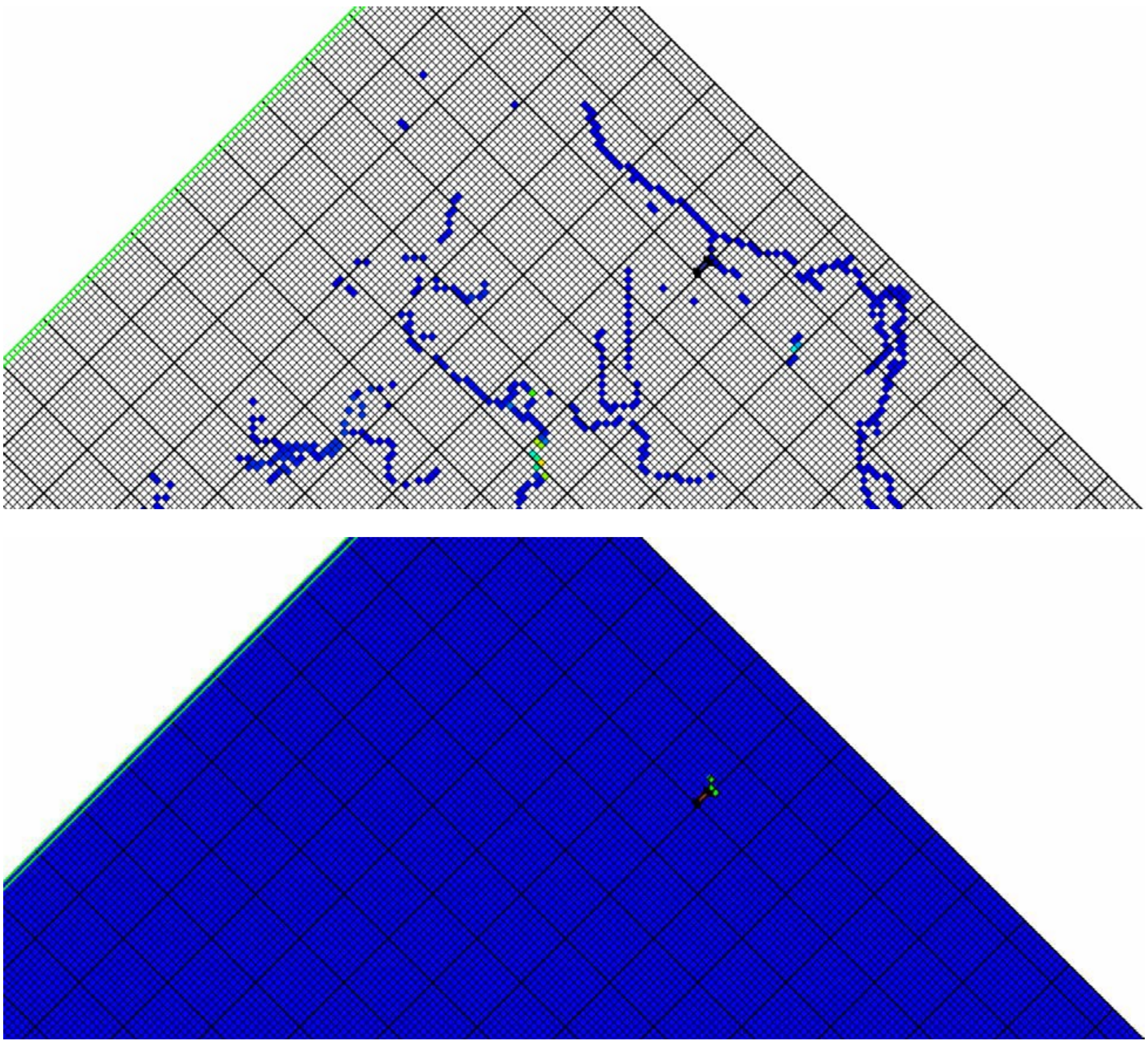
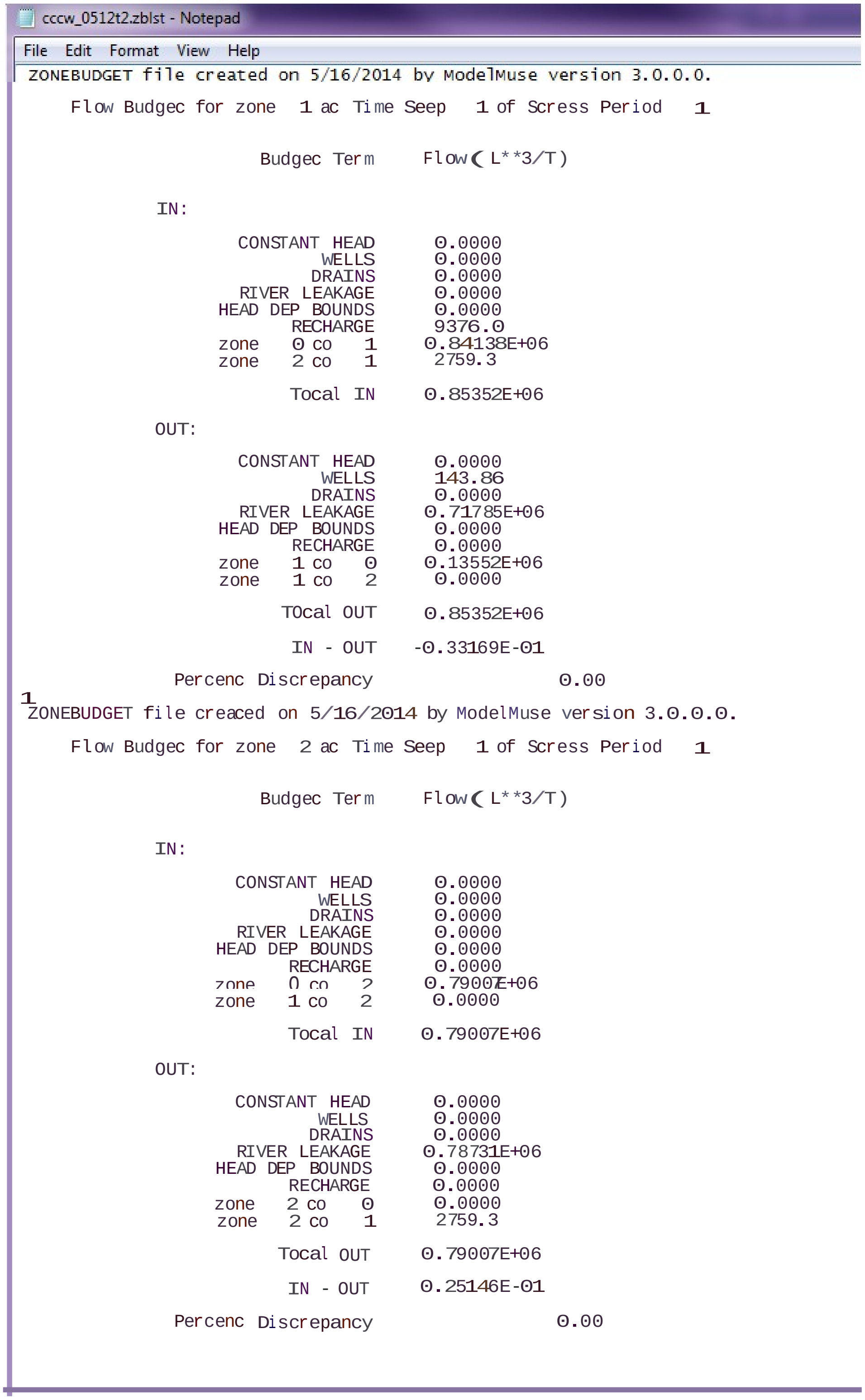


Figure 10. River Cells of the USGS MODFLOW Model and Zones for Zone Budge Analysis



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cccw_0512t2.zblst - Notepad
File  Edit  Format  View  Help
ZONEBUDGET file created on 5/16/2014 by ModelMuse version 3.0.0.0.
    Flow Budgec for zone  1 ac Time Seep   1 of Scress Period   1

                Budgec Term     Flow(L**3/T)


          IN:

               CONSTANT HEAD      0.0000
                       WELLS      0.0000
                      DRAINS      0.0000
               RIVER LEAKAGE      0.0000
             HEAD DEP BOUNDS      0.0000
                    RECHARGE      9376.0
             zone   0 co   1     0.84138E+06
             zone   2 co   1      2759.3

                    Tocal IN     0.85352E+06

          OUT:

               CONSTANT HEAD      0.0000
                       WELLS      143.86
                      DRAINS      0.0000
               RIVER LEAKAGE     0.71785E+06
             HEAD DEP BOUNDS      0.0000
                    RECHARGE      0.0000
             zone   1 co   0     0.13552E+06
             zone   1 co   2      0.0000

                   TOcal OUT     0.85352E+06

                    IN - OUT    -0.33169E-01

            Percenc Discrepancy              0.00
1
ZONEBUDGET file creaced on 5/16/2014 by ModelMuse version 3.0.0.0.
    Flow Budgec for zone  2 ac Time Seep   1 of Scress Period   1

                Budgec Term     Flow(L**3/T)


          IN:

               CONSTANT HEAD      0.0000
                       WELLS      0.0000
                      DRAINS      0.0000
               RIVER LEAKAGE      0.0000
             HEAD DEP BOUNDS      0.0000
                    RECHARGE      0.0000
             zone   0 co   2     0.79007E+06
             zone   1 co   2      0.0000

                    Tocal IN     0.79007E+06

          OUT:

               CONSTANT HEAD      0.0000
                       WELLS      0.0000
                      DRAINS      0.0000
               RIVER LEAKAGE     0.78731E+06
             HEAD DEP BOUNDS      0.0000
                    RECHARGE      0.0000
             zone   2 co   0      0.0000
             zone   2 co   1      2759.3

                   Tocal OUT     0.79007E+06

                    IN - OUT     0.25146E-01

            Percenc Discrepancy              0.00
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Figure 11. MODFLOW Zone Budget Results

Stream flow water temperature analysis corroborates significant groundwater discharge during the event on 10/21/2003. The observed stream flow water temperature is 16 ˚C below the tribal hatchery, the maximum and minimum air temperature for the day observed at the McMillin Reservoir Climate Station are 21.1 ˚C and 16.1 ˚C respectively, and the groundwater temperature is about 12 ˚C based on the observations in the USGS study at 1987 (Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington). The average daily temperature can be roughly estimated as the average of the daily maximum and minimum, which is 18.6 ˚C. Assuming surface water has a temperature that is equal to air temperature, the portion of ground water in the flow can be estimated using eq. 2, which is about 40% of the total stream flow.

$$12 * \text{groundwater ratio} + 18.6 * (1- \text{groundwater ratio}) = 16 \qquad (2)$$

The groundwater ratio of 0.4 estimated from water temperature has a similar magnitude with the value of 1/3 from MODFLOW zone budget.

Groundwater DO concentration for the Alluvial Aquifer with a range of 0.2–0.8 mg/l was observed around Clarks Creek in the USGS (1987) study “Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington”. If we assume 1/3 of the stream flow on 10/21/2003 was from groundwater, then groundwater contributes a DOD of 3 mg/l approximately.

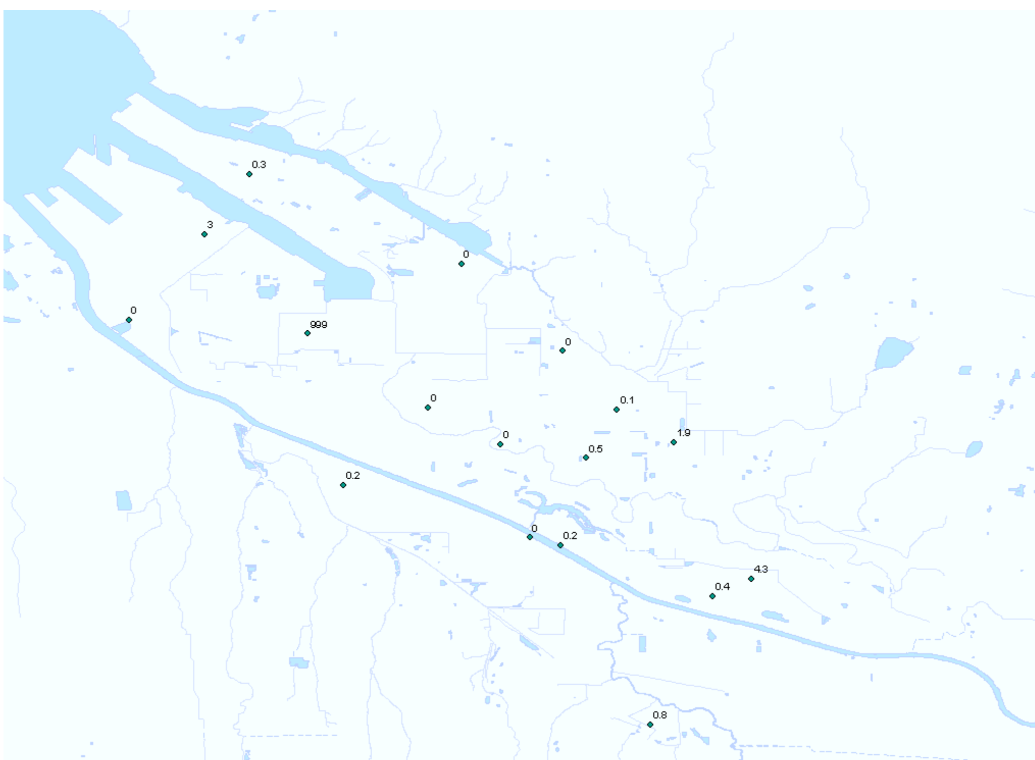

Figure 12. Alluvial Aquifer DO Concentration in mg/l from USGS (1987) study “Water Quality in the lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington”

Ecology response:

The storm event on October 21, 2003

The TMDL uses monitored conditions for the storm of 10/21/2003 as critical conditions for the development of the TMDL. This is selected as the critical condition because, among events monitored, it is the event for which the greatest reduction in DOD loading is needed. It should be noted that the smaller storm event on 9/12/2003 would produce similar required loading reductions.

Pierce County emphasizes that this was an extreme rainfall event, with a daily record rainfall total set at SeaTac Airport of 5.02 inches and 3.70 inches in the Clarks Creek rainfall series from WSU. As noted in the TMDL and confirmed by Pierce County's analysis, flows in Clarks Creek itself were not that extreme, with a recurrence interval of only 1 – 2 years.

It is appropriate for the TMDL to consider responses during a full range of events as the TMDL is based on the loading capacity, which is defined as "The greatest amount of loading that a water can receive without violating water quality standards" (40 CFR 130.2(f)). Water quality standards were violated during this event, and the loading capacity calculation must reflect this. The volume of flow during this event results in a requirement for a large reduction of DOD mass; however, as noted above, the percentage reductions required appear approximately consistent across a range of events and similar DO concentration responses during fall-winter storm events of a variety of sizes have subsequently been reported during monitoring in 2011-2012.

Refer also to additional issues discussed under "DO Modeling Concerns" in the response to Pierce County's cover letter.

TMDL Modeling

The comments note that the HSPF model over-predicted flow at the Tacoma Road gauging station during the 10/21/2003 event and did not capture the flow increase between Tacoma Road and the water quality observation point at 56th Avenue. The comments imply that this is calls into question the TMDL analysis, citing p. 35 of the TMDL which states "The HSPF model was used to predict flow and sediment loading to quantify the sediment loading capacity. The HSPF model outputs provide information on the critical storm conditions and the amount of flow each jurisdiction generates."

The argument that is made here is misleading. In the first place, it is the QUAL2Kw modeling analysis of the 10/21/2003 event that is used to establish the overall loading capacity for the TMDL and the corresponding needed load reductions. The QUAL2Kw analysis uses observed flows in the system and does not in any way depend on the HSPF modeling.

The role of the HSPF watershed model in the cited section of the TMDL is to determine the relative proportions of flow associated with each jurisdiction, not to predict the instream DO response. Because it is the relative amount of flow that is used to distribute the loading capacity to individual jurisdiction allocations some uncertainty regarding the absolute total flow prediction is inconsequential to the TMDL. That is, the purpose of the HSPF analysis of this event is to estimate the fraction of total flow that originates from each jurisdiction. This is largely a function of the distribution of impervious areas and low permeability soils. Responses to rainfall events of different magnitudes will provide a similar distribution of the fractional flow contribution.

Groundwater Discharge to the Stream

Pierce County provided estimates of groundwater discharge to Clarks Creek during the 10/21/2003 event based on a "preliminary water balance estimation" using the USGS MODFLOW groundwater model for the Chambers-Clover Creek Watershed (Johnson et al., 2011). These model runs have not been made available to us, nor has any formal documentation or calibration information been released as to performance under individual transient storm events.

It should be noted that the MODFLOW application is a large scale model that is not explicitly focused on Clarks Creek, but does include the Clarks Creek domain. The model was calibrated by USGS to observed head elevations in the aquifers and also to stream discharge, but the stream discharge calibration targets are average discharge and transient baseflow discharges for September 2007 and July 2008 only and the target for Clarks Creek is baseflow at the Tacoma Road gage, not discharge to individual segments of Clarks Creek. The model was run in steady-state (average) and transient mode, but at a coarse temporal resolution. For the transient simulation, Johnson et al. report that the groundwater model "was divided into 24 monthly stress periods to represent temporal variations in recharge, discharge, and other groundwater-flow system processes." In sum, the USGS MODFLOW modeling supports the general water balance simulation of the Clarks Creek watershed with the HSPF model, but is not implemented at a spatial and temporal scale that is sufficient to draw conclusions regarding groundwater discharges during the individual event of 10/21/2003. The MODFLOW model gives results on grid size of 1000 x 1000 ft = 1,000,000 ft2 at a monthly time step. In contrast, the QUAL2Kw model provides hourly results on reach segments that average around 40,000 ft2 in area (average length of 2,132 ft, width in the range of 10 -25 ft.)

The remainder of this section discusses a simplified analysis of mixing based on stream flow temperatures. This analysis is subject to high levels of uncertainty, as is described further in the response to DO Modeling Concerns in the Pierce County cover letter. As noted earlier under the response to Comment #20, more recent sampling by USGS of Maplewood Springs on 6/18/1996 measured in-situ DO at 7.2-mg/L, temperature of 9.7 degree-C, and a pH of 7 (Jones et al., 1999).

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Attachment Four

Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL
Engineering Feasibility of Draft TMDL Capital Improvement Projects

Many engineering challenges exist with the implementation of a TMDL on the Clarks Creek Watershed that relies on capital facilities. Preliminary language in the TMDL states that a 50% reduction in stormwater volume or 50% treatment is expected, along with a 66% reduction in sediment. Implementation of these goals would be extremely challenging, if not impossible, within the drainage basins that contribute to Clarks Creek from unincorporated Pierce County.

Soils

Soils in the upper basin area which collect the runoff for Woodland, Diru and Rody creeks are generally classified as till soils, which are not conducive to the construction of infiltration facilities and porous pavements. In order to meet the 50% reduction in stormwater runoff volume, infiltration will be the primary method available. The prevalence of poor soils in the Pierce County area of responsibility greatly limits the areas available to implement projects using infiltration.

Another consideration that exists with infiltration of large quantities of stormwater is the potential liability of Pierce County to private property. Even though the general soil classification is till soils, small areas of suitable soils for infiltration will exist as surficial soils over the till. The thickness of these areas can be varying from several inches to several feet. This leads to serious problems that can occur when subsurface piping of infiltrated stormwater travels onto private property. It is very difficult to prevent the water from traveling laterally through the subsurface. Water transported this way can flood basements, crawl spaces, saturated yards, cause sinkholes, and a large number of other problems.

Questions to Ecology

1. How does Ecology expect to achieve the TMDL implementation goals with till soils which do not support infiltration?
   - 50% volume reduction will require infiltration at the source point, or in a large regional facility.
   - Will Ecology take responsibility for damage to private landowners if the only available method of volume reductions is infiltration?

2. Without infiltration, the only method to meet the TMDL goals is 50% treatment. This requires very large facilities in an area with limited land available. Pierce County doesn't have eminent domain as a tool available to build stormwater facilities.
   a. **How does Ecology expect the TMDL goals to be implemented without consideration for local county code?**

General Feasibility of the Projects listed in the Sediment Study

If the requirement of the TMDL is to reduce the volume of stormwater by 50% then it is not feasible to implement projects using this principal. The combination of poor soils and large amount of developed infrastructure pose great challenges to implementing a TMDL not sensitive to these factors. In order for the successful implementation of a TMDL the projects need to carefully selected, requiring a large amount of preliminary engineering. Projects arbitrary selected and included without the necessary preliminary engineering will not be successfully. Based upon the review by Pierce County's Surface Water Management Utility, Capital Improvement and Engineering section we feel the projects suggested in the Sediment Study report are not practical to achieving the goals of the TMDL. The initial review discovered errors in the feasibility, cost, permitting, and general suitability of the projects listed. Below are the TMDL's suggested projects and their potential problems.

Meeting the goals of TMDL will require acquisition of many private lands with willing sellers. At this point there is no indication of availability of acres of feasible land with willing sellers. This task may require a condemnation act. **Would TMDL requirements justify condemnation?**

Pr01 – Rody Creek Channel Stabilization

Questions

- Access? This area is very steep and hard to access. Most likely a temporary access road will need to be built. All the land in this area is private and would require construction easements.
  - **How can Ecology expect to have this be a project to achieve the TMDL goals without coordinating with a private landowner prior to the adoption of the TMDL?**
- More sediment transport modeling should be conducted to determine the actual benefits of this project. This project seems to be based on more anecdotal evidence than actual science. Given the cost of the project more assurances will need to be made before it can be accepted.

Pr02 – Diru Creek Bank Stabilization

Questions

- Access? This area is very steep and hard to access. Most likely a temporary access road will need to be built. All the land in this area is private and would require construction easements.
  - **How can Ecology expect to have this be a project to achieve the TMDL goals without coordinating with a private landowner prior to the adoption of the TMDL?**
- More sediment transport modeling should be conducted to determine the actual benefits of this project. This project seems to be based on more anecdotal evidence than actual science. Given the cost of the project more assurances will need to be made before it can be accepted.
- Based on the analysis by Brown and Caldwell this reach is stated as relatively stable. Only low cost stabilization is required.
  - **If this is a low priority why is it included as a problem that needs to be addressed?**

Pr03 – Woodland Creek Channel Stabilization: Lower

- This project is now located within the City of Puyallup. Not a Pierce County responsibility.

Pr04 – Woodland Creek Channel Stabilization: Upper

- This project is now located within the City of Puyallup. Not a Pierce County responsibility.

Pr09 – Rody Creek Detention Facility Retrofit

Questions

- This project will be under construction in August 2014. One large water quality cell will be constructed that will treat all stormwater generated from the surround 12 acres of impervious land. Some water is assumed will infiltrate, but we do not have a very good estimate how much.
- This project will treat the water, but will not reduce volume.
  - Prior to the report being published the project information and details need to be updated to reflect the correct information.

Pr10 – Diru Creek Detention Facility

Questions

- This project will be very difficult to permit and construct. The land is currently owned by Forterra as conservation land.
  - **How does Ecology expect a stormwater detention facility to be built on a conservation land easement?**

- Permitting an in-stream detention facility is extremely, if not impossible to permit with WDFW and the USACE. The proposed area is already classified as wetlands.

    - **How does Ecology expect Pierce County to accommodate the environmental permitting challenges imposed on the County by WDFW and the USACE?**
    -
- Since the facility is over 10 acres-feet it will require inspection since it's considered a dam. This most like would require expensive structural modification to 84th St E and the assumption of a large liability by Pierce County due to the nature of the facility being constructed.

Pr11 – Woodland Creek Detention Facility
Questions

- All the land in this area is private and would require property acquisition and easements.

    - **How can Ecology expect to have this be a project to achieve the TMDL goals without coordinating with a private landowner prior to the adoption of the TMDL? Eminent domain is not an option available to stormwater facilities.**

- 50 acre-feet seems very unlikely. The required setbacks from the steep ravine located to the east limit the maximum size considerably. The maximum size Pierce County estimates could be constructed would be approximate 20 - 25 acre-feet.
- A large amount of water is already detained south of SR512. Did the hydraulic modeling reflect this when the sediment reduction and flows are calculated.
- A bypass structure required to divert flows into the detention facility are usually designed to pass the larger flows into the facility. Lower flows bypass and continue downstream in the natural facility. The smaller flows usually contain higher level of contaminates due to the first flush association with stormwater.
- This facility would primarily flow control to Woodland Creek. This seems to contradict the purpose of the TMDL.

Pr17 – 72nd Street Stormwater Improvements
Questions

- This project will be under construction in August 2014.
- This project will treat the water, but will not reduce volume.

    - Prior to the report being published the project information and details need to be updated to reflect the correct information.

Ecology response: *Attachment 4 includes questions on the feasibility of projects Pierce County chose to be evaluated using EPA and tribal grant funding. Pierce County may choose other projects to meet their TMDL implementation plan, if they are more feasible.*

In the Clarks Creek TMDL, EPA paid Tetra Tech to work with the Clarks Creek Initiative Team to select projects that NPDES dischargers could choose whether or not to include in their implementation plan. NPDES stormwater dischargers chose a variety of projects, some of which were under development for other reasons such as floodplain restoration, had already received funding, or were identified under city or county plans. For instance, Pierce County selected several projects from the Clarks Creek/Clear Creek Basin Plan to be evaluated for the dual benefits of taking basin plan recommendations and also meeting TMDL stormwater implementation targets. EPA funded these studies to help permittees quantify benefits *and to provide information on the scope of projects needed to meet DO targets if permittees chose to use stormwater implementation targets.*

Appendix H includes excerpts from the Tracking and Accountability Memo developed by Tetra Tech to evaluate projects selected by the Clarks Creek Initiative Team. The Clarks Creek Initiative Team, which included Pierce County, reviewed and commented on the memo. The tracking and accountability system gives credit for stormwater improvements for either reducing or treating stormwater flow volumes based on an October 21, 2003 storm event used to develop stormwater implementation targets. It also describes a method for permittees to receive "credit" for a wide variety of watershed projects across the watershed, a request from Pierce County and other entities on the Clarks Creek Initiative Team. The analysis then quantified the environmental benefit in terms of reduction and/or treatment of stormwater volumes comparing it to the stormwater implementation targets in the TMDL. For instance, the projects that Pierce County requested be evaluated resulted in meeting 91.1% of the DO implementation target. None of these projects included work that has already been done between 2003-2014. This process set forth a framework that allows permittees to use projects that may have multiple benefits and funding sources and receive credit towards their allocation, as long as they are treating or reducing stormwater flow volume.

The TMDL does not dictate the type or location of projects used to meet the allocations. The tracking and accountability memo was done in response to permittees requesting assistance in implementing the 50% reduction or treatment of stormwater flow volume. EPA also funded the tracking and accountability memo to provide an optional framework for permittees to use for other projects that may have not been considered when Tetra Tech worked with the Clarks Creek Initiative Team in 2012. This also provided information about how beneficial projects were to improve Clarks Creek for funding opportunities.

The Tribe's Sediment Reduction Project used a similar process for sediment reductions. Brown and Caldwell worked with stakeholders to identify projects and estimate design and costs for different BMPs. They analyzed these projects based on cost and environmental benefit. The Clarks Creek Initiative Team, which includes Pierce County, worked for one year meeting regularly to select and evaluate the most promising projects to reduce sediment in Clarks Creek. The result was a list of projects permittees may choose to use. See the link in Appendix I that gives summary sheets for permittees to use, if they choose, in implementing the Clarks Creek TMDL Implementation Plan.

Attachment Five

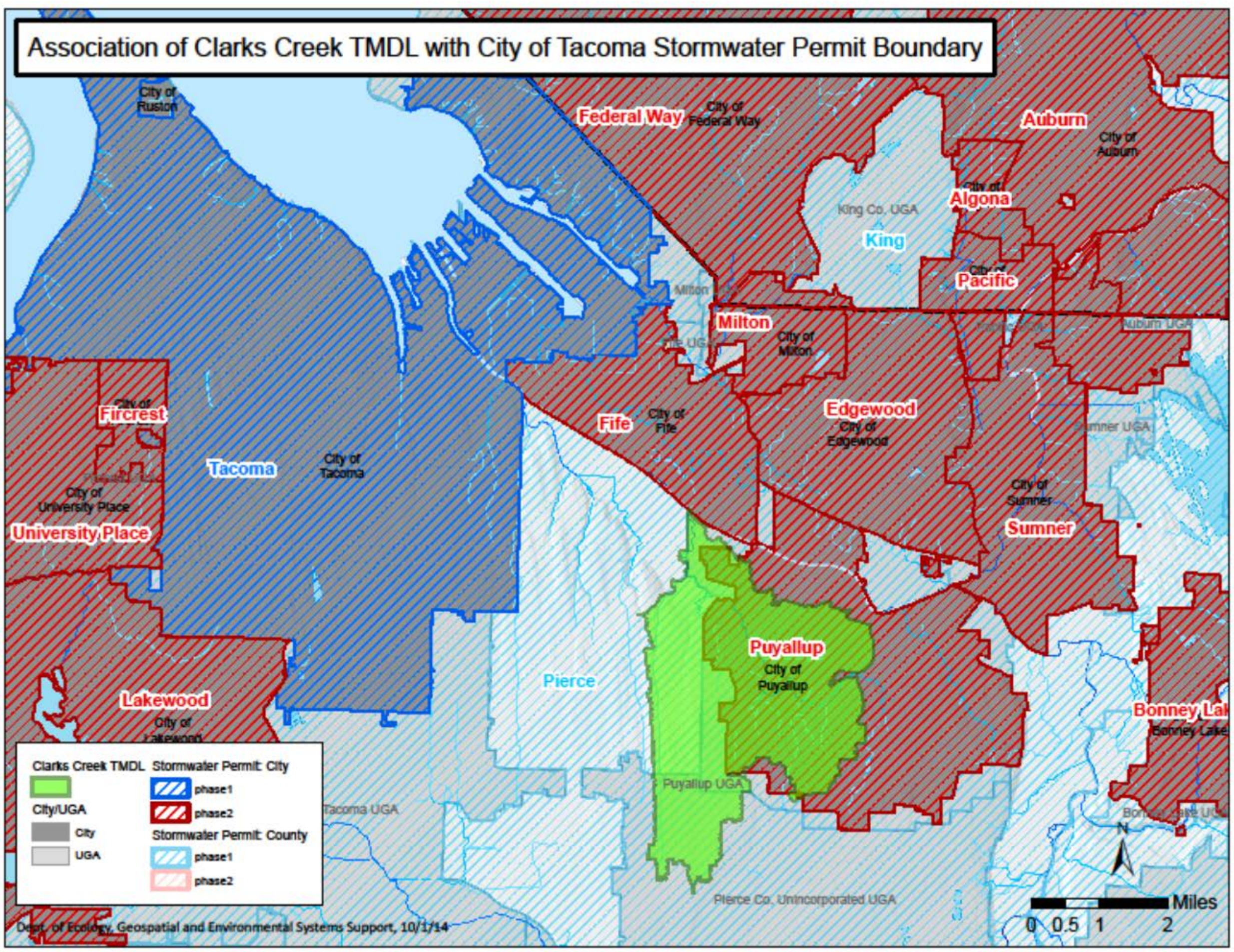
Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL
Not All Point Sources are Assigned Wasteload Allocations

Comment: Municipal General NPDES permit

The draft TMDL addresses WSDOT (Phase 1 Stormwater, Pierce County (Phase 1 Stormwater) and the City of Puyallup (Phase 2 Stormwater). However, the draft TMDL does not address City of Tacoma (Phase 1 Stormwater) which has a portion of its MS4 along Pipeline Road and discharges into Clarks, Diru, Rody and Woodland Creeks. Additionally, there are two school districts, Franklin Pierce and Puyallup, which may require coverage as a secondary permittee in the NPDES program.

Ecology response: *The city of Tacoma has no discharges from its MS4 in the watershed. The WLA is based upon current point source dischargers under NPDES permits. Should the need arise; the WLA could be reapportioned to adjust to new secondary MS4 permittees such as school districts, hospitals or drainage districts. Additionally, see Ecology's guidance on secondary permittee coverage and the petitioning process for bringing in new MS4 permittees available at, respectively,* *http://www.ecy.wa.gov/programs/wq/stormwater/municipal/secondaryneedpermit.html and http://www.ecy.wa.gov/programs/wq/stormwater/municipal/PetitionCriteriaRevcontact108.pdf.*

According to Ecology data the city of Tacoma does not discharge to Clarks Creek. See map Below:



Comment: Industrial NPDES Permit

The draft TMDL indicates that there are three industrial NPDES permits in the watershed. An assessment of land use codes maintained by the Pierce County Assessor identified potentially 10 or more additional sites whose land use descriptions match industrial permit SIC's which are not addressed.

Ecology response: *Ecology evaluated the number of facilities which discharge to Clarks Creek using the PARIS database. If the county has identified more facilities, please share this list with Ecology so these facilities can be evaluated. If further analysis shows that industrial activity is a significant source these can be captured under the reserve capacity or in an addendum to the TMDL.*

Comment: Sand and Gravel Permit

The draft TMDL indicates that there are two Sand and Gravel NPDES permits in the basin but both are ignored in the draft except for a statement that since they don't discharge directly to Clarks Creek they are not assumed to substantively contribute to impairment, even though one has been the subject to multiple enforcement actions by Ecology.

Ecology response: *Ecology evaluated both Industrial and Sand and Gravel facilities within the Clarks Creek Watershed. None of the Industrial facilities directly discharge to Clarks Creek or its tributaries. Northwest Cascade – Canyon Rim Estates (WAG501040) is permitted to discharge to Rody Creek; however, according to DMR data it has not had a surface discharge since starting operations in October 2010. The facility has three permit violations for late DMR submittals, but no permit enforcement actions. Miles S & G Plant 12 (WAG401041) is permitted to discharge to the ground. It has no permit violations or enforcement actions. If either of these facilities changes operations in a manner which necessitates incorporation of the facility into the WLA calculation, the permit manager will notify the TMDL Lead so the facility is included in the TMDL.*

If the county has identified more facilities, please share this list with Ecology so these facilities can be evaluated.

Comment: Hatchery Permit

The draft TMDL addresses the state hatchery on Clarks Creek. However, two tribal hatcheries are not assigned wasteload allocations.

Ecology response: *Please refer to the response to question 32.*

Attachment Six

Pierce County Comments on Clarks Creek Dissolved Oxygen and Sediment TMDL

Pierce County Statement at Ecology's Public Meeting, June 10, 2014 at 6:00 p.m., Puyallup Public Library, S Meridian Puyallup, WA 98371

Introduction.

Since 2008, Pierce County has been monitoring water quality and biological health in the Clarks Creek watershed and reporting that result in our annual Watershed Health Report Card. Overall, we are seeing a trend towards improvement in these indices. For example, Rody Creek is up to C+ in 2013 from a C in 2009 and it is improving in both Water Quality Index (WQI) and Benthic Index of Biological Integrity (BIBI). Diru Creek is a C+ in 2013, as it was in 2009, and is showing improvement in BIBI. Clarks Creek is also a C+, which it has been since 2011, although there are concerns with WQI and BIBI. We are proud that our efforts and those of our partners in the watershed through the Clarks Creek Initiative, begun by Pierce County in 2005, are resulting in improved conditions. Pierce County's goal is to see Clarks Creek watershed health improve, but we have significant concerns and questions about whether the TMDL will help us make progress towards that goal.

While Pierce County is still reviewing the draft Clarks Creek DO and Sediment TMDL, based on our review thus far, the County has significant concerns with the draft for the following reasons. First, for the past three years, Pierce County has worked in good faith with EPA, Ecology and the Puyallup Tribe on an alternate approach that would result in adaptive management actions better suited and more quickly implemented than the approach outlined in the TMDL. Nationally, EPA has specifically recognized the value of these alternate approaches[1] and it is disappointing that Ecology is apparently unwilling to use that approach here. Second, the data and modeling that form the basis of the TMDL and corresponding Implementation Plan are fundamentally flawed. Third, the surrogate approach employed in this TMDL is scientifically flawed, as well as arbitrary and unreasonable. While over 50,000 TMDLs have been developed nationwide, a mere handful of them have attempted to use the methodology employed by Ecology and, when challenged in court, they have been either abandoned or held unlawful. Finally, the development of the TMDL has actually slowed down Clarks Creek restoration. The single-focused capital facilities solutions proposed in the TMDL will be costly with no guaranteed improvement. Because the draft TMDL and its companion documents are exceedingly long and complex (there are over 800 pages to review), the County will be submitting additional comments before the close of the public comment period, extended by Ecology to July 21, 2014. We think that commenters should have until the end of August to submit comments and make that request tonight. In the interim, the County would appreciate receiving responses from Ecology to the following questions:

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1 *A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program,* December 2013: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/vision_303d_program_dec_2013.pdf

Pierce County Questions:

- **Why aren't wasteload allocations based on accurate, site-specific data?** The requirements of the TMDL are not derived with sufficient credible, scientific, site-specific data and information. Instead, the TMDL's requirements are based on assumptions and hypothetical scenarios. For example, the DO reduction targets are based on a flow event 11 years ago, which EPA's modelers and consultants characterize as "an extreme event," and which the model overstates by almost 3 times the observed flows. The sediment budget is not explicit in the size range of each particle size category by reach. What's more, the sediment reduction targets are based on a review of the percentage of fines in other Puget Sound streams, not on Clarks Creek natural baseline.

Ecology response: *The TMDL was developed through a collaborative process which included Pierce County, the City of Puyallup, the Puyallup Tribe of Indians, WSDOT, WSU Puyallup Research center and local citizens. Data was used from multiple sources including Pierce County and was collected credibly using quality assurance projects plans. This data was used in current up to date water quality models to development wasteload and load allocations for Clarks Creek. These models are used to develop TMDLs in Washington and across the county and are considered scientifically sound. The allocations were developed to get the Clarks Creek watershed back to meeting state water quality standards for dissolved oxygen and sediment and were calculated watershed wide. The TMDL was developed to meet the requirements outlined in state and federal law.*

The models used to derive the DO allocations were calibrated using 3 dry weather and 2 wet weather events. The storm event (October 21, 2003) selected for the development of the WLA/LA represents critical conditions and therefore is appropriate for calculation of the TMDL.

The sediment reduction allocation is based on three lines of evidence: the Newcombe and Jensen assessment that identified a 50-75% reduction in suspended sediment was necessary to reduce impacts to aquatic life, the Sediment Reduction Study HSPF model which would require a 76% reduction in sediment to return to natural forested conditions at the 66th Avenue site, and 64% reduction in sediment loading necessary to meet Puget sound lowland stream reference conditions that support a healthy aquatic environment. This question is also covered in more detail in the previous Ecology responses under the following comments:

Pierce County Letter – Comment: <u>DO Modeling Concerns</u>

- *Pierce County Letter – Comment: <u>Sediment Modeling Concerns</u>*
- *Pierce County Letter – Comment: <u>Certainty of Success</u>*
- *Pierce County – Attachment One, question 55b*
- *Pierce County – Attachment One, question 121*
- *Pierce County – Attachment Two, Comment 2*
- *Pierce County – Attachment Two, Comment 5*
- *Pierce County – Attachment, <u>Three The storm event on October 21, 2003</u>*

- **Why isn't low dissolved oxygen in groundwater considered "background"?** Much of the flow of Clarks Creek comes from groundwater discharging into the creek. Groundwater typically is low in dissolved oxygen and is suspected to be a significant factor in the DO levels of the creek. Under the TMDL, this should be counted as background. Pierce County should not be held responsible for "fixing" DO deficiencies that are naturally caused. Why doesn't the TMDL quantify and account for naturally-occurring DO demand?

Ecology response: *The TMDL does account for groundwater influences and natural background conditions. Natural background sources of low DO and sediment include surface runoff from undisturbed areas, natural rates of stream bank erosion, and groundwater with low DO concentrations. This is part of the load capacity not the load or wasteload allocation. This question is also covered in more detail in the previous Ecology responses under the following comments:*

- *Pierce County Letter – Comment: DO Modeling Concerns*
- *Pierce County – Attachment One, 10. (Page 4, paragraph 5)*
- *Pierce County – Attachment One, 20. (Page 10, bullet point 1)*
- *Pierce County – Attachment One, 29. (Page 24, paragraph 1)*
- *Pierce County – Attachment One, 66. (Page 45, paragraph 2)*
- *Pierce County – Attachment Two, Comment 5*
- *Pierce County – Attachment Three, The storm event on October 21, 2003.*

The TMDL also accounts for the anthropogenic sources that contribute to DO deficiencies in Clarks Creek and it assigns Wasteload and Load allocations to these. These reductions are necessary to return Clarks Creek to meeting state water quality standards.

- **Does Ecology believe that only construction projects can "fix" Clarks Creek?** The draft TMDL contains none of the programmatic actions that are typically important in addressing water quality issues, such as public participation on watershed councils, education and outreach.

Ecology response: *No, education and outreach is a component (e.g. the Elodea task force). The implementation of this TMDL already includes both projects and other programmatic actions. Examples of these were presented at the TMDL public meeting by the city of Puyallup, the Puyallup Tribe of Indians and the Washington State University Puyallup Research and Extension Center. These presentations are available on the Clarks Creek TMDL website at the following address: http://www.ecy.wa.gov/programs/wq/tmdl/ClarksCrDOtmdl.html*

- **Why does the draft TMDL require the County to develop two new plans, especially in light of the fact it already has an adopted, Clear-Clarks Creek Basin Plan?** The draft TMDL requires Pierce County to develop two plans (one to address dissolved oxygen, one to address sediment) to build drainage facilities in the watershed. No other entity has this same requirement. Why? Pierce County has a current, adopted basin plan in effect for the watershed, which should be implemented instead of requiring Pierce County to develop two additional plans.

Ecology response: *The city of Puyallup and Pierce County are both obligated to develop a plan to address DO and sediment reductions within the basin. The implementation portion of the TMDL has been clarified for Pierce County so that only one plan needs to be developed which addresses both DO and sediment reduction requirements. These same clarifications have also been added to the City of Puyallup's implementation section and plan development as well.*
Pierce County could amend or update the Clear-Clarks Creek Basin Plan to incorporate and address the DO and sediment TMDL because the current basin plan only addresses bacteria.

- **What are Department of Ecology's criteria to approve the plans from Pierce County?** According to the draft TMDL the two plans must be approved by Ecology, but it contains no standards or criteria by which Ecology will evaluate the plans and approve them.

Ecology response: *The plan will be evaluated on its ability to meet the wasteload allocations in the TMDL.*

The TMDL spent extra resources to help the Stakeholders by giving them implementation targets for Stormwater. The intent of the implementation targets was to save the stakeholders the time and resources necessary to model dissolved oxygen and sediment reductions and to show reductions with currently proposed project — giving them the flexibility to choose the projects.

The plan must show how Pierce County will:

- *Meet the Clarks Creek TMDL DO Wasteload allocation <u>or</u> reduce/treat stormwater discharging to the Clarks Creek Watershed by 50% and*
- *Reduce sediment levels by 66%*

The plan must outline how the above will be achieved and it must follow the steps identified in the implementation plan section of the Clarks Creek Dissolved Oxygen and Sediment TMDL, Table 19, Page 134.

- **Why aren't all "point sources" identified and given "wasteload allocations"?** TMDLs are supposed to assign responsibilities to all "point sources" in the watershed. However, the draft Clarks Creek TMDL singles out only three, including Pierce County. In reality, the watershed contains portions of another Phase I Municipal Stormwater Permittee; two potential secondary permittees, ten potential industrial stormwater general permittees, two potential additional hatchery permittees; and two existing sand and gravel permittees . All of these other sources are point source dischargers, but not one is assigned a Wasteload allocation. Additionally, nonpoint sources that Ecology has responsibility for are only given cursory consideration. The result of these omissions is a flawed TMDL that shifts all of these other point and non-point source pollution to the County and other permittees.

Ecology response: *The points sources identified above were all given a Wasteload or Load allocation as stated in previous Ecology responses under comments:*

- *Pierce County – Attachment One, 8. (Page 2, paragraph 1)*
- *Pierce County – Attachment One, 9. (Page 4, paragraph 1)*
- *Pierce County – Attachment One, 30. (Page 24, paragraph 2)*
- *Pierce County – Attachment One 32. (Page 24, paragraph 4) question B*
- *Pierce County – Attachment One Comments 33 through 36.*

- **How do we know we have achieved the goal?** The TMDL does not provide a pathway to success: even if ALL of the projects it includes are implemented, the County still would not meet the TMDL goals.

Ecology response: *The goal of the Clarks Creek TMDL as with all TMDLs is to bring the waters back into compliance with water quality standards. During the development of the Clarks Creek TMDL, Ecology determined the sources of pollutants to Clarks Creek and calculated allocations with the best available science and data. Ecology is confident that if these allocations are achieved, Clarks Creek will meet water quality standards for dissolved oxygen and sediment. Ecology believes the TMDL does provide a pathway to success and it goes beyond the typical TMDL analysis. It gives the stakeholders implementation targets and details how various projects could be used by the local jurisdictions to meet the wasteload allocations. For more detail see Appendix H. Allocation accounting and the following previous Ecology responses under:*

- *Pierce County Letter – Comment: <u>Certainty of Success</u>*
- *Pierce County – Attachment One, question 40*
- *Pierce County – Attachment One, question 41*

- **What is the basis for the stormwater flow reduction requirement?** The draft TMDL proposes that 50% of surface water flows be treated or eliminated, envisioning that Pierce County and others will construct capital drainage facilities within the watershed. Ecology's website for this TMDL states that a "TMDL is a calculation of the maximum amount of a ***pollutant*** that a waterbody can receive and still meet water quality standards." Does Ecology consider stormwater flow to be a pollutant even though a federal court has held otherwise? If so, why?

Ecology response: *As noted in the TMDL, Pierce County's assertion that the Draft Clarks Creek TMDL attempts to regulate stormwater flow as a pollutant is incorrect. The Clarks Creek TMDL sets implementation targets for stormwater that can be used to meet the pollutant reductions for DO and sediment.*

It is also incorrect that federal courts have ruled that stormwater flow is not a pollutant under the Clean Water Act. If Pierce County is referring to the U.S. District Court's decision on the EPA-issued Accotink TMDL, it is important to note that the district court's decision about the validity of the Accotink TMDL is not binding outside of that particular TMDL. This question is also covered in more detail in the previous Ecology responses under the following comments:

- *Pierce County Letter – Comment: <u>Clean Water Act Consistency Concerns</u>*
- *Pierce County – Attachment One, question 43b*

- **What is the basis for the sediment reduction requirement?** How can a "64% sediment reduction" and/or "66% reduction" be required when Washington State has no "sediment water quality standards"?

Ecology response: *Water quality standards do exist for anthropogenic inputs of sediment as with any other materials that are deleterious to the uses of state waters. Ecology therefore has the authority to limit such pollutants through waste load allocations in order to protect, maintain, and restore the designated uses of a water body.*

Ecology's authority to limit pollutants from entering state waters is clearly stated by the following state Water Pollution Control Act (WPCA):

Revised Code of Washington 90.48.080 – Discharge of polluting matter in waters prohibited.
It shall be unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the department, as provided for in this chapter.

Further, the WPCA defines pollution broadly:

Revised Code of Washington 90.48.020 – Definitions.

Whenever the word "pollution" is used in this chapter, it shall be construed to mean such contamination, or other alteration of the physical, chemical or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

See WAC 173-201A – Water Quality Standards for Surface Waters of the State of Washington for the authority of the Department of Ecology to use not only numeric but also narrative criteria to protect the existing and designated uses of state waters.

Washington Administrative Code 173-201A-010
(1) The purpose of this chapter is to establish water quality standards for surface waters of the state of Washington consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife, pursuant to the provisions of chapter 90.48 RCW. All actions must comply with this chapter. As part of this chapter:

(a) *All surface waters are protected by narrative criteria, designated uses, and an antidegradation policy.*

(b) *Based on the use designations, numeric and narrative criteria are assigned to a water body to protect the existing and designated uses.*

(c) *Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criteria for each parameter is to be applied.*
The following narrative criteria apply to all Surface waters of the state include lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Washington Administrative Code 173-201A-260(2)
The following narrative criteria apply to all existing and designated uses for fresh and marine water:

(a) *Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health.*

This question is also covered in more detail in the previous Ecology responses under the following comments:

- *Pierce County Letter – Comment: <u>Sediment Modeling Concerns</u>*
- *Pierce County – Attachment One, question 121*

Pierce County — Some other questions we have included:

- **What projects afford both DO and sediment benefit?**

Ecology response: *A project which addresses both the sediment and DO WLA or addresses both the stormwater implementation targets and the sediment reduction targets will benefit both DO and sediment. An example is the Meeker Creek stream restoration project, which is meandering the lower portion of the creek, adding riparian vegetation, reducing erosion/incision and stormwater inputs, and increasing channel complexity.*

- **How does the 50% flow reduction relate to 64% sediment reduction?**

Ecology response: *Most projects that reduce stormwater flows will likely also reduce sediment. As stated in the Accountability Memo (Appendix 3 of the TMDL),*

"The accounting can be done on the basis of suspended solids removal. For example, consider a channel restoration project that is anticipated to achieve a 20 percent removal of solids on a storm flow (for the 10/21/03 event) of 100 MG. The credit toward the needed "reduction in the volume of untreated stormwater" can be calculated by comparing the design removal rate of 20 percent to the target removal rate of 80 percent. That is, the project would be accounted as meeting 100 MG x 20%/80% = 25 MG.
This approach will allow the comparison and crediting of all types of BMPs and improvements that may contribute to the overall load reductions and water quality improvement goals. In addition to flexibility, it provides a common metric that can be used in cost-benefit comparisons between different projects.

- **Why does the TMDL call for both a 64% reduction and a 66% reduction of sediments?**

Ecology response: *We assume this comment refers to the difference between the Sediment Loading capacity discussed in the Sediment Analytical framework section on page 107 under Loading Capacity (64% reduction) versus the 66% reduction discussed in the Sediment Load and wasteload allocations section on page 119. The difference between the two numbers is the 64% reduction includes the 10 tons set aside for future development and the 66% reduction does not.*

As stated on page 119 of the Clarks Creek Dissolved Oxygen and Sediment TMDL:

> *"Because future development is anticipated in the Clarks Creek watershed, the TMDL sets aside a reserve capacity of 10 tons/year of sediment. The remaining allocation, which is a 66% reduction from current sediment loading, consists of 173-tons/year for point sources, 26-tons/year for nonpoint sources and does not include the reserve capacity."*

- **How much of the 50% flow reduction and the 64/66% sediment reduction has been achieved since 2003?**

Ecology response: *Absent a list of completed projects, Ecology does not know how much of the 50% flow reduction and the 66% sediment reduction has been achieved since 2003.*

Both the accountability memo in ***Appendix H. Allocation accounting*** *and the Sediment Reduction Plan Sheets in* ***Appendix I. Sediment reduction plan project sheets*** *outline how much could be achieved for a list of possible projects if completed. It will be up to the local jurisdictions to keep track of how they are meeting the Allocations and this will need to be identified in the plan they submit to Ecology.*

Finally, it's important to note that the Clarks Creek Watershed is actually currently improving without the TMDL in place. That is what we have been working on and that is what we want to see continue.

Ecology response: *Ecology appreciates all the work the stakeholders are doing to improve water quality in Clarks Creek. We believe the Dissolved Oxygen and Sediment TMDL will help Clarks Creek meet Water Quality Standards.*

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Comment from National Association of Clean Water Agencies (NACWA)

Dear Mr. Raunig:
The National Association of Clean Water Agencies (NACWA) appreciates the opportunity to provide these comments on the draft Clarks Creek total maximum daily load (TMDL) for dissolved oxygen and sediment. NACWA is a national advocacy organization representing the interests of municipally owned wastewater and stormwater utilities, with nearly 300 public utility members across the country. NACWA has 10 public agency members in Washington State, including Pierce County Public Works & Utilities.

NACWA has significant concerns with the draft Clarks Creek TMDL, specifically its attempt to regulate stormwater flow and assign flow-based wasteload allocations to municipal stormwater dischargers. NACWA has long opposed efforts to regulate stormwater flow through the TMDL process, including the assignment of flowbased wasteload allocations to municipal stormwater utilities. We believe regulation of flow as a pollutant surrogate in a TMDL is illegal under the Clean Water Act.

NACWA has previously submitted comments to the U.S. Environmental Protection Agency (EPA) opposing flow-based TMDLs. We also participated in federal litigation in Virginia to successfully strike down a flow TMDL. I have attached for your reference a copy of our EPA comments, our brief in the Virginia case, and a copy of the federal court decision invalidating the flow TMDL. NACWA believes the proposed Clarks Creek TMDL, if litigated, would face many of the same legal vulnerabilities that ultimately invalidated the Virginia flow-based TMDL. NACWA strongly urges the Department of Ecology to reconsider its use of flow in the TMDL.

Thank you again for the opportunity to provide these comments. Please do not hesitate to contact me at ngardner-andrews@nacwa.org or 202-833-3692 with any questions.

Sincerely,
Nathan Gardner-Andrews
General Counsel

Ecology response: *Stormwater pollution represents one of the most significant contributors of pollution to urban waterways in Washington State. Ecology has authority to regulate stormwater flow for municipal and other stormwater permittees. The state's Pollution Control Hearings Board has upheld the flow control standard and also ruled that Ecology require local governments to do more to address other hydrologic changes caused by land development. Furthermore, Ecology is authorized to use surrogates as deemed necessary by science-based TMDLs to set wasteload allocations for municipal and other stormwater permittees. The implementation of the stormwater flow based targets established by this TMDL should help ensure the attainment of water quality standards.*

Stormwater is regulated by Washington State under the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permits (Phase I and II permits). These municipal stormwater general permits include requirements to regulate stormwater flow to the receiving water body. In addition to the flow control requirements in the municipal stormwater general permits, Ecology has authority to establish additional flow control limits based on the wasteload allocations derived through the TMDL process. A linkage between the impaired designated use and stormwater flow established in a TMDL helps ensure that stormwater flow reduction will result in attainment of water quality standards. The regulation of stormwater flow is *a means to achieve reduction of pollutant loadings in the water body. See Pierce County Attachment One, Comments 55, 90 and 114; Attachment Two, Comments 5 and 6; and Attachment Three, responses for more information on why Ecology choose to use stormwater flow targets in this TMDL.*

Surrogate measures are used for TMDL allocations when the direct pollutant is too expensive or difficult to measure and there is a direct correlation between the surrogate and direct measures. The use of surrogates has been approved in several contexts. See, e.g. Weyerhauser v. Costle, 590 F. 2d 1011, 1022, n. 6 (D.C.Cir. 1978) (agreeing with the Second Circuit's approval of the use of BOD as a surrogate in C & H Sugar Co. v. EPA, 553 F.2d 280, 282 n. 7 (2d Cir. 1977), which the Court noted was not itself a pollutant); Associated General Contractors of Washington v. Ecology, PCHB Nos. 05-157, 158, 159 (2007) (approving use of turbidity as a surrogate measure for phosphorus in the construction stormwater permit); Copper Development Association v. Ecology, PCHB Nos. 09-135 – 141 (2011) (approving use of TSS as a surrogate in the industrial stormwater permit for discharges to 303(d) listed waterbodies); see also, Friends of the Earth v. EPA, 346 F. Supp. 2d 182, 201 n. 9 (D.D.C. 2004) (citing various cases approving surrogates), reversed on other grounds, 446 F. 3d 140 (D.C. Cir. 2006). Surrogate measures are also used to set a target for implementation activities such as how much stream shade is needed to reduce solar radiation that heats rivers. Additionally, EPA guidance authorizes the use of surrogates to establish TMDL wasteload allocations. Ecology is authorized to use surrogate measures for TMDL allocations when appropriate under the circumstances.

The Accotink case is not binding in Washington State. Ecology has authority to regulate stormwater, as well as establish measures as needed to restore water quality through a TMDL.

Don Russell

Clarks Creek Dissolved Oxygen And Sediment Total Maximum Daily Load
Comment 6/11/14:

Background

The Clarks Creek TMDL Water Quality Improvement Report and Implementation Plan reports that low dissolved oxygen (DO) levels, excess fine sediment and sand, and the overgrowth of elodea create conditions in Clarks Creek that harm fish and their supporting habitat. The goal and objectives of this Report are to describe the problems and actions needed to meet water quality standards and improve the ecosystem, increase DO concentrations and reduce sediment loads in the creek.

The Report cites that what is needed to improve DO and reduce sediment is to: (1) Reduce sediment load; (2) reduce dissolved oxygen deficit; (3) control the density of elodea; (4) increase riparian shade; and, (5) reduce 50% of stormflow volume or treat 50% of untreated stormwater. The Plan envisions that the proposed Implementation Plan will take 20 years to accomplish.

Preface

This paper comments on an assumption made about the source of fine sediment in Clarks Creek and the data contained in the Water Quality Improvement Report and Implementation Plan. It is my view that the Plan's assumption about the source of fine sediment in Clarks Creek is unsubstantiated, that the water quality parameters monitored were not adequately encompassing, and that the interpretation of the data is inadequate to serve as a foundation for a timely, responsive and cost effective Clarks Creek water quality improvement action Plan.

Fine Sediment/Low DO Assumption

One of the underlying assumptions in this TMDL is that sediment load in Clarks Creek is due to suspended sediment in stormwater runoff and stream bank and channel erosion occurring in Clarks Creek's steep gradient fast flowing upper watershed. This assumption holds that these suspended sediments are sequentially deposited on Clarks Creeks bed with the coarsest sediment (sand) deposited upstream and a half mile downstream of the WDFW hatchery and the fine sediment deposited downstream of this area, all the way to the Puyallup River.

Whereas stormwater runoff and stream bank and channel erosion in the upper watershed are operative to create this sorting effect they are not the only two factors, nor the primary factor, that is causing fine sediment loading and low DO in the low gradient alluvial plain reach of Clarks Creek. A very significant factor contributing to the sediment loading and low DO conditions in Clarks Creek below Meeker Ditch is the practice of discharging soluble (Fe++) and particulate (Fe+++) iron laden stormwater runoff from the City of Puyallup's stormwater collection and disposal system into Clarks Creek, and the fact that this system is currently below elevated groundwater levels caused by the buildup of sediment and shoaling of Clarks Creek.

For some unknown reason the adverse impact of iron pollution (low DO, insoluble iron compound bed loading and buildup of fine sediment in the alluvial plain reach of Clarks Creek, shoaling and lateral expansion, prolific elodea growth, flooding, depressed macroinvertebrate populations, increased groundwater level, riparian tree deaths, suffocation of salmon eggs, salmonid and macroinvertebrate gill abrasion and clogging) has gone unrecognized by all.

Iron/Low DO Linkage

Whereas the Report identifies sediment oxygen demand as a significant contributor to Clarks Creek's low DO condition it does not address the cause of this condition. Had an analysis of fine sediment to determine its iron content been conducted the data would have identified iron in both its reduce state (soluble as Fe++) and oxidized state (insoluble as Fe+++) as the primary cause of high sediment oxygen demand (Fe++ being oxidized to Fe+++) and high turbidity as a result of bed load fine sediment (Fe+++ in the form of particulate matter) disturbance during periods of increased flow in Clarks Creek below Meeker Ditch.

Iron Source

Apparently the alluvial soils in the Puyallup River valley in the vicinity of the City of Puyallup and Clarks Creek contain iron compounds that are solubilized (Fe++) when the soil becomes saturated with rising groundwater levels and devoid of dissolved oxygen. When anoxic iron laden soil waters are exposed to either atmospheric or dissolved oxygen the soluble iron (Fe++) is oxidized to Fe+++ and immediately forms insoluble iron oxyhydroxide (a flocculent orange brown precipitate) and iron hydroxide (a fine colloidal precipitate). This oxidation reaction consumes DO, releases hydrogen ions into the water which lower the pH of the water so affected, and results in the deposition of fine sediment on Clarks Creek's bed.

Conveyance of Soluble and Insoluble Iron to Clarks Creek

There are a number of east to west flowing drainage ditches (e.g., Meeker) and culverts (e.g. beneath the 7th Ave SW bridge) that collect iron laden groundwater and surface water runoff that discharge their contents into south to north flowing Clarks Creek. In the open atmosphere exposed Meeker ditch the soluble (Fe++) iron is converted to insoluble (Fe+++) orange brown iron oxyhydroxide which both imparts a cloudy brownish tint to the water and coats the bottom of the ditch as noted in the below left photograph. Iron hydroxide is colloidal in nature and imparts a cloudy or milky appearance to the water as noted in the below right photograph of iron laden groundwater being discharged into Meeker Ditch.

The total iron concentration at the groundwater discharge site in Meeker Ditch shown in the above right photograph was 15 mg/L. US EPA standards for iron concentration is 1 mg/L. Washington State surface water quality standards do not have an iron concentration standard.

Evidence of Iron in Clarks Creek

Below are photos of Meeker Ditch (between 13th and 14th St SW) iron laden water discharging into Clarks Creek (left hand photos) and a stormwater drain discharging a mix of iron laden water surface runoff and groundwater into Clarks Creek below the 7th Ave SW bridge (right hand photos) prior to precipitation (5/8/13) and soon after a precipitation event (5/13/13).




During periods prior to precipitation events the drainage system is apparently functioning to dewater iron (Fe++) laden groundwater as a result of its leaking into drainage system culverts (plus being discharging directly into Meeker Ditch). During precipitation events the drainage system discharges surface water runoff plus the Fe++ laden groundwater that has accumulated in the drainage culverts into Clarks Creek. The superimposed surface water runoff apparently causes a flushing of precipitated iron (Fe+++) oxyhydroxide that has accumulated in the drainage system during periods when there is no precipitation. The effect of this surface water runoff surge through the drainage system is to discharge copious quantities of iron Fe++ and Fe+++ from Meeker Ditch and the drainage discharge below the 7th Ave SW bridge into Clarks Creek, concurrently lowering DO in Clarks Creek as a result of Fe++ being oxidized to Fe+++.

Iron oxyhydroxide and hydroxide in Clarks Creek's sediment bed when exposed to anoxic (reducing) stream bed conditions release ferrous ions (Fe++) back into the water column. When these ferrous ions are exposed to dissolved oxygen they are oxidized back into particulate form to cause a cloudy (turbid) appearance in Clarks Creek's lower reaches and by this reaction the reduced DO conditions characteristic of Clarks Creek below Meeker Ditch.

The Effect of Iron Pollution in Clarks Creek

One of the previously mentioned effects is high sediment oxygen demand and thus low DO.
Other impacts of high soluble and particulate iron concentration are: (1) Iron is a stimulant fostering elodea growth; (2) iron oxyhydroxide, hydroxide and oxide are abrasive and damage delicate fish and macroinvertebrate gill tissues; (3) the precipitation of insoluble iron compounds on fish and macroinvertebrate gills and salmon egg surfaces results in their suffocation; (4) the buildup of fine grained iron laden sediment on the bottom of the creek bed results in its shoaling, lateral expansion, stream bank erosion and elevated groundwater levels all of which, under increased flow conditions, results in turbidity and the flooding of adjacent private property; (5) elevated groundwater levels turn former above groundwater level stormwater drainage systems into groundwater dewatering systems; and (6) elevated groundwater levels, iron pollution and periodic flooding drown riparian vegetation as is now occurring with

trees located adjacent to Clarks Creek. To plant more trees is counterproductive under present circumstances.

Ecology response: *The oxidation of ferrous iron consumes oxygen and can contribute to the depletion of DO in streams. We thank the commenter for providing detailed information and agree that there is plentiful visual and qualitative information on the presence of excess iron in Clarks Creek. Unfortunately, sufficient quantitative data were not available to develop an estimate of the extent to which iron oxidation contributes to the overall DO deficit in Clarks Creek, nor does the QUAL2Kw model contain routines to address iron oxidation. Therefore, DO depletion by iron oxidation is lumped in with the various other processes, including decomposition of organic matter, that contribute to the overall DO deficit in Clarks Creek.*

Oxidation of ferrous iron generally occurs quite rapidly in the presence of oxygen (C.F. Stumm, W., and Morgan, J. J., 1996, Aquatic Chemistry, Chemical Equilibria and Rates in Natural Waters, third edition, Wiley-Interscience, New York) and the interception of reduced iron by the stormwater conveyance system is one contributor to the low DO and high DO deficit in stormwater discharges noted in the TMDL. It is also the case that ferrous iron can be regenerated from anoxic sediments or discharged from direct groundwater seeps and subsequently contribute to DO consumption in the water column. These processes are likely one component of the overall sediment oxygen demand in Clarks Creek represented in the model. There is also evidence that reduced iron is a requirement for elodea growth, although we would expect to find sufficient iron levels in most hypoxic stream sediments.

Elevated iron concentrations in groundwater are likely a natural phenomenon in the Clarks Creek/lower Puyallup Valley streams. This is evidenced in the Jones, 1999 report which shows a pattern of low dissolved oxygen, high conductivity, and low nitrate concentrations in sampled Valley wells. The low concentrations of nitrate and dissolved oxygen in area groundwater reported by Jones are consistent with the reducing conditions and elevated iron concentrations you reported. While it is possible the stormwater system and old tile drains are delivering a greater volume of groundwater to the system than occurred naturally, the upland and instream sources of sediment far outweigh the groundwater derived iron precipitates you describe. Municipalities and citizens should continue to target the sources of iron precipitate and use their resources through their NPDES Stormwater Permit and other non-point source funding sources to fix them.

It is thus the case that the contribution of reduced iron to the overall DO problem in Clarks Creek is represented implicitly in the modeling and in the TMDL allocations as part of the total sediment oxygen demand and as a contributing cause to the high DO deficit in stormwater discharges. The general implementation guidelines that require removal or treatment of stormwater will be useful to address the iron components of the DO problem – either by removing the source or through use of treatment options that will encourage the deposition of insoluble iron precipitates. For long term success in the basin, the wasteload and load allocation must be implemented in the TMDL, and the upland and instream sediment sources must be reduced.

Further study of iron dynamics in Clarks Creek might well enable further refinement and optimization of the implementation plans to achieve water quality standards.

The Problem with the Clarks Creek TMDL

The TMDL proposed Implementation Plan not only mischaracterizes the condition of the Clarks Creek watershed and what is required to bring it into compliance with State water quality standards, it has a 20 year horizon for its completion. In the meantime damage is ongoing.

Ecology response: *Implementation of the TMDL should begin immediately upon approval. In fact, the Clarks Creek Initiative Team has already begun working on different implementation projects within the* *basin. The 20-year horizon includes planning, installation and time for projects to become effective. However, some implementation projects, such as riparian plantings, need the full 20 year implementation horizon to become mature.*

What Needs to Happen

In order to realize the Clarks Creek TMDL stated Goals and Objectives more immediate action, based upon a proper understanding and characterization of the present condition of this watershed is necessary. Sand and iron laden fine grained sediment loading controls need to be implemented sooner rather than later, and removal of iron laden fine sediment from Clark Creek's impaired bed needs to be undertaken concurrently in order to restore the Creek's natural function, not after sediment controls are effectuated over the next twenty years.

The current method of diver assisted suction dredging to removal elodea results in the dislodgement of iron laden fine sediment that will adversely impact the Puyallup Tribe's downstream fish rearing operation and do little to address the low DO condition of Clarks Creek.

Ecology response: *The current implementation plan will encourage controls on iron laden fine grained sediment loading. It is Ecology's opinion, however, that additional data would be needed to demonstrate the significance of iron chemistry to the overall impairment of Clarks Creek. Removal of existing sediment from the bed of Clarks Creek is likely to be ineffective if stormwater sources are not controlled first.*

The comment on suction dredging of Elodea is acknowledged. Suction dredging tends to dislodge significant amounts of fine sediment in general and is thus problematic – although it has been shown to be beneficial to the DO balance based on before and after studies. The Elodea Task force is exploring the use of more environmentally benign Elodea control methods for both short and long term success.

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WSDOT Review Comments

Clarks Creek Dissolved Oxygen and Sediment Total
Maximum Daily Load (TMDL) Water Quality Improvement Report and Implementation Plan

July 17, 2014 Letter

1) Lack of nexus between low dissolved oxygen (DO) and stormwater.

Background: Tetra Tech's 2010 Data Review and Analysis report states, "It does appear that the sediment budget and stormwater impacts are only two among many processes that contribute to the DO impairment, and are likely not the critical pathways to developing the DO TMDL." (Tetra Tech, 2010)

Conclusive evidence that stormwater is the cause of low DO in Clarks Creek is absent from the draft document. General statements in the draft document claim storm water can have low DO and contain pollutants that further deplete DO. However, these claims are unsubstantiated due to the lack of representative storm event data. Many attempts are made to show a correlation between storm water and low DO, but a correlation does not establish causation.

Comment: WSDOT recommends that Ecology establish a strong technical link through scientific analysis between stormwater and low DO in Clarks Creek before the TMDL is finalized. Alternatively, pursue other possible linkages that will better address the cause or causes or the DO problem. Without a strong cause and effect link, stakeholders and taxpayers risk treating symptoms rather than core problems.

Ecology response: *The language in Tetra Tech (2010) refers specifically to the initial exploratory analyses conducted and documented within the same report. Under the "Study Results" section of the TMDL report, these analyses are discussed with the full set of data and analyses available for the TMDL development. Tetra Tech (2010) represents a preliminary assessment of available data in the initial steps of building a conceptual representation of processes controlling DO. In addition, the statement in Tetra Tech (2010) is taken out of context in this comment. This statement is part of the larger "Recommended Technical Approach" section of Tetra Tech (2010), which recommends the pursuit of model development to further investigate the relative importance of different risk pathways.*

The draft TMDL document presents the results of a thorough analysis of DO impairment data collected at multiple temporal scales and flow regimes (during both baseflow and stormflow). In the Clarks Creek watershed, DO concentrations were measured and analyzed over several decades at a variety of time increments. First, general trends were evaluated based on the long-term data record. Then, data from several focused studies were reviewed. These studies included; 1) the sampling of temperature, DO, DO saturation, and turbidity before, during, and after elodea cutting events; 2) DO monitoring conducted by PTI in 2009 and 2010 with flow, turbidity, and conductivity; 3) comprehensive monitoring of storm drains and instream locations during storm events; and; 4) analysis using the QUAL2Kw model.

Within the body of evidence presented in the TMDL document, statistical correlation is used to interpret the nexus between DO and anthropogenic sources. On page 48, the TMDL states "The analysis shown in Figure 16 concluded that higher flows correlated to higher DODs at Tacoma Road (R2=70%; coefficient p<0.001)." The goal of this analysis was to determine whether there was statistically significant correlation. The p-value of less than 0.001 indicates that there is an extremely low probability that the positive correlation between flow and DOD (shown in Figure 16 of the draft TMDL document) is untrue. The R2 value indicates that 70 percent of the variability in DOD is explained by flow. Both statistics firmly support the statement that "higher flows correlated to higher DODs at Tacoma Road."

To address the statement: "a correlation does not establish causation," it is important to note that in studies of the natural environment, absolute proof of causation is often impossible without the ability to conduct experiments that control for all factors. Statistical correlation is widely used and accepted as one among multiple lines of evidence to link sources and stressors to impairments. For the case of Clarks Creek the causal nature of the linkage is supported by a coherent conceptual model of the processes leading to DO impairment, by repeated observations of low DO during stormwater events and in storm outlets (see especially the winter 2011-2012 monitoring), and by sensitivity analyses conducted with the deterministic QUAL2Kw model.

2) Complexity of the water quality issues in Clarks Creek.

Background: WSDOT believes water quality issues in the Clarks Creek watershed are more complicated than the TMDL alludes. Tetra Tech's 2010 Data Review and Analysis report states, "As shown in the Conceptual Model (see Section 1.4.4), DO impairments in Clarks Creek are affected by a variety of interacting stressor sources and processes." (Tetra Tech, 2010). WSDOT believes more information is necessary to fully understand the problems in Clarks Creek and determine the actions needed to help restore it. The complexity of the DO issue in Clarks Creek requires an extensive study to fully determine cause and effect.

Comment: WSDOT recommends Ecology compile and analyze the following information, at a minimum, for inclusion in this document before the TMDL is finalized for EPA approval:

- additional storm event data to achieve an acceptable statistical confidence level,
- quantification of groundwater impacts,
- characterization of sediment oxygen demand (SOD) components, and
- understanding of the relationship between external loading of sediment/nutrients and Elodea growth.

Ecology response: *Additional data are always welcome; however, minor gaps in data are not an excuse for inaction. The TMDL included and evaluated all of the bulleted items above. Please see Ecology's response to Pierce County's Attachment 1 - DO Modeling Concerns for a broad explanation of the incorporation of storm event data, groundwater impacts, SOD and external loading/elodea growth relationships on DO into the TMDL.*

Ecology addresses each of the issues in more detail in response to Pierce County:

- *Storm event data: Pierce County, Attachment 1- Comments 55, 72, 74, and 113*
- *Statistical confidence level: WSDOT Comment 1) Lack of nexus between low dissolved oxygen (DO) and stormwater*
- *Groundwater impacts: Pierce County, Attachment 1- Comments 20 and 114, Attachment 3- Groundwater discharge to the stream*
- *Sediment oxygen demand (SOD): Pierce County, Attachment 1 – Comments 15, 76, 101, 102, and 114*
- *External loading of sediment/nutrients and Elodea growth: Pierce County, Attachment 1 – Comments 15 and 44*

These issues are addressed in the TMDL in the following sections:

- *Storm event data: The 2010 data collected by PTI included storm events (see pages 45-49 in the draft TMDL document). Then in 2011-2012, PTI conducted comprehensive monitoring of storm drains and instream locations during storm events, as presented on pages 49-53 of the draft TMDL document and further documented in Tetra Tech (2012). Please refer to response under comment #1 regarding "statistical confidence level."*
- *Groundwater impacts: The quantification of groundwater influence is addressed on pages 45 and 98-99 in the draft TMDL.*

- *Sediment oxygen demand (SOD): Characterization of SOD is provided on pages 53 and 78-79 of the draft TMDL based on field observations and QUAL2Kw modeling.*
- *External loading of sediment/nutrients and Elodea growth: The understanding of this relationship documented in the conclusions and recommendations section (page 87 of the draft TMDL) and is summarized in the conceptual model (Figure 44).*

As noted in the Adaptive Management Section of the TMDL document (page 138 in public draft), TMDL implementation will involve further testing, monitoring, and evaluation of management approaches based on scientific findings.

3) Data quality and quantity.

a) Background: WSDOT believes insufficient storm event data were included in the TMDL analysis for the Clarks Creek watershed to representatively quantify stormwater impacts on low DO. Page 103 states, "While field data for water quality, sediment quality, and geomorphic analysis is limited, there is enough data to develop a reasonable loading capacity for the TMDL."

Comment: WSDOT recommends Ecology assess the "limited" data used to develop this TMDL to determine if it meets requirements of Ecology's Credible Data Policy (Ecology, 2006). WSDOT does not feel it is appropriate to use insufficient storm event data to project long term effects on Clarks Creek.

Ecology response: *The Credible Data Policy states that "data are considered credible if:*

- *The data consist of an adequate number of samples based on the objectives of the sampling, the nature of the water in question, and the parameters being analyzed."*

Ecology utilized all available storm/wet season data to determine the relationship in Clarks Creek. As stated in the TMDL, the low dissolved oxygen occurs at multiple locations along mainstem Clarks Creek during the wet and dry seasons collected between 1992 through 2010 (see graph below-Figure 11 from TMDL).

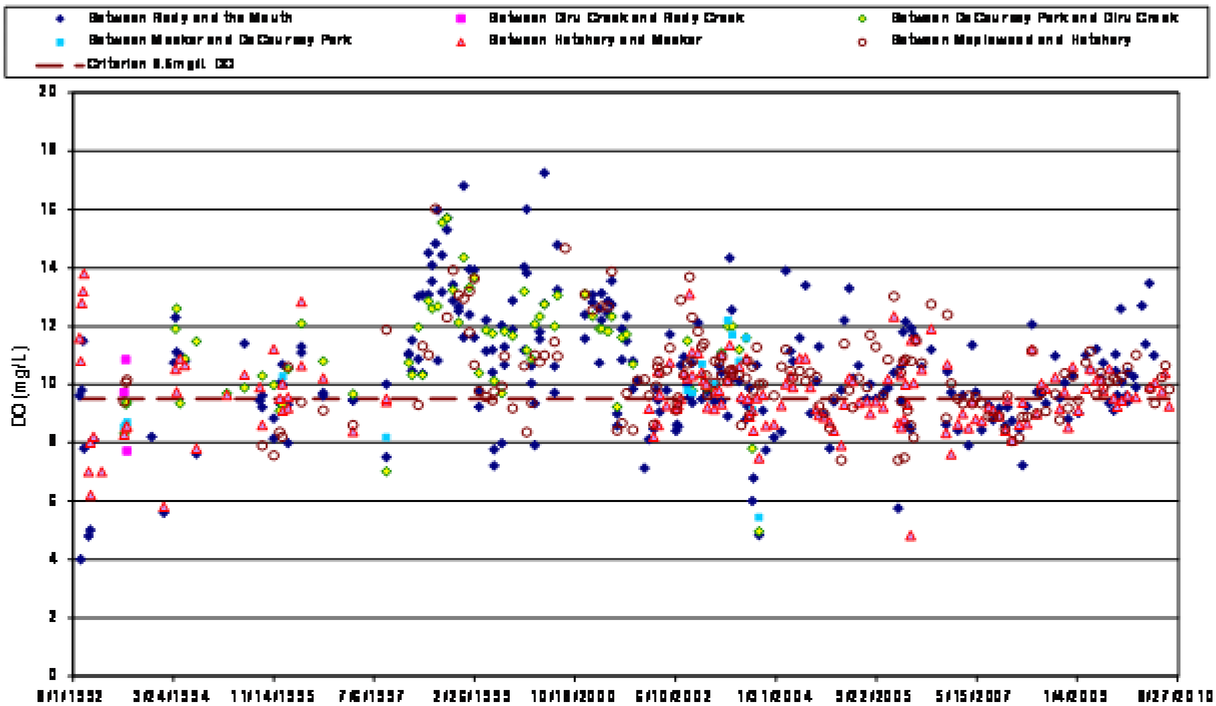

Figure 11. DO Concentrations measured in Clarks Creek 1992 - 2010

The TMDL further defined the relationship using continuous DO data collected by the Puyallup Indian Tribe in the fall of 2010 to precipitation data to show that the lowest DO levels occurred during the highest precipitation events. From continuous DO, turbidity and conductivity data collected between 2009-2010 by PTI, the TMDL concluded that higher flows correlated to higher DODs at Tacoma Road (see Figure 16 below).

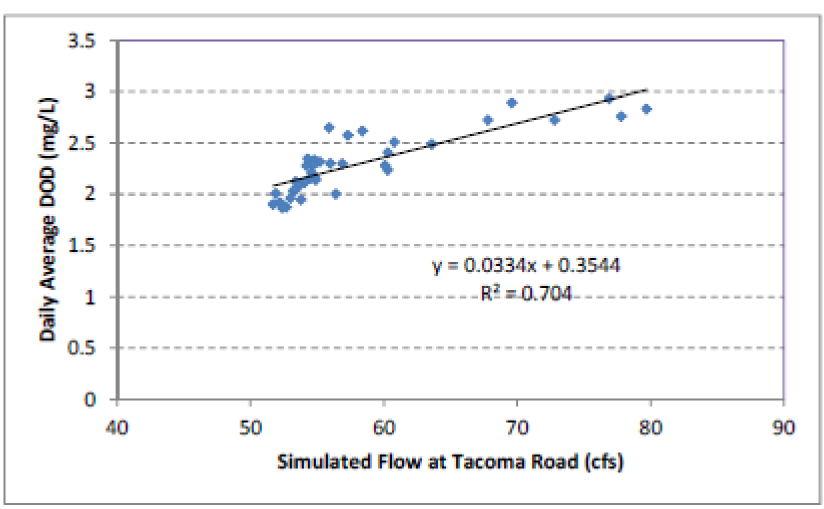

Figure 16. Relationship between DOD at the tribal hatchery (CLK-4) and simulated flow at Tacoma Road, Sept.-Oct. 2010 PTI monitoring.

Finally, additional sampling of 4 storm events in 2011 and 2012 confirmed that stormwater inflows deliver low concentrations of DO. The PTI monitoring data from 2010 combined with this study provide clear evidence that DO concentrations are consistently low during storm events and a general decline occurs as *flows increase throughout the wet season, indicating that stormwater has a cumulative effect on DO concentrations during the winter."*

The TMDL model was calibrated or corroborated to four dry weather and two wet weather events (see Appendix D of the TMDL for more details):

7/10/09: Represents the system at baseflow conditions before elodea cutting.
7/20/09: Represents the system at baseflow conditions when elodea cutting had proceeded only up to Tacoma Road.
8/6/09: Represents the system at a date after full elodea cutting with baseflow conditions.
8/20/02: Represents the system near baseflow conditions, assuming no elodea cutting.
9/12/03: Represents the system during stormflow with flows 20-percent above baseflow conditions.
10/21/03: Represents the system during 2-year rainfall event - this is the critical condition.

Model parameters perform well across the range of dry and wet condition events available for calibration. It is true that calibration addressed only one "large" storm event, but this is the extent of events for which synoptic measurements of flow and DO were available at the time the modeling was conducted. Ecology is confident that an adequate number of samples and storm events were used to calculate the TMDL.

b) **Background:** Sediment data used for calculating load reductions was limited and mostly model-based, yet TSS is presented as a driver for DO depletion through elodea establishment and SOD. Sediment characterization was completed during a one week period of time shortly after elodea cutting, which stirs up sediment and could affect DO levels in the creek.

Comment: WSDOT recommends that Ecology demonstrate the representativeness of the sediment data used to calculate load reductions.

Ecology response: *The sediment reduction is based on three lines of evidence, including the Newcombe and Jensen assessment that identified a 50-75% reduction in suspended sediment was necessary to reduce impacts to aquatic life, the Sediment Reduction Study HSPF model which would require a 76% reduction in sediment to return to natural forested conditions at the 66th Avenue site, and 64% reduction in sediment loading necessary to meet Puget sound lowland stream reference conditions that support a healthy aquatic environment. Hayslip (2013) evaluated eight Puget Sound Lowland reference streams to determine the percent silt and fines present at reference locations in streams with similar elevations, gradients, and geology as the Clarks Creek basin. The Sediment Reduction Study relied on data specific to the Clarks Creek basin and Hayslip used data from reference streams to draw conclusions and calculate load reductions.*

Based on these assessments, "the loading capacity is expected to meet designated uses because; 1) it is equivalent to the reduction necessary in percent sand and fines to meet reference conditions; 2) it is expected that aquatic life will respond beneficially to the sediment reductions (Newcombe, 1996); and 3) the reduction will result in a long-term average flow weighted TSS concentration of about 2 mg/L, which is similar to TSS concentrations in reference Puget lowland systems." Finally, Ecology must develop the loading capacity to achieve water quality standards under all conditions; in this case, those were where the highest reductions were needed.

c) **Background:** WSDOT questions the scientific credibility of the data used to calibrate and corroborate the model. We were unable to locate the specific criteria, including data quality objectives (DQOs) and quality control (QC) procedures, used to evaluate the secondary data due to the circular nature of the references and lack of supporting documentation.

Comment: WSDOT recommends that Ecology include, as an appendix, the sample data used to calibrate, corroborate and develop allocations, as well as the associated data quality objective and quality control documents used to ensure the scientific credibility of the data. If this information is not available, WSDOT recommends collecting additional data using scientifically credible data collection procedures.

Ecology response: *The TMDL summarizes modeling and QAPP documentation, and provides reference to additional more detailed documentation in QAPPs and model reports. On page 39, the draft TMDL states:*

> *As part of the Clarks Creek DO study for PTI, Brown and Caldwell collected and analyzed data according to the study's quality assurance project plan (QAPP) (Brown and Caldwell, 2009). Stormwater data from the oxygen-demanding sources investigation for PTI was collected and analyzed according to the study's quality assurance project plan (Tetra Tech, 2011b). Field data collection and hydraulic modeling for the Clarks Creek Sediment Action Plan was completed according to the QAPP designed for the project (Brown and Caldwell, 2011). See Appendix B for a summary of the Model QAPPs for the HSPF and QUAL2Kw modeling.*

In the draft TMDL Appendix B, see page B-163 for a summary of the HSPF Model QAPP, and see page B-168 for 163 for a summary of the QUAL2Kw Model QAPP. Appendix B also summarizes the model calibration and corroboration exercises, stating clearly that observed data were used and providing figures that illustrate the data used. Additional documentation can be found in the model documentation: Tetra Tech (2011) and Tetra Tech (2012) for QUAL2Kw and HSPF, respectively. Conventional data collected for the bacteria TMDL is summarized in the QAPP prepared for the grant by URS and Brown and Caldwell in 2002 (City of Puyallup, 2002).

City of Puyallup. 2002. Clarks Creek Watershed Pollution Reduction Project Quality Assurance Project Plan. Prepared by URS and Brown and Caldwell.

4) Model assumptions and uncertainty.

Background: Groundwater and SOD may play an important role in the quality and quantity of Clarks Creek and its tributaries. Both were included in the model based on assumptions and estimates as the result of insufficient data. WSDOT feels that in order to meaningfully evaluate sources of DO impairment and long term attainment of water quality standards, it is important to more thoroughly understand and account for groundwater impacts and SOD components.

The QUAL2Kw model for Clarks Creek was calibrated using three summer dry season samples from 2009, and then corroborated against two summer dry season samples from 2002/2003. Finally, the model was applied to a 2003 storm/high flow event. Due to lack of data, assumptions were made to populate the model. These uncertainties compound upon each other resulting in questionable model outputs. The model documentation (Tetra Tech, 2011) states, "In sum, data sets available for model development are not comprehensive. Therefore, the model is used primarily in an exploratory and sensitivity analysis mode." Yet, as stated on page 36 of the draft document, the model was used to determine loading capacity for DOD, allocations for DOD and sediment, and the stormwater implementation target.

Comment: WSDOT feels the model should not have been used in this capacity and strongly questions the validity of its model outputs. WSDOT believes that additional information, described in Comment 2, is necessary before model outputs are used in decision-making.

Ecology response: *The language in Tetra Tech (2011) refers specifically to the initial exploratory and sensitivity analyses conducted and documented within the same report. Under the "Modeling Framework" section of the TMDL report, the sensitivity analyses are listed as one of several potential uses of the QUAL2Kw model. Tetra Tech (2011) represents a preliminary assessment of QUAL2Kw capabilities in the* *initial steps of building a conceptual representation of processes controlling DO. The statement in Tetra Tech (2011), which is taken out of context in this comment, is not applicable to the subsequent TMDL modeling.*

In addition, the comment misstates the basis for the sediment allocations and stormwater implementation targets, for which the modeling was used. In fact, the model was calibrated to four dry weather and two wet weather events (as is stated in Appendix D):

7/10/09: Represents the system at baseflow conditions before elodea cutting.
7/20/09: Represents the system at baseflow conditions when elodea cutting had proceeded only up to Tacoma Road.
8/6/09: Represents the system at a date after full elodea cutting with baseflow conditions.
8/20/02: Represents the system near baseflow conditions, assuming no elodea cutting.
9/12/03: Represents the system during stormflow with flows 20-percent above baseflow conditions.
10/21/03: Represents the system during 2-year rainfall event - this is the critical condition.

It is true that calibration addressed only one "large" storm event. More events would be desirable, but this is the extent of events for which synoptic measurements of flow and DO were available at the time the modeling was conducted. Model parameters perform well across the range of dry and wet condition events available for calibration. In fact, although more resource demanding approaches can improve modeling accuracy and precision, which may allow smaller margins of safety and higher load allocations. Selection an approach ultimately depends upon available resources and if it will represent the system sufficiently to determine if beneficial uses can be restored through allocations. The TMDL meets state and federal guideline as it was developed with the best data and models available at the time and the load allocations were calculated under critical conditions to protect the beneficial uses of Clarks Creek.

5) Wasteload allocations

a) **Comment**: WSDOT questions the legal authority for establishing sediment WLAs when a sediment water quality standard does not exist.

Ecology response: *Water quality standards do exist for anthropogenic inputs of sediment as with any other materials that are deleterious to the uses of state waters. Ecology therefore has the authority to limit such pollutants through waste load allocations in order to protect, maintain, and restore the designated uses of a water body.*

Ecology's authority to limit pollutants from entering state waters is clearly stated by the following state Water Pollution Control Act (WPCA):

Revised Code of Washington 90.48.080 – Discharge of polluting matter in waters prohibited.
It shall be unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the department, as provided for in this chapter.

Further, the WPCA defines pollution broadly:

Revised Code of Washington 90.48.020 – Definitions.

Whenever the word "pollution" is used in this chapter, it shall be construed to mean such contamination, or other alteration of the physical, chemical or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or *to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.*

We encourage the commenter to refer to the following section of state rule WAC 173-201A – Water Quality Standards for Surface Waters of the State of Washington in relation to the authority of the Department of Ecology to use not only numeric but also narrative criteria to protect the existing and designated uses of state waters.

Washington Administrative Code 173-201A-010
(1) The purpose of this chapter is to establish water quality standards for surface waters of the state of Washington consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife, pursuant to the provisions of chapter 90.48 RCW. All actions must comply with this chapter. As part of this chapter:

> ***(a)*** *All surface waters are protected by narrative criteria, designated uses, and an antidegradation policy.*
>
> ***(b)*** *Based on the use designations, numeric and narrative criteria are assigned to a water body to protect the existing and designated uses.*
>
> ***(c)*** *Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criteria for each parameter is to be applied.*

The following narrative criteria apply to all surface waters of the state include lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Washington Administrative Code 173-201A-260(2)
The following narrative criteria apply to all existing and designated uses for fresh and marine water:
(a) Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health.

b) **Comment:** WSDOT recommends that Ecology ensure that all known "point" sources in the watershed are assigned a WLA (secondary NPDES permittees, hatcheries, Industrial and Sand & Gravel NPDES permittees, etc.,) to achieve a more equitable distribution of responsibility.

Ecology response: *As stated in response to Pierce County Comment 32 A, the tribal hatcheries are currently below the fish production threshold requiring Federal Hatchery NPDES permits and their discharge were considered non-significant. The TMDL establishes the monitoring to quantify the hatcheries influence on Clarks Creek. If needed, the TMDL will use this monitoring data to establish a wasteload allocation for the tribal Hatcheries.*

Ecology evaluated both Industrial and Sand and Gravel facilities within the Clarks Creek Watershed. None of the Industrial facilities directly discharge to Clarks Creek or its tributaries. Northwest Cascade – Canyon Rim Estates Sand and Gravel facility (WAG501040) is permitted to discharge to Rody Creek; however, according to DMR data it has not had a surface discharge since starting operations in October 2010. Miles S & G Plant 12 (WAG401041) is permitted to discharge to the ground. If either of these facilities changes operations in a manner which necessitates incorporation of the facility into the WLA calculation, the permit manager will notify the TMDL Lead so the facility is included in the TMDL.

The WLA is based upon current point source dischargers under NPDES permits. Should the need arise, the WLA could be reapportioned to adjust to new secondary MS4 permittees such as school districts, hospitals or drainage districts. Additionally, see Ecology's guidance on secondary permittee coverage and the petitioning process for bringing in new MS4 permittees available at, respectively, *http://www.ecy.wa.gov/programs/wq/stormwater/municipal/secondaryneedpermit.html and http://www.ecy.wa.gov/programs/wq/stormwater/municipal/PetitionCriteriaRevcontact108.pdf. If WSDOT has identified more facilities, please share this list with Ecology so these facilities can be evaluated.*

6) Confusing/contradictory information.

a) **Background:** WSDOT interprets the implementation target (50% reduction of stormflow volume or untreated stormwater) to apply watershed-wide (within the TMDL boundary). However, Tables 14 and 15 suggest volume reductions are required at specific locations.

Comment: WSDOT suggests deleting Tables 14 and 15 or adding clarification.

Ecology response: *The implementation targets provide surrogate measures for evaluating implementation of the TMDL and summarizing the many different implementation options into a single score. These reductions are assigned to the major stormwater inputs, which are the stormsheds of Meeker Creek Conveyance, Pioneer Way plus 7th Avenue Conveyance, Woodland Creek, Diru Creek, and Rody Creek. These are drainage areas, not individual point locations. As shown in Table 14 and 15, implementation targets are provided for the whole watershed as well. Division into drainage areas assists in assigning allocations to individual regulated entities; however, it is the total reduction requirement for each entity (not the location of individual projects) that is the ultimate requirement. Implementation targets are provided based on modeling of individual stormsheds as suggested guidance for implementation planning.*

b) **Background:** Pages 45-50 state, "stream flows are high in winter when stormwater runoff is high, and water temperature and plant growth are low. Under these conditions, pollution in storm water contributes to an accumulation of oxygen-demanding substances over time as well as acute contributions of low DO concentrations." However, the only storm water monitoring presented in the draft document (conducted by PTI in 2011 and 2012) did not provide conclusive evidence of this claim.

Comment: WSDOT recommends that Ecology delete statements in the draft document that are unsupported by conclusive evidence or citation. Ecology should add evidence to support a clear quantifiable tie between storm water and low DO.

Ecology response: *See responses to comments #1 and #2 above. The cited conclusion is made in the report on the 2011-2012 monitoring. It also follows logically that higher stormflows result in higher loads of nutrients and organic matter, while lower temperatures result in lower rates of decomposition. The comment is correct in that time series of sediment measurements were not conducted over the course of the winter; however, Ecology does not believe that such data collection is necessary to support the statement. Therefore, it is not deleted. The explanation of the tables occurs in the paragraph above the tables:*

> *"To calculate the amount of stormwater flow volume that needs to be either treated or detained by a jurisdiction in a given drainage area, the WLA (or LA) is set equal to one-half the stormwater flow volume predicted to be generated by the HSPF model for the 10/21/03 event from upland land areas within that jurisdiction and specified conveyance drainage area. Table 14 shows the total stormwater flow volume for the 10/21/03 event originating within each jurisdiction by conveyance. Table 15 presents the targets in terms of untreated stormwater flow volume (50% reduction or treatment of stormwater flow volumes from Table 14) to be reduced. These targets are met if stormwater volume is reduced or if additional stormwater is treated such that, if a storm event identical to the 10/21/03 event were to occur, untreated stormwater flow would not exceed the flow volumes in Table 15."*

Comment: In addition, we would like to provide the following specific comments, which include the page number and wording in question or of concern:

7) Page xii and xvii - Implementation target date (year) is not consistent:

- Page xii, paragraph 1: "When completed the TMDL reductions should be achieved by 2034."
- Page xvii, paragraph 3: "When completed, the TMDL reductions should be achieved by 2033."

Ecology response: *Comment noted. Date changed to 2034.*

8) Page 2, first sentence: "Ecology uses the 303(d) list to prioritize and initiate TMDL studies across the state." However, this TMDL was initiated in 2008 but DO wasn't added to the 303(d) list until the 2012 marine water update (12/21/12). WSDOT suggests removing this contradictory statement.

Ecology response: *Comment noted. For more details, see Background section under Why Ecology Conducted a TMDL Study in this Watershed:*

> *In May 2008, Ecology conducted a fecal coliform bacteria TMDL analysis on Clarks and Meeker Creeks. At that time those waters were listed as Category 2 (waters of concern) for DO and pH, and scientists thought the low DO and high pH was likely caused by the natural conditions in the groundwater that feeds Clarks Creek. Therefore, Ecology did not pursue TMDL development for DO or pH in the basin at that time.*
>
> *Since 2008, the Puyallup Tribe of Indians (PTI) has conducted studies to confirm DO impairment. In November 2009, Brown and Caldwell performed an investigation that also showed there was DO impairment in Clarks Creek. The studies indicated anthropogenic causes and elodea overgrowth were contributing to the DO excursions. The DO in the lower reaches of Clarks Creek appeared to be influenced by biochemical oxygen demand (BOD) and SOD. At the time of the studies, Ecology was completing the TMDL for fecal coliform and, to continue the momentum, decided that the DO impairment needed to be addressed even though it was not officially on the 303(d) list at the beginning of this study. As a result of the new data, the creek was placed on the 2012 303(d) list with an impairment for DO.*

9) Page 133 summarizes WSDOT's municipal permit requirements within the TMDL boundary. Suggest the following revisions for clarity and consistency with permit language:

"WSDOT will implement the following, which includes some pollution-prevention measures that address ~~fecal coliform and~~ sediment delivery, for state road and highway runoff according to its Stormwater Management Program Plan (SWMPP) and Municipal Stormwater NPDES General Permit in all applicable Phase I and II coverage areas:

- IDDE (source identification and control).
- Construction stormwater pollution prevention.
- Implementation of Highway Runoff Manual (stormwater BMP design manual equivalent to Ecology's Stormwater Management Manual.)
- Stormwater BMP retrofit program.
- Highway maintenance program.
- ~~WSDOT will inventory highway stormwater discharge locations within its right-of-way inside the Clarks Creek DO and Sediment TMDL boundary.~~

"WSDOT will inventory its stormwater-related facilities to document their location <u>and aid in</u> set<u>ting</u> levels of maintenance service, identify deficiencies and illicit discharges, and address deficiencies by prioritizing retrofits. All known ~~sewer~~ outfalls, discharge points, and ~~structural~~ stormwater treatment/ ~~and flow~~ control facilities ~~BMPs~~ (including UIC facilities) owned or operated by WSDOT will be mapped. WSDOT must m~~M~~aintain and update the inventory to reflect new construction and system modifications as they occur. ~~Mapping must continue on an ogoing basis as additional outfalls are found and as new BMPs are constructed or installed.~~"

Ecology response: *Comment noted. Text on page 133 in reasonable assurance section updated to reflect changes suggested above.*

10) Page 134, Table 19: Suggest adding the following sentence prior to the table, "Compliance with the following specific actions constitutes compliance with the assigned Wasteload allocations."

Ecology response: *Comment noted. Text on page 133 in reasonable assurance section updated to reflect changes suggested* ***above.***

11) Page 135, Table 19: Suggest the following revision based on verbal agreements with EPA and Ecology staff of WSDOT's assigned action: "WSDOT will inventory highway stormwater discharge locations within its right-of-way inside the Clarks Creek DO and Sediment TMDL boundary."

~~WSOOT will inventory its stormwater related facilities to document their location, set levels of maintenance service, identify deficiencies and illicit discharges, and address deficiencies by prioritizing retrofits.~~

~~All known sewer outfalls and structural stormwater treatment and flow control BMPs owned by WSDOT will be mapped. Mapping must continue on an ongoing basis as additional outfalls are found and as new BMPs are constructed or installed.~~

Ecology response: *Comment noted. Text in Table 19 updated to reflect changes suggested* ***above.***

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Clark County

Comments on draft Clarks Creek TMDL
Email Received 07/21/2014,

Comment: While Clark County does not have a direct stake in the Clarks Creek TMDL, the approach to this TMDL does raise some concerns. An overarching concern is that the TMDL appears to assume stormwater is the cause of a complex web of conditions leading to increased growth of an undesirable aquatic weed, and then sets out to prove it. Cherry picking and misinterpreting information to support an argument is a real problem with this report. One example is the use of BIBI scores from a low-gradient, sand-dominated stream to compare to gravel-pool-riffle reference streams. Then using the expected lower scores for a sand dominated stream to argue there is too much sediment loading to Clarks Creek.

Ecology response: *It is incorrect that a causal link was assumed prior to the study. Extensive exploratory analysis was performed on multiple datasets representing different temporal and spatial scales before the conclusions were drawn and the conceptual model was developed that describes the linkages between stormwater runoff and low dissolved oxygen as part of the complex processes occurring in the watershed.*

The B-IBI is a quantitative measure of the biological health of a particular stream reach that can be tracked for changes through time as well as for comparison with scores from other stream reaches. The applicability of the B-IBI within the Puget Lowland is broad enough to be relevant at multiple scales. The Pierce County Watershed Health Monitoring Program collected benthic macroinvertebrate data at three locations within the Clarks Creek basin between 2001 and 2010. The samples were collected on Diru, Rody and Clarks Creek. The B-IBI scores tabulated at the sites ranged between Fair and Poor. On the B-IBI index categorical scale (adapted from Karr et al., 1986 and Morley, 2000) this means "total taxa richness is reduced – particularly intolerant, long-lived, stonefly, and clinger taxa; the relative abundance of predators has declined; and the proportion of tolerant taxa continues to increase" and the "Overall taxa diversity is depressed; the proportion of predators are greatly reduced as is long-lived taxa richness; there are few stoneflies or intolerant taxa present; and the dominance by the three most abundant taxa are often very high." The decline of total tax richness, intolerant, long-lived, stonefly and clinger taxa are all indicative of human disturbance and sediment deposition in the stream (see attached table). Ecology used the best available data in the basin to support the TMDL.

There is no reference or least disturbed sites in Clarks Creek, so to estimate natural background sediment conditions, EPA evaluated reference sites outside of the basin. Reference sites were selected based on 3 criteria. First, the reference sites needed to be located in the same ecoregion, the Puget Lowland ecoregion, and have similar elevations, gradients, and geology as Clarks Creek. Second, the reference sites were required to have minimal human disturbance. Third, the reference sites had to have a consistent data set for B-IBI and percent sand/fines that was collected under an approved Quality Assurance Project Plan (QAPP). The reference sites that were used to develop the reference condition were: Big Beef Creek, Chuckanut Creek, Coal Creek, Coulter Creek tributary, Crandall Creek tributary, Dewatto River, Oyster Creek, and Surveyor Creek. We then used the range of data from all of these sites, not any one specific site, to compare to Clarks creek.

Finally, the negative relationship between sediment and macroinvertebrates is well established both regionally and internationally. As percent fines and sands increase, taxa richness declines and more pollutant tolerant species dominate. The following references provide further details on this both regionally and throughout the U.S.

Cuffney, T.F., Brightbill, R.A., May, J.T., Waite, I.R. 2010. Response of benthic macroinvertebrates to environmental changes associated with urbanization in nine metropolitan areas. Ecological Applications 20: 1384-1401.

Larsen, S., Pace, G., Ormerod, S.J. 2011. Experimental effects of sediment deposition on the structure and function of macroinvertebrate assemblages in temperate streams. River Research and Applications 27: 257-267.

US Environmental Protection Agency. 2000. National water-quality inventory. Office of Water, US Environmental Protection Agency, Washington, DC.

Comment: In light of the weak body of data and a complex set of conditions leading to the Elodea problem, an adaptive management approach appears the more practical course given the high cost and low certainty of success of treating and infiltrating huge volumes of stormwater runoff. The empirical relationship between riparian shade and Elodea coverage in Figure 26 suggests a waste load allocation for riparian shade should be implemented before an all-out stormwater retrofit program. Ecology may claim that revisiting TMDLs is not cost effective, but the cost of attaining loading targets by constructing stormwater retrofit projects will be tenfold higher or more of the cost to re-visit the TMDL now and again. Expensive retrofitting with public funding should be a last resort not the first off-ramp because it's convenient.

Ecology response: *The study results cite multiple data sets and analysis results, including statistical correlation, indicating that stormwater is a major stressor linked to both sediment and low dissolved oxygen in Clarks Creek. Allocations for riparian shade alone would ignore the multiple stressors identified by Ecology's study and the linkages between those stressors as illustrated in the conceptual model (page 44 of the TMDL). The TMDL is based on dissolved oxygen deficit and sediment load, and the stormwater implementation targets are provided as guidelines, not requirements, for implementation. As discussed in the implementation plan, many types of projects are recommended for implementation and are not limited to stormwater retrofit projects. The TMDL allows permittees the flexibility of selecting implementation projects based on relative cost-effectiveness. Implementation is expected to occur over a long period of time, yielding the opportunity to modify permit requirements if additional data and information are forthcoming. Therefore, the strategy will, in practice, represent an adaptive management approach.*

Comment: Considering the lack of data to support models and conclusions, the effort to improve DO and reduce Elodea growth should focus on better understanding the exact cause of these problems. If it is unequivocally found that stormwater runoff bearing sediment is the cause, a TMDL on sediment loading would be reasonable. It does not appear to be the case at this time.

Ecology response: *The draft TMDL document presents a thorough analysis of data collected at multiple temporal scales and flow regimes as well as extensive modeling analysis of both dissolved oxygen and sediment. The study results and linkages between sources, stressors, and impairments are documented in the Study Results section of the draft TMDL. Model calibration is summarized in Appendix B, and additional documentation of data used to support modeling can be found in the model documentation: Tetra Tech (2011) and Tetra Tech (2012) for QUAL2Kw and HSPF, respectively.*

Comment: I'm concerned that the analysis relies heavily on the use of a water quality model that is not calibrated to Clarks Creek data.

Ecology response: *Both the HSPF and QUAL2Kw models were calibrated using data collected in Clarks Creek as documented in the draft TMDL (Appendix B). Additional documentation of data used to support modeling can be found in the model documentation: Tetra Tech (2011) and Tetra Tech (2012) for QUAL2Kw and HSPF, respectively.*

Comment: Generally, there are speculative statements presented as fact. For example, the report on page 41 notes that there is a small drop in dissolved oxygen concentration below a fish hatchery discharge but dismisses influence of the hatchery and speculates that the drop caused by low gradient hydraulics and macrophyte growth below the hatchery. Is that data presented elsewhere in the report?

Ecology response: *The paragraph on page 41 in the draft TMDL document was referring to a series of box plots that were inadvertently omitted from the draft. On average there is a small decline in DO below the state hatchery. This decline could be a result of inputs from the hatchery, other inputs of water depleted in DO, or stream conditions. Because the hatchery discharge occurs at about the point where the stream velocity decreases due to lower gradient on the alluvial plain and near the upstream occurrence of Elodea growth, both of which affect the DO balance, the data alone are not sufficient to distinguish between these potential sources. That is why we use a model.*

Comment: Qualified conclusions are presented as factual basis for TMDL assessment. On page 44 the following paragraph is used to draw a direct link between Elodea and DO. However, the link is fairly qualified as "appeared to affect DO":

"In 2009 and 2010, PTI and Brown and Caldwell conducted a study of temperature, DO, DO saturation, and turbidity before, during, and after elodea cutting events at CLK-4, CLK-TR, and CLK-8 (see Figure 7 for site locations). These studies provided information to assess the impacts of elodea on the DO balance in Clarks Creek (Brown and Caldwell, 2009). The study concluded that "elodea appeared to affect DO concentrations in the creek. Daily minimum DO concentrations appeared to increase after the City removed elodea from the creek" (Brown and Caldwell, 2009)."

Ecology response: *The word "appear" does not imply that statistical confidence was assessed. Instead, the word "appear" refers to a visual interpretation of data providing evidence that DO increases following Elodea cutting. Table 5 across pages 44-45 shows that average minimum DO and minimum DO saturation increased consistently across the three locations sampled after Elodea cutting. These data represent one among several lines of evidence relating Elodea to DO concentrations. This footnote is meant to describe the purpose of a single monitoring study, not the basis for the TMDL, which would not be appropriate for this section. The TMDL document sections "Conclusions and Recommendations" and "TMDL Analysis" summarize the evidence that supports the conceptual model, identification of major stressors and sources, and basis for the TMDL allocations.*

Comment: Water temperature data are grab samples and not appropriate for comparison the 7-day moving average maximum daily temperature.

Ecology response: *Seven-day moving average maximum daily temperatures (7DADMax) are mentioned in the TMDL primarily as part of explaining the applicable water temperature standards. The TMDL document does not address temperature impairments, and indeed provides evidence for attainment of these criteria. The following statement is found on page 60: "Assessment against the water quality criteria for temperature requires continuous monitoring data because these criteria involve 7-day averages of daily maximum temperatures. PTI has conducted continuous temperature monitoring at several locations, which allows partial assessment against these criteria. Only station CLK-8 is within the segment of Clarks Creek for which the supplemental spawning/ incubation criteria of 13 ºC (as a 7-day average of daily maximum temperatures) applies from September 15 to July 1. The highest 7-day average of daily maximum temperatures observed at CLK-8 during the supplemental period is 11.2 ºC.*

Comment: Total suspended solids concentrations are quite low at ~ 20 mg/l. The TMDL uses estimated TSS from the HSPF model to create data to calculate a salmon stress metric of 'mild to moderate'. This synthetic pollutant effect on a beneficial use seems speculative when real data could be used to decide if there is a stress on salmon. That real world data is lacking in Clarks Creek to match TSS concentration and duration to salmon stress.

Ecology response: *Relatively low TSS concentrations can still contribute to biological impairment. As explained under the section "TMDL Analysis – Sediment –Analytical Framework," both suspended and bedded, in-channel sediment sources have been identified as causing impairments. The section goes on to discuss how relatively low TSS concentrations were more difficult to capture with the modeling, with the implication that modeling may be underestimating TSS concentrations and their resulting contribution to the sediment load. Thus, the draft TMDL document provides a conservatively low estimate of the severity score. In addition, compliance with standards was not solely based on the Newcombe and Jensen assessment results.*

The Salmon Habitat Limiting Factors Report for the Puyallup River Basin (Kerwin, 1999) specifically identifies habitat limiting factors in Clarks Creek, Diru Creek, Meeker Creek, and Rody Creek (Table 2) as "fish passage, floodplain connectivity, bank stability, LWD, Pools, side channel habitat, substrate fines, riparian, and water quality." Specifically, the report says tributary streams in the lower Puyallup River Subbasin (including Clarks Creek, Meeker, Diru, and Rody Creeks) "…have suffered the fate of most streams found in urban settings. They carry high levels of fecal coliform bacteria and stormwater that is contaminated with heavy metals, oil, grease and organic compounds. Large amounts of fine sediments are also typically found in most reaches." There is a large body of literature to support sediment as a limiting factor on salmon. Here are a few citations: Kerwin, J., 1999, Jensen et al., 2009; Reiser, D.W., 1998; Waters, T.F., 1995.

Jensen, D.W., E.A. Steel, A.H. Fullerton, G.R. Pess, 2009. Impact of Fine Sediment on Egg-To-Fry Survival of Pacific Salmon: A Meta-Analysis of Published Studies. Reviews in Fisheries Science: V17:I 3.

Kerwin, J. 1999. Salmon Habitat Limiting Factors Report for the Puyallup River Basin (Water Resource Inventory Area 10). Washington Conservation Commission, Olympia, WA.

Reiser, D.W., 1998. "Sediment in gravel bed rivers: Ecological and biological considerations." Gravel-Bed Rivers in the Environment. P.C. Kingeman, R.L. Beschta, P.D. Komar, and J.B. Bradley, eds., Water Resources Publications, Highlands Ranch, Colorado, 199-225.

Waters, T.F. 1995. Sediment in streams—Sources, biological effects, and control. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, MD.

Additionally, the factors influencing fish communities have also been shown to negatively influence stream macroinvertebrate communities. Several references are provided below.

Cuffney, T.F., Brightbill, R.A., May, J.T., Waite, I.R. 2010. Response of benthic macroinvertebrates to environmental changes associated with urbanization in nine metropolitan areas. Ecological Applications 20: 1384-1401.

Larsen, S., Pace, G., Ormerod, S.J. 2011. Experimental effects of sediment deposition on the structure and function of macroinvertebrate assemblages in temperate streams. River Research and Applications 27: 257-267.

US Environmental Protection Agency. 2000. National water-quality inventory. Office of Water, US Environmental Protection Agency, Washington, DC.

The 64% reduction is based on three lines of evidence, including the Newcombe and Jensen assessment that identified a 50-75% reduction in suspended sediment was necessary to reduce impacts to aquatic life; the Sediment Reduction Study HSPF model which would require a 76% reduction in sediment to return to natural forested conditions at the 66th Avenue site, and 64% reduction in sediment loading necessary to meet Puget sound lowland stream reference conditions that support a healthy aquatic environment. "This loading capacity is expected to meet designated uses because 1) it is equivalent to the reduction necessary *in percent sand and fines to meet reference conditions; 2) it is expected that aquatic life will respond beneficially to the sediment reductions (Newcombe, 1996); and 3) the reduction will result in a long-term average flow weighted TSS concentration of about 2 mg/L, which is similar to TSS concentrations in reference Puget lowland systems." Finally, Ecology must develop the loading capacity to achieve water quality standards under all conditions; in this case, those were where the highest reductions were needed.*

Comment: The report generally ignores groundwater, and there's no mention of dissolved phosphorus in groundwater which could be a major contributor to Elodea growth. Also, there is no mention of groundwater flow into the channel bed which could also be a significant source of low-DO water and phosphorus.

Ecology response: *The statement that "the report generally ignores groundwater" is incorrect as groundwater is discussed on pages 22, 27, and 45 of the draft document and the TMDL modeling accounts for groundwater influences.*

Ecology reviewed all of the USGS groundwater reports for available phosphorus data in the Clarks Creek basin. Only one report sampled groundwater for phosphorus. The purpose of the Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington Report 86-4154 was to assess the quality of ground and surface waters in and adjacent to the lower Puyallup River valley to determine its suitability for various uses including use in hatchery ponds. Dissolved phosphorus data, collected from groundwater from February through August 1984 and presented in the 1987 USGS report, for Maplewood Springs and one Clarks Creek shallow well show concentrations of 0.02-mg/L and 0.15-mg/L, respectively. The report concluded, "Dissolved phosphorus concentrations … should not pose serious water-quality problems (Ebbert et al., 1987)."

The study results sub-section on phosphorus states that water column phosphorus concentrations "in general may be of limited significance in a water body dominated by rooted macrophytes such as elodea, as these plants are typically able to compensate for any shortfall in their phosphorus needs by uptake from the sediment (Angelstein and Shubert, 2008)." While some phosphorus may be contributed to stream sediment by direct groundwater seepage, the majority is expected to derive from stormwater washoff. This occurs because phosphorus associates with particulate solids and has a relatively low solubility. Most phosphorus is sorbed within the soil matrix, resulting in limited transmission via groundwater. Therefore, dissolved phosphorus in groundwater was not considered a major contributor to Elodea growth. Phosphorus loading to the stream from diffuse groundwater was accounted for during the QUAL2Kw model calibration and is documented in Tetra Tech (2011).

Groundwater flow into the stream channel is addressed in the modeling using the term "diffuse inflow," and the modeling of diffuse inflow is documented on pages 45, 100, and B-170 of the draft TMDL document. Diffuse inflow represents all minor sources that enter the creek through locations other than defined and explicitly represented tributaries and stormwater conveyances. This includes minor tributaries, direct runoff from lands along the creek, anthropogenic inputs from irrigation or exterior washing activities, springs, other direct groundwater input, and ground water that seeps to the surface on land adjacent to the stream. As noted above, phosphorus loading from diffuse inflow was accounted for during QUAL2Kw model calibration (Tetra Tech, 2011).

J. C. Ebbert, Bortleson, G. C., Fuste', L. A., and Prych, E. A., 1987. Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington. U.S. Geological Survey: Water-Resources Investigations Report 86-4154. Tacoma, WA.

Comment: It's impractical to think about stormwater runoff as a point source. Urban stormwater runoff is nearly as uncontrollable and uncertain as nonpoint sources like Agriculture, so to simply assume that because models say loads will be achieved by intensely applying stormwater BMPs is irresponsible.

Municipal stormwater permittees should not be held to the same standard as other permittees for the purpose of assigning waste load allocations. Large areas of the permittees stormwater systems are receiving runoff from properties out of the permittees control. These areas where storm connections were made before the onset of the Phase I permits should be identified and assigned a load allocation not under the control of the permittees.

Ecology response: *TMDL development follows established federal rules (40 CFR 122.26(b)(9)) that define the outfalls of municipal separate storm sewer systems (MS4s) as point sources. The issue of stormwater systems receiving runoff from properties outside the jurisdiction should be handled during the permitting process and is not the responsibility of the TMDL development process.*

Comment: Ecology seems to rely on reasonable assurances for assigning load allocations to non-point sources, but what's the reasonable assurance that reducing runoff volume from permitted MS4s will meet load targets? A model simply doesn't provide the assurance.

Ecology response*: The terms "reasonable assurance" has a specific meaning in the context of TMDLs. According to EPA's TMDL guidance (http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/final52002.cfm):*

> *When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.*
>
> *When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.*

This should not be confused with methods for assigning load and wasteload allocations among the identified sources. See response to comment #2 above regarding the fact that the TMDL is based on DOD and sediment load (not runoff volume), and see response to comment #3 above regarding model documentation. See other comments regarding non-point pollution reasonable assurance under Comment 4 Question B.

Comment: Ecology should not rely on assigning waste load allocations to non-pollutants. This is not an argument against surrogate pollutants or indices of toxicity, but against non-pollutants; like water or runoff or runoff volume or impervious area. The relationship between the activities undertaken and the outcomes have not been verified, only modeled, and will require significant financial resources with uncertain gains. Furthermore, the courts have said that federal law does not authorize EPA to regulate non-pollutants. Testing the state's authority to regulate non-pollutants hasn't happened in court yet but could soon and that's not a good use of resources either.

Ecology response: *As noted in the TMDL, Clark County's assertion that the Draft Clarks Creek TMDL attempts to regulate stormwater flow as a pollutant is incorrect. The Clarks Creek TMDL sets implementation targets for stormwater that can be used to meet the pollutant reductions for DO and sediment.*

It is also incorrect that federal courts have ruled that stormwater flow is not a pollutant under the Clean Water Act. If Clark County is referring to the U.S. District Court's decision on the EPA-issued Accotink

TMDL, it is important to note that the district court's decision about the validity of the Accotink TMDL is not binding outside of this particular TMDL. In addition, the court limited its decision to an interpretation of the parts of the Clean Water Act that are relevant to TMDLs, and it did not discuss the permitting aspects of the Clean Water Act. The decision, therefore, does not address in any way the EPA's municipal separate storm sewer system (MS4) permitting program or the parts of the Clean Water Act or EPA's regulations that address that program.

The Clarks Creek DO and Sediment TMDL is issued by the Washington Department of Ecology and must meet state regulations. State regulations must be equal or more stringent than federal Clean Water Act standards. The district court ruling on the Accotink decision does not apply to the use of stormwater flow surrogates by Ecology for TMDL pollutant allocations when following guidance established by the EPA and as authorized by state and federal laws and rules. Ecology has successfully used surrogate measures for TMDLs in the past and will continue to use them where appropriate to establish meaningful and achievable water cleanup targets.

The EPA continues to believe that, under appropriate conditions, surrogate TMDLs can be a valuable tool for restoring and protecting impaired water bodies. They also may, in appropriate circumstances, provide a more efficient and cost-effective means for addressing certain impairments caused by multiple pollutants rather than by using a pollutant-by-pollutant approach. For example, addressing impairments caused by stormwater discharges and runoff in a way that is measurable, that adequately represents the pollutants and stressors contributing to the impairment, and that facilitates implementation can serve as a cost-effective tool for restoring urban waters affected by stormwater pollutants. One of the benefits of the surrogate approach is that it highlights the benefits to state and local governments of focusing their efforts on controlling high flow storm events rather than engaging in pollutant-by-pollutant reduction strategies.

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Puyallup Historical Hatchery Foundation

Date: 6/28/14

To: Department of Ecology – Washington State
Attention: Brett Raunig

From: Puyallup Historical Hatchery Foundation

Re: Clarks Creek – TMDL Report

The Puyallup Historical Hatchery Foundation was created in 2012 with a mission to preserve the Puyallup Hatchery as a State treasure and more importantly, to teach to watershed education utilizing the beautiful natural grounds it operates on and Clarks Creek which flows through it.

Within the scope of our mission, our goal is to see the complete restoration of Clarks Creek and help in that regard in an appropriate manner.

Several Directors from our Foundation attended the TMDL presentation that was held at the Puyallup Library on June 10, 2014. We appreciate the considerable time, effort and cost that went into the collection of data presented in the study.

In our opinion, this study and plan for the next 20 years will not fulfill the goal of a fully restored Clarks Creek. Within the reasoning and scientific data supplied and submitted by Don Russell, more positive action could occur which was overlooked and/or omitted from the TMDL Report. We concur with his writings and would ask that you review all that he has submitted in response to the issued draft TMDL study as being our concerns as well.

We truly believe that a full restoration of Clarks Creek is possible and it is important to present a TMDL study that will work on all its issues over the coming years. This exciting opportunity to document and record this work will be a shining example to others of what is possible when citizens care.

Patty Carter

Patty Carter, Director
Puyallup Historical Hatchery Foundation

Mailing Address: PHHF, 2011 5th Avenue SW, Puyallup, WA 98371
Email: puyalluphatchery@yahoo.com Phone: 253.640.1376
Hatchery location: 1416 14th Street SW, Puyallup, WA

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Puyallup Historical Hatchery Foundation

Comment:

Ecology response: *Ecology appreciates the Puyallup Historical Hatchery Foundation involvement in the TMDL process. We understand that local landowners are interested in dredging the creek to remove the sediment that has accumulated over the years. Without the implementation of the Clarks Creek Dissolved Oxygen and Sediment TMDL, this activity would need constant maintenance as new sediment from upland sources filled in. For more detailed information please refer to previous Ecology Comments to Don Russell:*

- *Comment Don Russell 6/11/14 – The Effect of Iron Pollution in Clarks Creek*
- *Comment Don Russell 6/11/14 – The Problem with the Clarks Creek TMDL*
- *Comment Don Russell 6/11/14 – What Needs to Happen*

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Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

July 8, 2014

Brett Raunig
Washington Department of Ecology
P.O. Box 47775
Olympia, WA 98504-7775

Re: EPA Public Comments on Clarks Creek Dissolved Oxygen and Sediment Total Maximum Daily Load (TMDL)

Dear Brett:

Thank you for the opportunity to review the Clarks Creek Dissolved Oxygen and Sediment TMDL. We have appreciated the collaboration and stakeholder outreach since the process began four years ago. The Clarks Creek Dissolved Oxygen and Sediment TMDL shows great promise for resulting in near-term and long-term improvements in the basin, and we look forward to supporting these efforts. Enclosed are the EPA's comments. If you have any questions, please contact me at 206-553-6328 or by e-mail at Wu.Jennifer@epa.gov.

Sincerely,

Jennifer C Wu

Jennifer Wu, Environmental Engineer
EPA Region 10, Seattle
Office of Water and Watersheds, Watershed Unit

Overall Comments

1. The document does a good job of describing the problems in the watershed, how problems were identified, and what needs to be done. In particular, the reasonable assurances section and implementation section provide detailed information on existing programs, specific projects that jurisdictions can undertake to meet their allocation, and possible grants. Although the EPA does not approve or disapprove the implementation of TMDLs, it would be helpful to identify prioritized projects, if known, that would result in the greatest environmental benefit and any other detail on implementation activities that would result in more on the ground improvements (e.g., Elodea Task Force recommendations, WSU Puyallup Projects, Pierce Conservation District, etc). Also, any other information related to highlighting specific projects, partnerships, leveraging funds and resources, etc would be useful to include, if available.

Ecology response: *Comment noted. Ecology has added items to the implementation plan to include currents efforts and ongoing projects - items added include: the Elodea Task Force, Stream Side adjacent Landowners, and Clarks Creek Initiative Group.*

Specific Comments

2. Pages xvii, paragraph 2, Executive Summary. Sediment Targets. The Executive Summary describes the dissolved oxygen stormwater implementation targets in some detail and briefly states that sediment needs to be reduced. It would be helpful to briefly describe the sediment problems in the same way that dissolved oxygen is described or make a statement that the sediment target is to reduce levels by 64%.

Ecology response: *Changed the following statement from: "The implementation target for DO is to reduce 50% of stormflow volume or treat 50% of untreated stormwater. Pierce County and the city of Puyallup are required to develop a plan with BMPs to meet these implementation targets. When the TMDL is released they will have 18 months to develop this plan." to: "The implementation target for DO is to reduce 50% of stormflow volume or treat 50% of untreated stormwater. The Sediment TMDL wasteload allocation prescribes a 64% sediment reduction. Pierce County and the city of Puyallup are required to develop a plan with BMPs to meet these targets. When the TMDL is released they will have 18 months to develop this plan."*

3. Pages xvii, paragraph 1, Executive Summary. Load Allocations for elodea densitv and riparian shade. The end of paragraph 1 should include load allocations for elodea density and riparian shade and who is responsible for meeting those load allocations.

Ecology response: *The following sentence has been added to the end of the paragraph, "Load allocations for elodea density and riparian shade, implemented through non-point source compliance programs by Pierce County and the City of Puyallup, are required to achieve water quality standards in Clarks Creek."*

4. Pages xvii, paragraph 3, Executive Summary. TMDL reduction achievement date. Based on dates in other parts of the TMDL, it appears that TMDL reductions should be achieved by 2034, not 2033.

Ecology response: *Date changed to 2034.*

5. Page 5, 4th paragraph. Purpose of sediment reduction study. While dissolved oxygen and sediment are clearly linked, the Puyallup Tribe's grant application to EPA for the sediment reduction project was because they believed that sediment itself was impairing Clarks Creek. Therefore, the interest in sediment in Clarks Creek is two-fold. Sediment itself is a problem, and sedimentation causes and/or contributes to low dissolved oxygen.

Ecology response: *Text in the paragraph changed from "While total suspended solids (TSS) and turbidity have been measured historically in the watershed, much of the work studying sediment in Clarks Creek has occurred in recent years and was initiated for the purposes of understanding the DO impairment. The interaction between sediment and dissolved oxygen led to the assessment that sediment itself is also impairing designated uses as well as contributing to the DO impairment. Ample evidence of the sediment impairment has been collected through studies on fine sediment and fine sediment levels compared to reference stream conditions, sediment loading evaluations and biotic integrity." to "While total suspended solids (TSS) and turbidity have been measured historically in the watershed, much of the work studying sediment in Clarks Creek has occurred in recent years and was initiated for the purposes of understanding the sediment impairment, sedimentation and its role in DO impairment. The interaction between sediment and dissolved oxygen led to the assessment that sediment itself is also impairing designated uses as well as contributing to the DO impairment. Ample evidence of the sediment impairment has been collected through studies on fine sediment and fine sediment levels compared to reference stream conditions, sediment loading evaluations and biotic integrity."*

6. Page 6, 2nd paragraph. EPA Funding for TMDL. PTI requested contractor funds from EPA to do a TMDL.

Ecology response: *Changed text from "In 2009, PTI requested EPA initiate a TMDL for DO on Clarks Creek. The basis of this request was predicated on the following:" to "In 2009, PTI requested contractor funds from EPA to initiate a TMDL for DO on Clarks Creek. The basis of this request was predicated on the following:"*

7. Page 26, last paragraph. Industrial stormwater discharges. It appears that since the sand gravel permitted facilities do not discharge into Clarks Creek, they do not contribute to the impairment in Clarks Creek, rather than them "not substantively contributing [sic]" to impairment.

Ecology response: *Changed text from "According to Ecology's PARIS database reviewed in June 2012, three (3) industrial permitted facilities and two (2) sand and gravel permitted facilities are located in the Clarks Creek watershed; none of these facilities directly discharge to Clarks Creek, and therefore are not assumed to substantively contribute to the impairment in Clarks Creek." to "According to Ecology's PARIS database reviewed in June 2012, three (3) industrial permitted facilities and two (2) sand and gravel permitted facilities are located in the Clarks Creek watershed; none of these facilities directly discharge to Clarks Creek, and therefore do not contribute to the impairment in Clarks Creek."*

8. Page 36, Table 9. Models. It appears that some of the bullet points are missing information in the table.

Ecology response: *Replaced with correct table (below).*

HSPF

- Use simulated flow data throughout watershed to analyze water quality observations,
- Describe production and transport of sediment and other pollutants as a function of land use and flow.
- Develop overall sediment balance.
- Estimate upland sediment production rates.
- Simulate existing conditions and build-out conditions.
- Analyze SOD in conjunction with the density of elodea.
- Generate flow-duration curve to analyze flow regime of storm events with available data and determine critical conditions.
- Provide an additional line of evidence for the sediment loading capacity.
- Estimate percent of stormwater flow from sources for DOD allocations.
- Determine implementation targets based on stormflow by jurisdiction.

QUAL2Kw

- Develop DO Mass Balance during critical conditions.
- Explore the system's sensitivity to changes in nitrate, riparian shading, SOD, and flow withdrawals.
- Determine the reduction needed from various pollutants to meet DO water quality standards under critical conditions.
- Determine loading capacity for DOD; and allocations for DOD and sediment.
- Determine implementation targets based on stormflow by jurisdiction.

9. Page 88, 5th bullet. Sediment Summarv. There is a lot of information in this bullet, and it might be easier if it were simplified such as the following: "While fine sediment transport is expected in a basin ... the amount of fine sediment and sand (versus gravel) in the lowlands is double to almost triple the 90th percentile of percent fines and sands in reference basins of similar slope. A 63% (or 64%} reduction in sediment is needed to meet the reference conditions." If the other information of actual% fines and sands is already in the text, I would suggest not including it in the summary bullet point, since it's easy to get confused with the% targets versus% fines and sands.

Ecology response: *Changed text from "While fine sediment transport is expected in a basin with glacial till in the uplands, the amount of fine sediment and sand (versus gravel) in the lowlands is double to almost triple the 90th percentile of percent fines and sand in reference basins of similar slope (37%). At two sites, Clarks-08 and Clarks-09, sand and fines make up almost 100% of the bed composition, thus requiring a 63% reduction to meet reference conditions. At the same two sites, the percentage of fine sediment (silt and clay only) is 50% to 80% greater than the 90th percentile for reference basins: 41% at Clarks-08 and 35% at Clarks-09." to "While fine sediment transport is expected in a basin, the amount of fine sediment and sand (versus gravel) in the lowlands is double to almost triple the 90th percentile of percent fines and sands in reference basins of similar slope. A 63% (or 64%) reduction in sediment is needed to meet the reference conditions."*

10. Pages 116-117, Load allocations for elodea density and riparian shading. Please clarify whether these load allocations are assigned to an entity.

Ecology response: *The following text was added to this section of the TMDL, "These load allocations are assigned to stream adjacent landowners and entities with control over land use activities."*

For clarity Ecology also combined the "Reduction in elodea density" and "Riparian shading" sections and renamed them ***Elodea density and riparian shading****.*

Nonpoint source pollution reduction requires involvement and commitment at both the local and state level. Local governments have a role to play in addressing nonpoint source pollution, and are well suited to address local water quality issues. They are more directly tied to the community and have unique opportunities to work directly with residents to address identified pollution issues such as those outlined in a TMDL. Local governments also have more control over land use regulation via critical area ordinances, zoning or other ordinances.

TMDLs encourage people to proactively address nonpoint pollution and comply with the load allocation by taking advantage of existing regulatory and financial incentive programs. To address nonpoint pollution, local governments can conduct a variety of activities such as education and outreach, code enforcement and code development, create and/or implement local pollution reduction programs such as pollution identification and correction programs, and develop incentive programs to promote the adoption of best management practices. These are a few examples of how local government can provide oversight and monitoring of nonpoint source pollution, which also can be used to address water quality impacts that stem from the lack of stream-side vegetative buffers.

Ecology also has laws and regulations that can be used to prevent or correct nonpoint source pollution such as RCW 90.48, the Water Pollution Control Act. Ecology staff often coordinates with local governments to assist in the implementation of TMDLs and TMDL related programs, and can provide regulatory compliance assistance when needed or appropriate.

In EPA's 1991 "Guidance for Water Quality-Based Decisions: The TMDL Process", they state "In order to allocate loads among both point and nonpoint sources, there must be reasonable assurances that nonpoint source loads will in fact be achieved. Where there are not reasonable assurances, under the CWA, the entire load reductions must be assigned to point sources."

11. Page 119, 2nd paragraph. Sediment allocation. Please clarify the remaining allocation requires a 66% reduction. The loading capacity requires a 64% reduction, but part of that is a reserve capacity. Is that correct?

Ecology response: To clarify this section the following text on page 119, 2nd paragraph was reworded to include the following text:

> *"The loading capacity of the stream is set at 209 tons/year or .57 tons/day based on a 64% reduction of the current conditions simulated sediment load (580 tons/year or 1.59 tons/day) at Clark Creek at 66th Avenue (monitoring station CLK-4) estimated by HSPF modeling (Tetra Tech, 2012a).*
>
> *Because future development is anticipated in the Clarks Creek watershed, the TMDL sets aside the reserve capacity of 10 tons/year of sediment. The remaining allocation, which is a 66% reduction from current sediment loading, consists of 173-tons/year for point sources, 26-tons/year for nonpoint sources and does not include the reserve capacity. With the reserve capacity set aside the % reduction needed increases from 64% to 66%."*

12. Page H-212 to H-213, Geomorphic Flows. It should be noted that the TMDL group had discussed the concept of geomorphically significant flows earlier on in the project, but concluded that sediment allocations derived from the sediment reduction study and Puget Sound Lowland reference stream data would be adequate to address sediment problems.

Ecology response: *Comment noted. No text added to the appendix.*

Edits

13. The following are typos or minor grammatical edits:
    a. Title Page, Dissolved Qxygen.
    b. Page xi, 4th paragraph, last sentence....reference streamsL and reduced sediment...
    c. Page 37, 1st title at top of page. Water quality [space needed) data.
    d. Page 74, 2nd paragraph, 1st sentence. Figure 38 [space needed] presents e.
    Page 97, 1st paragraph, 1st sentence. Reaeration —no dash.

Ecology response: *All changes noted above were corrected.*

The Puyallup Tribe of Indians

Comment: Regarding the draft TMDL document, can a global be done on the final to change the names of the 2 tribal hatcheries to Diru Creek Tribal Hatchery and Clarks Creek Tribal hatchery? Also, please articulate distinct allocations for each of the tribal hatcheries in the document so it is clear what the expectation is.

Ecology response: *Ecology updated the TMLD document and changed the text for the tribal hatcheries to Diru Creek Tribal Hatchery and Clarks Creek Tribal hatchery. The tribal hatcheries allocation was split into two distinct allocations based on the average lbs of fish and feed used at the facilities. See the following updated TMDL Allocation table below:*

Table 1. Allocations Expressed as DOD (kg/d)

	DOD (kg/d)
TMDL (kg/d) = WLA + LA + MOS	**719**
Total WLA (kg/d) +	**625**
*WLA: State hatchery**	24
WLA: City of Puyallup MS4	318
WLA: Pierce County MS4	263
WLA: WSDOT	21
Total LA (kg/d)	**94**
LA: Properties adjacent to creek	90
LA: Diru Creek Tribal Hatchery	2.4**
LA: Clarks Creek Tribal hatchery	1.6***
MOS (kg/d)	*implicit*

+Due to rounding, the WLAs add up to 626 kg/day.
*This translates to a CBOD-5 of 47.7 kg/day.
**This translates to a CBOD-5 of 4.56 kg/day.
***This translates to a CBOD-5 of 3.04 kg/day.