West-Side Stream Crossings, Fisheries, and Aquatic Resources Impact Assessment Review

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1 Olympic Pipeline Summary of Impacts to West Side Fisheries and Aquatic Resources

The Olympic Pipeline Company ("Olympic") proposes to build and operate a 231 mile long Cross-Cascade Pipeline between Woodinville, Washington, and Pasco, Washington. Approximately 57 miles of the proposed pipeline, along with two pumping stations, are located in western Washington. Of the 57 miles of pipeline in western Washington, 53 miles of it are located in the Snohomish/Snoqualmie Basin. The proposed location of the pipeline route is described in detail in Section 2.1 of the Revised Application, as well as in many other sections of the Revised Application. Along the 57 miles of pipeline in western Washington, 84 streams and 45 wetlands will be crossed. The type of proposed crossing methods at streams include trenching (30), crossing above and below culverts (44), and using bridges (10).

Olympic concludes that the primary impacts to fishery resources from pipeline installation and associated construction will be to water quality (sedimentation) and physical alteration of in-stream and stream adjacent habitat. Revised Application, page 3.4-73. Olympic further concludes that construction impacts will be minimal and be short in duration so long as the proposed mitigation measures are implemented. Olympic also concludes that operation and maintenance activities should have no impacts on aquatic resources so long as the proposed mitigation measures are implemented.

2 Summary of Additional Necessary Information

This section describes information which, in addition to the information found in the Revised Application, must be used to properly evaluate this project's impacts to fish and habitat.

Four literature sources not identified by Olympic that discuss fish distribution, stream habitat condition, and landscape conditions over much of the pipeline route within the Snoqualmie watershed include:

- Snohomish River Basin Work Group, 1996. Snohomish River Basin fish mapping workshop, August 16, 1995. Marysville, WA
- Weyerhaeuser Company, 1993. Tolt Watershed Analysis Report. Tacoma, WA
- Weyerhaeuser Company, 1995. Griffin-Tokul Watershed Analysis Report. Tacoma, WA
- Stober, Q.J., C.R. Steward, and F. Winchell, 1983. Tolt River Fisheries and Instream Flow Analysis. Final Report. Department of Water. Seattle, WA

Information contained in these documents would, if consulted, have provided a more complete understanding of the aquatic resources present, and the types of the landscape processes active in the region. The information would have been valuable in siting a pipeline, designing a pipeline, and addressing cumulative effects.

2.1 Fish Resources and Habitat Preferences

The following information is discussed to more fully describe the fishery resources at risk, their distribution, and habitat preferences. The following discussion focuses on salmon and trout resources in the Snoqualmie drainage.

Section 3.4, at pages 3.4-62 to 3.4-67 of the Revised Application, briefly summarizes fish resources along the different sections of the Snoqualmie Basin crossed by the pipeline. Despite that description, however, the lower Snoqualmie River is not used only as a migration corridor by the species discussed in the Revised Application. See page 3.4-62. It is also used by chinook salmon for rearing (Snohomish River Basin Work Group 1995), and for rearing by steelhead, cutthroat trout, and coho. North Fork Cherry Creek (stream crossings 18 and 19) support anadromous salmon and resident trout. Cherry Creek (stream crossing 20) is a primary spawning area for steelhead (Snohomish River Basin Work Group 1995) and is most likely used by other species of anadromous salmon for spawning and rearing.

The middle Snoqualmie River is not only a migration corridor, but it is also used by chinook salmon, and steelhead for rearing and spawning, by pink salmon and possibly chum for spawning (Snohomish River Basin Work Group 1995). It is also used for rearing by steelhead, coho, cutthroat and other nonsalmonids. Harris Creek and its tributaries (stream crossing 23 and an unidentified stream) are highly productive coho streams. The Harris Creek stream crossing and the associated wetlands provide excellent rearing habitat for coho. Harris Creek, in the vicinity of the stream crossing, is also used by steelhead (Snohomish River Basin Work Group 1995). The lower 6 miles of the Tolt River is one of two primary spawning areas for chinook, pink, and steelhead in the Snoqualmie watershed. In fall 1998, chinook were observed spawning in the vicinity of the proposed Tolt River crossing site. Side channels, like stream crossing 27, provide excellent rearing habitat for coho, juvenile trout, and also provide excellent spawning habitat for coho. The lower Tolt River also provides rearing habitat for steelhead, chinook, coho, and cutthroat trout.

The upper Snoqualmie River (below the falls) is not only used by the species discussed in the Revised Application (page 3.4-64), but is also used by steelhead for spawning and rearing (Snohomish River Basin Work Group 1995). Steelhead also have access to the lower mile of Tokul Creek, just downstream of the pipeline crossing. Griffin Creek is one of, <u>if not the most important</u>, coho producing area within the Snohomish watershed. Within the Snoqualmie River system between 1984 and 1992, Griffin Creek escapement ranged from 29% to 43% of the total escapement to the Snoqualmie River (Griffin/Tokul Watershed Analysis 1995). See <u>Attachment 1</u> to this Report (Snohomish Coho Eescapement Iindex (1984-1993)). Griffin is also used by cutthroat trout, steelhead, and, to a lesser extent, chinook, pink, and chum salmon. The use of the Snoqualmie River by Dolly Varden/Bull trout is unknown. It is suspected that they may use portions of the lower Snoqualmie River, including the lower portion of Griffin Creek as rearing habitat (Griffin/Tokul Watershed Analysis 1995).

The Snoqualmie River above the falls (mile post 34 to mile most 57) provides habitat for rainbow and cutthroat trout. In addition to rainbow and cutthroat trout, brook trout and mountain whitefish also inhabit the S. F. Snoqualmie. Other resident species include sculpin spp, longnose dace, and large-scale sucker (South Fork II 1983)

2.1.1 Chinook Salmon

Chinook salmon in the Snohomish Basin have been proposed for listing under the ESA as a threatened species. The following information is provided to more fully describe their distribution within the Snoqualmie than provided in the Revised Application.

The chinook stock in the Snoqualmie River project area is Snohomish fall chinook. Their distribution includes the Snoqualmie River, Sultan River, Pilchuck River, Woods Creek, and Elwell Creek (SASSI 1993). Approximately 75% of the fall chinook escapement spawns in the Snoqualmie drainage (Curt Kramer, WDFW, personal communication). Within the Snoqualmie River, fall chinook principally rear in the Snoqualmie River from Snoqualmie Falls to its confluence with the Skykomish River. A disproportionately high number of fall chinook juveniles rear for a year within the Snoqualmie River; however, where fall chinook yearlings rear is not certain (Snohomish River Basin Work Group 1995). Juvenile chinook prefer backwater and natural bank habitat. Stream banks that are hydromodified (e.g. rip-rap) are utilized by one-third of the number of chinook that use natural banks (PFMC 1997). The principal spawning areas for fall chinook in the Snoqualmie River are a) between river mile 34 and 40; b) between river mile 22 and 25; c) the lower 5 miles of the Raging River; and d) the lower 6 miles of the Tolt River. Rearing and spawning may also take place to a limited degree in the Raging River (river mile 5.0 to 9.0), the Tolt River (river mile 6.0 to 11.0), the lower 1.6 miles of the S.F. Tolt River, Tokul Creek (river mile 0.0 to 0.5), Griffin Creek (river mile 0.0 to 5.0), Cherry Creek (river mile 0.0 to 3.0), and Patterson Creek (river mile 0.0 to 2.0).

On page 3.4-169 Olympic states that none of the stream crossings in the project area will impact spawning areas used by wild Puget Sound chinook populations. Olympic couldn't be more incorrect. Chinook spawn at the Tolt River crossing and possibly at the Cherry and Griffin Creek crossings. Construction impacts and operational impacts pose a serious risk to the spawning population that use the Tolt River at and downstream of crossings 26 and 27, including the Snoqualmie River. Pipeline spills along the major stream crossings downstream of the Tokul Creek pose a very

serious threat to fall chinook.

2.2 Types of Potential Impacts to Salmon from Construction

Starting on page 3.4-101 of the Revised Application, the adverse impacts to fish resources from construction of the pipeline are summarized. In addition to the information provided in the Revised Application, the following information is submitted to expand upon the impacts and fish responses that can be expected during construction.

Construction can be expected to affect one or more of the following habitat and life stage requirements: a) water quality and quantity, b) food quantity, c) the quality and quantity of spawning and rearing habitat, and d) access. The loss of one or more of these habitat requirements will result in a reduced production potential.

Construction impacts on these habitat requirements can best be described by evaluating impacts according to life stages. During each life stage of the pacific salmon, one or more of these habitat requirements change. Therefore, pipeline construction impacts on habitat requirements will affect different life stages. Life stages include adult migration, juvenile rearing, spawning and incubation. Since habitat requirements vary by salmon life stage, impacts to habitat from construction and operation will also vary. The timing of salmon and trout freshwater life phases can be found in Attachment #2

2.2.1 Adult Migration

Adult migration can be hindered or blocked by construction of the pipeline. Migrating salmonids avoid water with high silt loads and cease migration when such loads are unavoidable (Cordone and Kelley 1961). They also avoid high water temperatures. Localized increases in water temperatures may delay adult migration to spawning areas upstream of the pipeline crossing. These avoidance responses can result in potentially lower production upstream and downstream of the crossing. This causes a reduction in the utilization of habitat within the stream system. Migration that is hindered by construction can also result in a delayed mortality. Returning adult salmon do not feed while in freshwater and rely on energy stores accumulated during their marine residence. Increased stress during migration or delays can increase the utilization of energy stores leading to mortality prior to spawning, or reduced fecundity. Construction at several crossings (e.g. Tolt River, Cherry Creek, Griffin Creek) during September and October may block access or delay migration of adults to spawning areas upstream.

2.2.2 Rearing

Pipeline construction can lead to direct mortality of adults and juveniles at the construction site, since Olympic mentions no attempt at removing fish from crossing locations. If suspended sediment levels become high enough, direct mortality to juvenile salmon is possible. Suspended sediment concentrations in excess of 1000 mg/l have been shown to cause direct mortality to salmonid fry (May 1996; Newcombe & McDonald 1991; Noggle 1978). Stress and avoidance are two other responses that are highly likely that can result in a delayed mortality or lowered production. High turbidity levels caused by construction will reduce the amount of juvenile rearing at and downstream of stream crossings. Bisson and Bilby (1982) reported that juvenile salmon avoided water exceeding 100 mg/l. Sigler et al. (1984) found that steelhead trout and coho salmon exhibited higher emigration rates in turbid streams and decreased resistance to other environmental stressors. Chronic levels of turbidity in excess of 50 ntu can significantly reduce steelhead and coho populations and growth (Noggle 1978). These avoidance responses result in potentially lower production at the crossing site and downstream. Newly emerged fry appear susceptible to even moderate turbidities. Turbidities equivalent to 125-275 mg/l of bentonic clay reduced growth and caused more young coho salmon and steelhead to emigrate from laboratory streams (Sigler et al. 1984). Late summer construction that causes increased turbidity can decrease feeding efficiency and reduce macro-invertebrate production for 2-3 months or longer, resulting in a reduction in juvenile growth which may determine whether juvenile trout or coho survive over the winter.

Increased turbidity and the deposition of fine sediment that will be produced by pipeline construction will have a negative effect on algae and macro-invertebrates. Turbidity levels as low as 25 (ntu) can decrease primary

productivity by as much as 50% (May 1996). Reductions in macro-invertebrate species diversity and community composition often accompany inputs of fine sediment into stream systems (May 1996; Karr 1991).

Pipeline construction at stream crossings will also reduce other important components of rearing habitat cover and pool volume. The loss of riparian vegetation and the cover it often provides will reduce the quality of rearing habitat and therefore the carrying capacity of the stream at the crossing site. The loss of large woody debris and cover it provides will, if not properly mitigated, also reduce the quality of rearing habitat. The presence of mass wasting features and high erosion potential at a number of stream crossings could result in pool filling downstream of the pipeline, thus decreasing rearing space Cover and pools are two important elements of rearing habitat. Cover includes undercut banks, low lying riparian vegetation, large woody debris, depth, large substrate, turbulence. Salmon search out cover for refuge from predators and high water velocities . Pool within a stream are the primary location for rearing (Nelson 1998). They provide a variety of conditions (i.e. depth, velocity) for many species and life stages. The loss of these components will reduce the quality and quantity of rearing habitat. Impacts from pipeline construction will be both short term and long term depending on the mitigation measures proposed, whether they are successfully implemented, and how the stream responds at the pipeline crossing. The presence of mass wasting features, high erosion potential, scour and lateral migration, at a number of stream crossings could result in negative long term changes to rearing habitat.

2.2.3 Spawning

Increased levels of fine sediment from construction can be deposited in spawning gravels, reducing spawning success. Increased fine sediment in spawning areas can reduce egg survival by impeding the movement of water through spawning sediments or by preventing alevins from emerging from the streambed. During egg incubation, water must circulate around the eggs to provide oxygen and remove metabolic waste. Increased fines within the spawning gravels will reduce this circulation, resulting in mortality, delayed hatching, and decreased growth. Attachment 2 to this Report illustrates the impact that elevated fine sediment levels can have on embryo survival (Bjornn and Reiser 1991). Small increases (10%) in the percentage of fines can have a significant effect on embryo survival. The impact from small increases in fine sediment can be even more deleterious if fine sediment levels are already high (15%). Impacts from the construction will vary site by site. The success of mitigation measures and the subsequent flows will determine the level of impact. To say that “impacts will be short-term” (Revised Application page 3.4-101) ignories local site conditions, construction methods, and the sensitivity of the resources present. Spawning impacts caused by sedimentation from pipeline construction can result in the loss or significant reduction of an entire year class of fish, causing a reduction in the salmon population for several subsequent annual cycles - or, in the case of pink salmon, eliminate a portion of the run. Attachment 3 to this Report illustrates the impact that elevated fine sediment can have on embryo survival (Bjornn and Reiser 1991).

Olympic mentions on page 3.4-102 of the Revised Application, “…that by properly timing construction the release of sediment will not reduce reproductive success.” Olympic thus suggests that if fine sediment levels are a problem in spawning gravels, a fish will simply move to another location. This analysis does not take into account, however, the avoidance response that could force more fish into a smaller area, leading to a lower egg-to-fry survival. Olympic also fails to mention that chinook, coho, pink, and chum spawn in the fall, during and shortly after the construction window. The generation of fines could seriously affect, depending on stream flow, where spawning occurs and the success of the spawning. Olympic mentions winter and spring freshets that remove the fines; however, these usually occur after chinook and pink spawn, and they may not occur until November and December when coho and chum are spawning.

3 Errors and Omissions in the Revised Application

The Revised Application fails to provide enough information on the resources and site conditions present at stream crossings to meaningfully evaluate project impacts. It provides an inadequate review of aquatic resources and site conditions at stream crossings, and the potential for impacts that may arise from pipeline construction and operation. The Revised Application overlooks informational resources and provides an insufficient review of existing resources. It fails to present a complete picture of the potential types, severity, or magnitude of impacts. Potential

impacts to aquatic resources are discussed in several sections, making the Revised Application difficult to review. Finally, organization of the document splits up the assessment of impacts so that each are evaluated independently, indirectly minimizing the level of impact to a resource.

3.1 Stream Crossing Conditions and Processes

Threats and impacts to fisheries and aquatic resources are discussed in several sections of the Revised Application (e.g., water, plants and animals, earth, construction), making evaluation difficult. The Fisheries and Aquatic Resources section often refers to other sections of the Revised Application to elaborate on impacts, making it much more difficult to get a sense of a true measure of the impacts and their potential magnitude. Pipeline impacts in one section are not clearly conveyed to other relevant sections. The Revised Application is frequently ambiguous when discussing mitigation measures.

For example, Olympic relies on several commonly used data sources, listed on page 3.4-57 of the Revised Application, to evaluate stream crossing conditions and the presence of aquatic resources. However, the resolution of the databases and maps do not lend themselves to describing site specific information for which they were used without extensive field checking. The resolution of the data (e.g., topographic maps), and in some cases the accuracy of the data (Data96) used to assess conditions, were inadequate. In a study conducted by Dragovich et al. (1993), USGS topographic maps tended to underestimate local slopes, which has a significant influence on the potential for surface erosion or mass wasting. The stream catalog (Williams et al. 1975) and the Washington Rivers Information System (WARIS) provide generalized information by stream, but not by reach. In a study conducted by Bahls and Ereth (1994), the Washington State Department of Natural Resources (DNR) stream typing database was found to greatly underestimate the occurrence of fish-bearing streams and other stream types in watersheds of the Olympic Peninsula. Conroy (1998) also documented major errors in the (DNR) stream typing database. The DNR stream typing database underestimates fish use in the Snoqualmie Basin by 50 percent (Conroy, personal communication).

Olympic relies on habitat surveys at stream crossings to characterize stream crossing conditions. For example: “The habitat characteristics of the project streams were developed from the field survey information.” Revised Application at page 3.4-61. However, the qualitative nature of the habitat surveys and the limited number of actual on-site surveys gives an inadequate basis to assess crossing or local conditions. Stream channel conditions that are qualitatively described by one observer can be described significantly different from another observer. Qualitative descriptions are very subjective. What is observed depends on the experience and background of the observer. Quantitative measurements, on the other hand, are far more useful in describing actual site conditions, and may be used for modeling or other numerical evaluations. For example, channel and valley cross sections would have been useful in describing conditions (e.g., confinement, channel entrenchment), and evaluating scour and lateral migration. Also, stream crossing information was not collected consistently.

Likewise, fish presence data at the pipeline crossings were not collected consistently. In some cases, alternate sites were assessed and analogized to the actual crossing site, with the assumption that the alternate stream held the same conditions as those present at the actual crossing site (e.g., Humpback Creek, Little Bear Creek). Habitat surveys were conducted on only 24 of the 84 stream crossings between Thrashers Corner and Snoqualmie Pass. On page 3.4-58, Olympic mentions surveys conducted in 1996 and 1997. However, no field data was provided.

Within the Sammamish and Snohomish river systems, Olympic discusses three major stream crossings. However, the Revised Application fails to mention that fish utilization was unknown for four of the first eight stream crossings (Table 3. page 20, Fisheries and Aquatic Resources Report). Of the fourteen crossings identified within the lower Snoqualmie River, fish utilization at five stream crossings was described as unknown. A late route alteration on the Snoqualmie Valley, east of stream crossing 11, adds two more stream crossings that were not assessed. These stream/ditches on the valley floor often provide winter rearing habitat for anadromous salmon. Olympic states on page 3.4-58 that existing bridges will be utilized at eleven stream crossings. However, the use of the bridge on the lower Snoqualmie has not been approved, and the impacts of horizontal directional drilling at this site have not been adequately discussed. Adjacent to the Tolt River, along the south bank (crossing 27), the pipeline route crosses a

deep-seated landslide, two unidentified stream crossings, and (within 100 feet) parallels a small stream - none of which are discussed. In the Snoqualmie drainage, upstream of the falls, the pipeline route is located very close to the Snoqualmie River (mile post 34), the Middle. Fork. Snoqualmie (mile post 40), and the South Fork Snoqualmie (mile posts 44 and 46), making the pipeline at these locations very susceptible to damage from lateral migration. The Revised Application does not discuss the affected environment at these locations.

The South Fork Snoqualmie and its tributaries are very active, geomorphically. The Revised Application (page 3.4-66) mentions that high bedload movement, aggraded conditions, and unstable streambanks were reported for tributaries to the South Fork Snoqualmie. These observations indicate that very dynamic conditions are present on this system. Many of the South Fork Snoqualmie tributaries are prone to debris torrents, stream scour and channel migration, all of which individually pose a real threat to the pipeline and aquatic resources. The Revised Application (page 3.4-67) makes reference to a report by Pfeiffer (1997) which indicates that the primary factor impacting stream habitat in the South Fork Snoqualmie is the intentional removal of large woody debris. It is more likely that other equally important factors or processes such as changes in sediment supply, and runoff patterns are at work that determine channel and habitat conditions within the South Fork Snoqualmie. (Barry Gall, USFS, personal communication). Other available references that should be used to describe channel conditions within the South Fork Snoqualmie and the dominant processes within the drainage are the South Fork Snoqualmie Watershed Analysis (1995) and Booth et al. (1991). Based on Table 3 in the Fisheries and Aquatic Resources Report, fish utilization for all the stream crossings within the South Fork Snoqualmie is unknown.

3.2 Cumulative Impacts

Olympic provides no meaningful discussion on the cumulative effects of the pipeline. Assessment of cumulative impacts is very important to understanding the overall quality of the watershed. The production of fines from construction may have a far more serious impact if a stream system already has a high level of fines, where fish production is already limited by sedimentation. The relative impact of pipeline construction or a spill becomes more severe in a watershed if fish resources are already depressed, or if habitat conditions as a whole are degraded. Construction or operational impacts can have a far more significant impact if they occur in major salmon production areas (i.e. Tolt River, Griffin Creek, Harris Creek, and Cherry Creek).

In four sub-basins in the Snoqualmie Basin, watershed analyses have been conducted: Tolt (1993), Griffin, and Tokul Creek (1995), and the South Fork Snoqualmie (1995). In these specific sub-basins Olympic might have assessed whether pipeline impacts would, together with other land uses, have a significant cumulative impact on aquatic resources. Watershed analysis results describe the current overall condition of the watershed, as well as conditions within specific areas of the watershed. Watershed analysis results also determine the types of land management actions may be permitted within a particular area of the basin. Watershed analysis information would have been useful in locating a pipeline route. Information generated by existing analyses was not used in the Revised Application. In addition to results, methods described in the analyses to evaluate stream channels, fish habitat, and upslope conditions would have been useful to Olympic for assessing other areas along the pipeline corridor.

In the Griffin/Tokul Watershed Analysis (1995), fish habitat was assessed. The pipeline crosses Griffin Creek in segment #3. The habitat assessment in this Analysis concluded that segment #3 rearing habitat and spawning habitat conditions were of concern. The assessment found that the occurrence of important habitat such as pools and cover were infrequent in segment #3; that occurrences of large woody debris in this segment were low (0.62 pieces/channel width); that fine sediment accumulations were observed; and that summer water temperatures are naturally high (18 degrees C). These conclusions have a direct bearing on the impact that pipeline construction can have on fish and fish habitat.

Pipeline construction will increase the amount of fine sediment within the channel, further degrading spawning habitat. Increased fine sediment levels will cause pool filling, decreasing rearing habitat volume and quality. Pipeline construction will reduce the amount of large woody debris and riparian vegetation, resulting in decreased rearing habitat quality and quantity. Both large woody debris and riparian vegetation provide important types of cover. In Griffin and Tokul Creeks, undercut banks and riparian vegetation are the most common cover types.

Removal of riparian vegetation will decrease shading, locally increasing stream temperatures that are already high. Reductions of rearing and spawning habitat conditions are magnified by the high salmon use in this segment. In other words, further degradation from pipeline construction poses a significant threat to fish resources and could result in increased losses in fish production.

3.3 Mass Wasting

Mass wasting that may be caused by pipeline construction, and mass wasting that will occur during operation of the pipeline, pose significant threats to fish and fish habitat. Without more information on site conditions or construction methodology or details, meaningful comment or analysis is difficult. Section 3.4 of the Revised Application provides very little discussion of impacts to fisheries and aquatic resources from mass wasting activities.

Mass wasting is common to the forested slopes of the Pacific Northwest. The types of mass wasting in this region include shallow-rapid landslides, debris torrents, large persistent deep-seated failures, and small sporadic deep-seated failures (WFPB 1997). The susceptibility of an area to shallow rapid landslides is increased with the loss of root strength, which will occur within the 30-60 meter-wide pipeline route. Potential mass wasting sites include not only those mentioned in the Revised Application (e.g. Peoples Creek (Crossing 15) and Cherry Creek (Crossing 20)) where shallow rapid landslides were observed, but also at locations like Griffin Creek (Crossing 28), Humpback Creek (Crossing 78) and Olallie Creek (Crossing 83) where trees still exist but will be removed during construction. Shallow rapid landslides were observed in the vicinity of the pipeline route during the Griffin/Tokul Watershed Analysis (1995), at stream crossing 28.

Debris torrents originating naturally or resulting from land use activities (e.g., logging) upstream of the pipeline have not been assessed. These physical processes can expose the buried pipeline to hydraulic and abrasive forces, resulting in pipeline leak or rupture. Debris torrents occur when landslide material first enters a steep first or second order stream channel and then liquefies. Once in the stream channel, the material moves downstream, increasing in volume to several orders of magnitude over the initial slide volume. Some debris torrents are triggered by debris avalanches of less than 100 cubic meters, but may ultimately accumulate to 10,000 cubic meters (Swanston and Swanson 1976). The possibility of debris torrents damaging the pipeline over the next 50 years must not be ignored and requires detailed evaluation. Many of the tributaries to the South Fork Snoqualmie are susceptible to debris torrents (i.e. Hall, Harris, Carter). These streams are susceptible to bed scour in the steeper locations and to lateral channel migrations and incision in locations of lower slope.

Deep-seated failures crossed by the pipeline pose unacceptable risk to fish and aquatic resources. These landscape features are capable of delivering 1000's of cubic yards of sediment to stream channels if disturbed. One such deep-seated slide, the Deforest Creek slide, delivered approximately 1.6 million cubic meters of sand and sediments to Deer Creek in the Stillaguamish drainage between 1984 and 1991 (GeoEngineers, Inc. 1992). Large deep-seated landslides like those present at the Cherry Creek crossing (20), the Tolt River (27), and the South Fork Snoqualmie (crossings 59 – 61), are in similar terrain (i.e. glacial) to landslides that have occurred in the Stillaguamish watershed. Glacial deposits occur along much of the pipeline route. In addition to the deep-seated failures identified by Olympic the Griffin/Tokul Watershed Analysis (1995) identified both deep-seated and shallow-rapid landslides in the vicinity of the proposed pipeline crossing. Pipeline construction on these deep-seated failures can alter drainage patterns destabilizing them or increasing their activity.

Mass wasting along the pipeline route is a natural threat to fish resources. Increased activity of landslides can deliver significant amounts of sediment to a stream or river causing significant channel changes. Large deep-seated landslides account for a significant amount of sediment load to the Stillaguamish watershed. The Deforest Creek slide alone doubled sediment loads to the entire Stillaguamish River (Collins et al. 1997). Landslides often occur catastrophically. These deep-seated landslides have been attributed to a decrease in salmon production in the Stillaguamish River (Williams et al. 1975) and are a limiting factor to salmon production in the Tolt River (Williams et al. 1975). The construction and operation of a pipeline through areas prone to deep-seated landslides and debris flows (e.g., tributaries to the S.F. Snoqualmie) pose a threat to the pipeline and fish resources.

In one case study, an Olympic refined products pipeline located in Spencer Creek near the Kalama River in southwest Washington fractured approximately ten years ago from earth movement, resulting in a relatively minor product spill. According to published news reports, the Company had prior notification from a neighboring landowner of the impending slide, but the Company's response procedures apparently did not prevent the fracture or spill. The resulting petroleum product leak caused a fish kill involving coho salmon for which the Olympic Pipe Line Company received administrative penalties and natural resource damage assessments by Washington's resource agencies. A catastrophic pipeline rupture would likely have released tremendous volumes of product, resulting in major fish and habitat losses. This case study would have been instructive in the evaluation of Snoqualmie Basin mass wasting features for impacts to fish and habitat.

3.4 Scour and Lateral Migration

Please see the DEIS comments of the Tulalip Tribes and other parties regarding the total lack of scour analysis in the Revised Application and DEIS. Even the DEIS at page 3-34 states: "The level of investigation proposed by Olympic to evaluate scour and lateral migration potential at most stream crossings would not be adequate to determine sufficiently conservative burial depths for the pipeline…". In fact, Olympic admits that it "does not intend to conduct a comprehensive site specific scour analysis until the pipeline is permited.." Olympic's Consolidated Response to Motions for Continuance, at 5 n.3. The lack of any site specific scour analysis makes meaningful analysis or comment on impacts to fish and habitat very difficult.

Stream scour and lateral migration are natural geomorphological processes that commonly occur in streams in western Washington. Stream scour and lateral migration can expose a buried pipeline to hydraulic and abrasive forces potentially causing a rupture and or leak (DEIS 3-19). Scour and lateral migration occur during the wet months during high water events. The wet months are also the period when salmon are present in the greatest numbers and are most vulnerable.

Stream scour can be stream-wide or local. It can occur at a reach or habitat unit scale where local hydraulics caused by obstructions (e.g., large woody debris) constrict the stream flow, alter flow direction, or increase stream velocities. Increased scour can also occur locally when bed control points are removed naturally or by human intervention. For example, when a log jam or culvert is removed, a channel bed will adjust by incising into the substrate that was stored above the bed control point. Watershed-wide channel scour can occur when the volume of water normally conveyed within a channel increases (e.g., surface runoff from development). Scour can also occur when the sediment supplied to the stream decreases. Human manipulation of the channel by straightening or removing the hydraulic roughness (e.g., removal of large woody debris) will result in scour. Scour can also occur catastrophically by a debris torrent (Benda and Cundy 1990).

Lateral migration describes the erosion of streambanks and the natural progressive movement of a stream channel across the valley floor. It can occur locally in streams and rivers, or on a much broader scale, depending on the valley confinement. Lateral migration can occur progressively or castrophically (e.g., channel avulsion). Channel migration can be accelerated by natural or man-made changes that constrict or deflect flow toward the migration direction. It can also be accelerated thorough increases in stream flow, increases in sediment supply, or through the removal of riparian vegetation. Lateral migration and channel avulsion are particularly active processes on alluvial fans (e.g. S.F. Snoqualmie tributaries) and in some channels that occupy broad floodplains (e.g. Tolt River, upper Snoqualmie).

Stream scour and lateral migration occur during western Washington's wet season (i.e. October – March). It is during this time that pipeline and resources are at risk of damage and spills. This is also the season that salmon are present in their greatest numbers. For instance, in Griffin Creek during November through January, when rain fall and stream flow are the highest, adult coho, eggs, and juveniles from the previous year are all present. Also present are yearling and subyearling steelhead and several age classes of cutthroat. A pipeline spill caused by lateral migration could potentially destroy or impact all three species.

Discussion on the impacts that channel scour or lateral migration on pipeline operation are found in Section 3.3 (Water) and Section 2.14 (Construction Methodology). The applicant provides no discussion on the potential impacts to fish resources from a spill caused by scour or lateral migration in the Fisheries Section of the Revised Application.

The scour evaluation used by Olympic to determine scour depth is wholly deficient. As stated in the DEIS (page 3-34), "The level of investigation proposed by OPL to evaluate scour and lateral migration potential at most stream crossings would not be adequate to determine sufficiently conservative burial depths for the pipeline…." This analysis does not take into account sediment supply, channel slope, or various channel cross sections (e.g. entrenched channels, confined channels). Determination of scour depth is critical to the protection of the pipeline and protection of aquatic resources. The depth of the pipeline at stream crossings must be determined via a scour evaluation. The depth of pipe burial may also have an influence on crossing corridor width, and therefore the area disturbed during construction. Scour depth must be determined not only in the present day channel, but also across the full width of any floodplain that could experience lateral migration (DEIS Page 3-34). For example, analysis of the floodplain width suggests that the Tolt River crossing's pipeline burial depth must be two feet below scour depth for over 1000 linear feet. Using a pool depth of 15 feet at bankfull to approximate scour depth, the pipeline would have to be buried approximately 24 feet from bankfull across the full width of the floodplain. This would require digging a trench 24 feet deep at the island and approximately 18 feet at the side channel.

In Olympic's scour evaluation screening procedure, 11 streams are identified that require additional investigation. Out these eleven streams, only five had a seven foot scour potential. All five streams are located east of Snoqualmie pass. The streams that are determined to have high scour potential probably do have the correct channel conditions (i.e. slopes < 1%, and regime type channels). Six additional crossings were added where stability problems are reported (e.g., Tolt River) or are unique (e.g., Columbia River).

Olympic's scour evaluation screening procedures are based on procedures described by Williams et al. (1992), whose work determined scour potential primarily by drainage size and secondarily by a stream features and crossing conditions. Olympic mentions that similar information on in-channel conditions was collected, but does not clearly describe how that information was used.

Many stream crossings west of Snoqualmie Pass have conditions that warrant further study. Stream crossings between the Thrasher Pump Station and mile post 8 (lower Snoqualmie River) will be particularly susceptible to increased scour as the area is urbanizes over the next 50 years. The loss of temporary bed control points immediately downstream of a crossing can lead to increased scour at the pipeline crossing (e.g., a log jam 20 meters downstream of the proposed Cherry Creek crossing is controlling the bed elevation at this crossing). Stream crossings on many of the South Fork Snoqualmie tributaries occur on alluvial fans that are highly unstable and are susceptible to scour and lateral migration over the next 50 years.

3.5 Hyporheic Zone

Streams in the Pacific Northwest coastal ecoregion have three interactive aquatic habitats: in-channel habitat, floodplain habitat, and subsurface habitat. The subsurface habitat or hyporheic zone is the interstitial habitat beneath the streambed. The hyporheic zone provides retention of nutrients and provides an important medium for biological processing (Naiman 1992). The potential disruption of this zone and its ecological processes from the pipeline are not discussed, rendering comment difficult. For example, how would trenching affect the rate of biological processing/ How would increased sedimentation affect the rate of biological processing? How would a product spill affect biotic activity in the short term? Long term?

4 Pipeline Construction Impacts to Fish and Fish Habitat

Construction impacts to fish resources could vary from minor to major depending on the species present, the life stage and numbers of fish present, and the percentage of the population present relative to the entire population. For example, if a significant number of spawning salmon are affected by pipeline construction, and that spawning

population represents a significant percentage of the entire population, impacts to the entire population could be significant (e.g., chinook, coho).

Of 84 stream crossings identified in western Washington, 30 will be invasive crossings. Of the 30 invasive stream crossings, more than half provide fish habitat at the crossing or just downstream of the crossing. In addition, 8 wetlands will be invasively crossed. These numbers also do not include stream crossings that are not identified in the Revised Application, nor do they include stream crossings where culverts will be replaced.

4.1 Under Culvert Pipeline Crossing

One stream crossing methodology discussed in the Revised Application is placing the pipe under a culvert. Olympic considers this type of stream crossing noninvasive - a misleading characterization. Under-culvert crossings may not be as invasive as trenching, but they are more invasive than placing a pipe over a culvert. With under-culvert crossings, the culvert will be removed and the stream flow will be handled by flume. Revised Application at 2.14-10. This methodology will result in increased sedimentation and dewatering, which can lead to spawning and rearing mortality and reduced rearing area.

Olympic proposes narrowing of the construction to 30 feet at some crossings. This may not be feasible at some locations where a much wider crossing will be required. For instance, the Tolt River crossing will require a very deep trench, especially through the island, which may make the suggested construction corridor width infeasible. To date, the Revised Application does not provide detailed information on this important crossing, making comment and evaluation extremely difficult. Evaluation of scour and the subsequent depth of the trench at many stream crossings will have a bearing on the width of the corridor and, therefore, the amount of stream and riparian area disturbed.

Olympic suggests that stream crossing construction within dry channels will minimize impact. This construction method will nevertheless result in increased sedimentation to the stream channel below the crossing point when stream flows eventually do occur at a later point in time.

4.2 Lack of Site Specific Detail

The physical impacts to stream habitat and fish from construction at stream crossings can not be adequately assessed because Olympic has not provided information on site conditions and site-specific construction plans. Some examples include:

- The crossing method has not been determined for the lower Snoqualmie River (11).
- The typical diverted stream crossing described in the Revised Application (page 2.14-10) can not be constructed as depicted for the Tolt River (26) crossing because of the size of stream, channel depth, and angle of flow.
- The steepness of the valley walls adjacent to many stream crossings (e.g. Cherry Creek, Griffin Creek, Olallie Creek, and Humpback Creek), and the geology present, will require special construction considerations, which can not be assessed for impact without site specific plans.

On page 3.4-75 Olympic correctly states, “The actual impacts to the fish and aquatic habitat and resources will depend on the methodology selected for crossing the streams, the timing of construction, and the protective measures applied” and that “[t]he level of impact is directly correlated to these crossing methods and other environmental variables, sensitivity of the aquatic resources and the effectiveness of the mitigation measures.” In fact, however, Olympic fails to provide sufficient information on site conditions, (e.g., slope of valley walls, bed control points, channel and valley topography) and design (e.g. trench depth), and inadequately describes the resources present (i.e., fish utilization is unknown in 58 of the first 83 stream crossings), to determine project impacts.

The aquatic resources present at most of the stream crossings are not described in the Revised Application and not fully known. In Table 3.4-8 of the Application, stream crossings, fisheries utilization, potential impact area, sensitivity index and proposed crossing methods are summarized. This table is very similar to Table 3 in the Fisheries and Aquatic Resources Report. In Table 3 (Fisheries Utilization) of the Fisheries and Aquatic Resource Report, fisheries utilization was unknown or the stream was not surveyed for fish presence for many of the crossings. In Table 3.4-8, the term "unknown" was changed to "no fish" without explanation or additional information to support this change.

4.3 Uncertainty in Construction Methodology and Mitigation

The Revised Application does not provide adequate information to properly or thoroughly evaluate construction methodology and mitigation techniques. For example, it does not indicate how extensively concrete coating will be used. Concrete coating is mentioned as a mitigation measures in Section 1.4 (page 6, 15, 17), Section 3.3 (page 47 and 76), Section 2.15 (page 16) to prevent impacts to groundwater, and to prevent damage from liquefaction. In the construction methodology section the Revised Application indicates that concrete coating will extend to the limit of maximum meander. However, it does not identify whether concrete coating will be used only at stream crossings, or whether it will extend across floodplains as well, or, if so, how far across those floodplains. The Snoqualmie floodplain, for example, is very vast and inadequate information is provided to comment or evaluate that potential mitigation measure.

Also, the Revised Application does not clearly state how many miles of new road will need to be built to access the pipeline (page 2.10-21). Monitoring is frequently discussed but the frequency and type of monitoring are not described. For example, on page 2.10-15 performance monitoring of BMP's will be conducted at critical areas on a routine basis prior to and after major storms. There is no indication as to the definition, however, of a "major storm." What type of performance monitoring of BMPs, and who will do the monitoring, is not stated. The Revised Application is also unclear how construction will proceed on steep banks and how stream banks will be protected. In the Fisheries and Aquatic Resources section, Olympic states that steep banks will have to be graded or contoured. This could result in heightened sedimentation. In the construction methodology section, however, the Revised Application states that approaches to crossings will be spanned or matted (page 2.14-2). These alternative measures are not mentioned in the Fisheries and Aquatic Resources section.

The Revised Application does not clearly state how hydrostatic testing will be conducted. On page 3.4-73 hydrostatic testing procedures are summarized. The reader is referred to Section 2.5 and 2.7 where potential impacts from hydrostatic testing are discussed. In Section 2.5, three main sources of water are discussed as well as three discharge points (outside the Snoqualmie). On page 2.5-6, the Revised Application states that "other streams and rivers may serve as small scale sources." However, some small streams crossed by the pipeline are closed to further water appropriations, and others will be at summer low flow levels. The location of these sources is not identified. Small temporary water withdrawals can have an impact on those small streams by causing the stream to go dry downstream of the withdrawal point. For example, a significant number of these streams will be as low as a quarter (112 gal/min.) to a tenth of a cfs (45 gal/min.). If the stream goes dry downstream of withdrawal points, fish mortality could occur.

Pipeline construction at stream crossings will occur during low flow periods. During summer low flows, many streams will be flowing at a rate of less than one cfs. Under conditions of very low flow, depending on how the crossing is constructed, the area of the streambed impacted by the construction could be much larger than the 30 ft. corridor suggested by Olympic. Here again, site specific crossing information is essential to a meaningful evaluation. In a small low gradient stream (1% - 2%), at summer low flow levels, a trench that is 5 to 6 feet deep could potentially lower the water table causing the stream to go dry for a significant distance upstream and possibly downstream. The downstream impacts will depend on how filtration is handled and the location of the return flow. Again, construction detail and BMP are not provided.

The Revised Application discusses unique stream crossings, but the unique stream crossings conditions on Cherry Creek and Griffin Creek were not included. See pages 2.14-14 through 2.14-19. The unique conditions on Cherry

and Griffin Creeks include adjacent shallow and deep-seated landslides. Unique landscape conditions and problems are not mentioned for several such crossings. For example, a deep-seated failure is located on the south bank of the Tolt River, but a detailed discussion of that failure is not found in the Revised Application. The dynamic nature (i.e. channel avulsions and debris torrents) of many of the South Fork Snoqualmie tributary stream crossings also present unique crossing problems.

On page 3.4-75 Olympic correctly states, "The actual impacts to the fish and aquatic habitat and resources will depend on the methodology selected for crossing the streams, the timing of construction, and the protective measures applied." Later Olympic states, "The level of impact is directly correlated to these crossing methods and other environmental variables, sensitivity of the aquatic resources and the effectiveness of the mitigation measures." Olympic fails to provide sufficient information on site conditions, (e.g., slope of valley walls, bed control points, channel and valley topography), design (e.g. trench depth), and inadequately describes the resources present (i.e., fish utilization is unknown in 58 of the first 83 stream crossings), to determine project impacts. In Table 3.4-8 of the Revised Application, stream crossings, fisheries utilization, potential impact area, sensitivity index and proposed crossing methods are summarized. This table is very similar to Table 3 in the Fisheries and Aquatic Resources Report. In Table 3 of the Fisheries and Aquatic Resource Report, fisheries utilization was unknown or the stream was not surveyed for fish presence for many of the crossings. In Table 3.4-8 of the Revised Application the "unknown" was changed to "no fish". The Revised Application fails to explain the apparent change and fails to provide additional information to confirm the absence of fish presence at these locations.

4.4 Construction Window

On page 3.4-98 of the Revised Application general construction windows are listed. These windows have been established by WDFW to reduce the impact of construction on fish resources. Construction windows do not eliminate impacts, however. At all crossings where fish occur, they will be present during construction. In fact, during the construction window of June 15 to October 15 identified for Snohomish and King Counties, chinook spawning and chinook holding will not be avoided (i.e., Tolt R.iver). Chinook and pink salmon spawn in the Tolt River between mid-September through October (SASSI 1993). In addition, chinook adults may be holding in pools in the Tolt River before mid-September. Steelhead spawning occurs into June, with fry still emerging in August. At the Cherry Creek crossing (20), during the construction window, coho fry, steelhead eggs or fry, and one year old steelhead juveniles will be present, along with several different ages of cutthroat trout and nonsalmonids. The construction will also occur during sensitive life history stages (e.g., steelhead and trout eggs, alevins, and newly emerged fry). Construction windows need to be crossing and resource specific.

4.5 Bedload Transport

As to bedload transport, the Revised Application states that "[c]onstruction methodologies used for the Cross Cascade Pipeline Project should produce no increases in bedload transport, but will release varying amounts of suspended sediment." Construction of the pipeline will result in increased sediment loading to surface waters crossed or adjacent to the pipeline corridor. Sources of the sediment will include in-channel trenching, surface runoff from the construction corridor, in particular areas of high surface erosion and mass wasting potential. Overall sediment delivery to streams will be minor to major depending on site conditions, construction methods and timing, mitigation measures to be implemented, and maintenance of mitigation measures. The duration of the impact will also vary but could be long term if pipeline construction exacerbates mass wasting activity, or if mitigation measures do not perform as designed, or if significant channel erosion and lateral migration occur. Construction could also significantly alter local bedload transport and storage if the construction exacerbates mass wasting activity or significant channel erosion and or lateral migration takes place.

4.6 Turbidity Above Natural Conditions

The expected levels of suspended sediment (or turbidity) from construction are high, and will probably be in the range of 2000 to 3000 mg/l (Revised Application page 3.4-101). These levels can lead to juvenile mortality (May 1996; Noggle 1978), but more likely will result in avoidance behavior (Bisson and Bilby 1982: Sigler et al. 1984).

In addition, the increased sedimentation will occur during a period when turbidity levels are naturally very low, when juvenile salmon are acclimated to low turbidity, resulting in a greater stress response (i.e. fleeing, or lower growth). This increased turbidity also can be expected to occur during the critical rapid-growth stages of juvenile salmon, which may influence survival later in life.

4.7 Removal of Vegetation

The impact from the removal of vegetation will be highly variable. Impacts will most likely vary by crossing. At all invasive stream crossings, tree removal will occur. The loss of trees within the riparian zone will have a wide variety of impacts, including increased stream temperature, reduction in bank stability, the loss of overhead cover, a reduction in small organic matter, a reduction in terrestrial insects, and the loss of large woody debris recruitment. The project-related loss of trees from the riparian zone, and the cumulative loss of trees from the riparian zone (current conditions within the BPA corridor) will result in an overall reduction in habitat quality and reduced salmonid production. The permanent loss of trees from the riparian zone is a long term impact. The significance of the impact will vary from minor to major.

The level of impact on aquatic resources from removal of riparian vegetation will depend on the resources present, how quickly the crossing location recovers, and the condition of the riparian zone within the stream system. For example, if the removal of riparian vegetation leads to channel widening or channel avulsions, major impacts to aquatic resource could occur. If a stream has naturally high stream temperatures (i.e. 18 degrees C), a loss of riparian vegetation will decrease shading and will locally increase stream temperatures to stressful levels, resulting in lower quality habitat and a lowered salmonid production.

Removal of riparian vegetation and large woody debris at stream crossings will also reduce the availability of a critical component to streams. Large woody debris influences the physical chemical and biological processes within streams. It traps organic matter, and influences the transport and storage of sediment. Channel conditions such as gradient, sinuosity, width, and depth are often regulated by large woody debris (Nakamura and Swanson 1993). There is no other structural element as important to salmonid habitat in Pacific Northwest streams as large woody debris (May 1996). Based on my experience performing habitat surveys in streams in the Puget Sound Region, streams frequently have too few pieces of large woody debris in-channel, and the addition of more large woody debris over time is unlikely because land management (e.g. silvicultural) activities have removed recruitable trees from the riparian corridor. The loss of trees through pipeline construction will add to this region wide problem.

Olympic also did not evaluate the condition of roads along BPA corridors, although “numerous roads ... follow the corridor.” Revised Application at page 3.4-58. Forest and rangeland road construction and usage can contribute to serious degradation to salmonid habitat (Furniss et al. 1991). The production of fine sediment from roads is a function of the amount of traffic, revegetation of the road surface over time, the composition of the road surface and maintenance. Sedimentation to streams from roads occurs through surface erosion and mass wasting. Higher levels of surface erosion and mass wasting can be expected from poorly maintained roads or low standard roads. Failure of road fills is common on steep terrain. This is particularly true on low-standard roads (Furniss et al. 1991), which are typical of roads on rural BPA right-of-ways. A significant amount of surface erosion was observed at the Cherry Creek crossing (20) from the access road on the north side. Drainage from the road on the south side of the crossing may contribute to slope instability on the south side.

4.8 Stream Widening

From my experience stream widening should be expected at some sites. It is unrealistic to assume that with the bank instability noted at several crossings (e.g., S.F. Snoqualmie tributaries), and the tendency for lateral migration at moderately confined to unconfined crossings (e.g., Griffin Cr., Tolt R.), that stream widening will not occur at some crossings. Stream widening results in a decrease in the quality of fish habitat. Olympic mentions that monitoring will be used as a mitigation measure to prevent bank erosion, and that if it does happen it will be rectified. Using monitoring as a mitigation measure assumes a bank erosion problem will be caught before it happens or becomes overly severe. This mitigation measure does not take into account that bank erosion can occur quickly or

catastrophically.

4.9 Culvert Failure

Culvert failure at stream crossings can be a major source of increased sediment loading to streams. When stream crossings fail they do so catastrophically, causing local scour and deposition and additional erosion downstream. A culvert evaluation was not performed for this project, and must be required to properly evaluate impacts. A culvert sized for a 50-year flood has a 33% chance of failure during a 20-year design life (Furniss et al. 1991). Considering the life of the culvert would have to be as long or longer than the pipeline, a culvert should be sized for at least a 100 or 200 year flood event. Culvert siting must also take into account passing juvenile and adult salmon. Impacts to aquatic resources from replacing culverts after 20 years also need to be taken into account.

4.10 Acoustic Shock

The Revised Application (Page 3.4-105) states that Olympic does not propose to use in-water blasting. However, it is probable that construction within some areas in or near streams may require blasting bedrock. Sites within the Snoqualmie watershed where blasting may be required include Peoples Creek (15), and some S.F. Snoqualmie tributaries (e.g., Olallie Creek or Humpback Creek), where the depth of alluvium or colluvium may be shallow. In steep locations adjacent to streams, blasting may destabilize colluvium, which may lead to shallow landslides at the time of the blast or later. Olympic does not describe the measures that will be implemented to reduce this threat.

4.11 Area Estimates of Impacted Habitat

In Table 3.4-8 Olympic summarizes the area impacted by the crossing methods. Olympic underestimates the area impacted or does not fully know the areas impacted. Within the Snoqualmie Basin, 24 stream crossings are listed where impacts will occur. Nine additional crossings, mostly wetlands, will also be impacted, and the wetland area impacted has been grossly understated (Joint Wetlands Report (Cooke, 1999)). Both the Revised Application and the Joint Wetlands report recognize the habitat value of wetlands, yet fish use within wetlands was not evaluated by Olympic, rendering comment or analysis impossible.

At least 4 additional stream crossings are present that were not identified. They include two crossings between mile posts 8 and 9; two crossings between mile posts 24 and 25; and one crossing between mile posts 20 and 21. The estimates of the habitat area impacted by the construction are based on stream width and the assumption that the construction corridor will be 30 feet in width. It is unclear how channel widths were determined for 14 of the 24 crossings, and therefore potential impact. Based on the field surveys in Appendix B of the Fisheries and Aquatic Resources Report, channel widths were reported for only 10 stream crossings where invasive methods were proposed. The depth of scour and the depth of the trench will have a bearing on the width of the stream channel disturbed. Since evaluation of scour at many of the stream channels will more than likely require additional assessment (see Joint Geohazards Report), the width of area disturbed can not be determined at this time. The estimates of potential impact also do not include the riparian zone.

Using information provided by Olympic in Table 3.4-8 of the Revised Application, stream areas impacted by construction can be conservatively estimated. There are at least 21 stream crossings in western Washington that will receive invasive stream crossings that are utilized by fish. (assuming that all named tributaries to the S.F. Snoqualmie have fish presence). The potential for direct (invasive) stream impact will therefore exceed 21,400 square feet. Olympic has also recognized that pipeline construction can lead to increased sedimentation downstream of the stream crossings. The amount of fine sediment generated by construction and the length of time habitat is affected by the increased level of fine sediment will vary. The level and duration of impact will depend on flow levels, duration of construction, the level of disturbance to the 30 foot corridor, the effectiveness of mitigation, and how the construction site recovers from the trenching and riparian manipulation. Assuming some habitat degradation (e.g. pool filling, reduced macro-invertebrate densities) from sedimentation within 1000 feet of the pipeline crossing (Revised Application at page 3.4-112), the area of stream habitat degraded by sedimentation will be in excess of 250,000 square feet (based on widths used by Olympic and my observations of stream width).

Therefore, anticipated direct impacts of at least 21,400 square feet, combined with anticipated sedimentation impacts of at least 250,000 square feet, indicates that a total of not less than 271,000 square feet of stream channel will be impacted by construction activities in western Washington alone. This assessment is conservative since it does not include wetland habitat impacts, impacts to unidentified crossings, or sedimentation impacts from construction under culverts. This represents a significant impact to fish resources in western Washington.

4.12 Stream Crossing Sensitivity

Starting at page 3.4-108 and through page 3.4-113 of the Revised Application, Olympic describes at length a model to determine stream crossing sensitivity. How its conclusions were used and what the impact sensitivity really means is unclear. The methods used to my knowledge are not based on any generally accepted procedures. The sensitivity of the analysis is not described. For example, where Olympic assigns a value of 8.18, what does that mean, and how is it significantly different from a value of 4.55? The stream crossing sensitivity analysis was conducted on 43 of the 76 stream crossings within the Snoqualmie Basin. Several factors were used to assess sensitivity of a stream crossing. The information used to determine a value for a factor was not described. If field information was used to determine fish presence, then, as discussed previously, it must be noted that data were not collected on all crossings. If regional database (e.g., Data96, topographic maps, regional hydrographs) information was used, the resolution of the databases for this type of analysis, as indicated above, may lead to questionable results.

4.13 Noncompliance with the Aquatic Conservation Strategy

The Cross-Cascades Pipeline Project does not comply with many of the objectives and components of the Aquatic Conservation Strategy described at page 3.4-107 of the Revised Application. The goal of the Aquatic Conservation Strategy is to restore and maintain the ecological health of watersheds (FEMAT 1993). The pipeline project will make achieving this goal more difficult. It is a region wide strategy that federal agencies must comply with, but also provides a strategy for the region as a whole. It is not limited to aquatic systems that are utilized by anadromous salmonids as Olympic suggests. (Revised Application at page 3.4-106).

One component of the strategy is to maintain the natural disturbance regime. Land use activities that do not maintain the natural disturbance regime need to be limited or excluded in those parts of the watershed where they are apt to alter the disturbance regime (e.g. high erosion or mass wasting areas).

Several objectives that are not achieved by the pipeline project include:

- The project will maintain or reduce the diversity and complexity of riparian and in-channel habitat.
- The project will maintain or decrease the physical integrity of the aquatic system.
- The project will decrease water quality necessary to support aquatic and wetland systems, impacts could be short term or long term.
- The project will not maintain and restore patterns of sediment, nutrient, and wood routing.
- The project will not maintain and restore species composition and structural integrity of riparian areas.

In addition, the Cross-Cascade Pipeline project runs counter to the basic components of the Strategy. For example, riparian reserves are areas where special use standards apply, yet the pipeline crosses unstable areas, streams prone to debris flows, and will result in the removal of riparian vegetation. The pipeline crosses key watersheds and threatens species proposed for listing under the ESA. Watershed analysis was not attempted, and existing watershed analysis information was not used. Watershed restoration will be more difficult to implement and achieve - a good example is the Snoqualmie floodplain. If stream and wetland habitat enhancement or restoration were desired in the

Snoqualmie floodplain (east of stream crossing 11), restoration or enhancement atop an existing pipeline would be problematic.

5 Operation and Maintenance Impacts to Fish and Fish Habitat

5.1 Petroleum Spills

The primary concern over impacts to fish and habitat from pipeline operation and maintenance is the potential for refined petroleum product spills. Product spills to the marine environment are not addressed here. Crude oil spills to the marine environment from increased tanker traffic to north Sound refineries will be addressed by Washington Environmental Council. This analysis focuses in impacts to fish and habitat from pipeline releases in freshwater areas. We conclude that a freshwater petroleum product spill could have a significant impact on fish and fish habitat in western Washington. We concur with EFSEC, whose DEIS correctly states that "an accidental spill from the pipeline, depending on location and severity, has the potential to have a major impact on fisheries".

A significant length of the pipeline in western Washington will be located within and adjacent to streams (84) and wetlands (45), increasing the risk of spills affecting aquatic resources. In his joint technical report, Mastendrea (1999) estimates that over the 50 year life of the pipeline, 54 spills will occur. According to his estimates the volume of petroleum spilled along the pipeline would amount to 120 gal/mile/year, on average, and a total of 990,000 gallons will be spilled over the life of the pipeline. Because of the unstable terrain, elevational changes, and mass wasting processes present, the risks to the pipeline can be considered higher in western Washington than along other sections of the pipeline. If a spill did occur in a stream or river in western Washington, the steeper slopes and higher water velocities in many streams would provide conditions for rapid dispersal, which could impact significant areas of valuable fish habitat. Should a petroleum spill occur adjacent to the Tolt River (see Cascade Columbia Alliance (1999) (Tolt River spill scenario), lethal concentrations of petroleum products would be released into the Tolt River and into the Snoqualmie River.

The Fisheries and Aquatic Resources section of the Revised Application provides very little discussion on fish and habitat impacts from petroleum product spills. Olympic optomistically concludes that impacts to aquatic resources will be short in duration, and small in area. Revised Application at 3.4-103. These conclusions are based on the following assumptions:

- Most of the pipeline is located upland.
- Response would be swift, containment and recovery would occur quickly.
- Monitoring and the leak detection system would detect leaks quickly.

Olympic fails to point out however that the pipeline has the greatest risk of failure in western Washington where landslides and debris torrents occur. Landslides and debris torrents tend to be located adjacent to and within habitat occupied by aquatic resources. With these assumptions Olympic ignores the fact that much of the terrain crossed by the pipeline is remote and can present difficult conditions for quick response.

Landslides and debris torrents typically occur during inclement weather conditions (e.g., flooding). Flooding in the Snoqualmie occurs frequently. Spill response would be much more difficult in flood conditions than during normal flow conditions. Winter conditions along the S.F. Snoqualmie also pose difficulties for quick response.

Also, Olympic provides inadequate infromation to evaluate toxicity of petroleum product spills to fish at all life stages. With no site specific scour information, no dispersion modelling, no toxicity information, and inadequate fish surveys to determine actual fish presence, evaluation of toxicity to fish in the Snohomish Basin from freshwater spills is problematic.

Finally, It should be noted that Olympic's optimism in the Fisheries and Aquatic Resources section of the Revised

Application (impacts short in duration and small in area) appears to be substantially contradicted by Olympic's own product spill scenarios (i.e. 2 through 6), as described in its Product Spill Analysis (Feb. 28, 1997). Even Olympic's own conservative spill scenarios in the Snoqualmie drainage do not suggest impacts that are short in duration (e.g., Harris Creek; moderate to long term), or relatively small in area (e.g., Harris Creek 4 miles), or small in volume. Even more catastrophic impacts to fish and habitat can be expected to occur under realistic spill scenarios. See Spill Scenarios, Cascade Columbia Alliance (1999).

5.2 Spill Prevention

Olympic's spill prevention and control measures are listed on page 3.4-125 of the Revised Application, and are discussed in Section 2.9. Spill prevention relies, for the most part, on a leak detection system and visual inspections of the pipeline. The leak detection system as proposed can not reliably detect leaks of less than 1% of average pipeline flow (application, page 2.9-20), which amounts to 25,200 gal/day at the pipeline's initial capacity, and 46,200 gal/day at full capacity. None of the slow leak scenarios presented by Olympic approach the amount of product that can be lost by a slow leak, therefore the worst case slow leak scenario was not addressed. Low level leaks can go on for some time. A small leak in the Yellowstone Pipeline was discovered in January of 1993 next to Camas Creek on the Flathead Indian Reservation. It was estimated that the leak went undetected for approximately 45 days (see Camas Creek Case Study below). Not only was the leak small enough that a leak detection system would not have discovered it, the visual inspections (inspections similar to those proposed by Olympic) conducted by Conoco also did not discover it. In addition, the effectiveness of the remote leak detection system ultimately relies on subjective, individual interpretation of the information received. Human error in data interpretation can occur, which may allow low level leaks to go undetected for indeterminate periods. Human error may also occur in communicating the existence of a spill, or the existence of conditions which indicate the likelihood of a future spill (see e.g. the discussion of the Spencer Creek spill, above). Also, Olympic's spill prevention system relies heavily on visual inspections which are designed to occur every two weeks by aerial surveillance. The effectiveness of the visual aerial inspections along a Cascade mountain pipeline is speculative, especially in winter weather and snow conditions. Aerial surveillance will only detect the largest spills (Cascade Columbia Alliance 1998).

Olympic concludes that spills that will occur in waterways would have significant short term impact on vegetation and aquatic resources (Page 3.4-127). Olympic claims the impact would be short term because of the dynamic nature of the environment. Olympic appears to ignore the variability of conditions present along the pipeline route, and that site conditions would significantly influence spill impact duration. In the Camas Creek case study, described below, impacts were not short term. Aquatic resources (e.g. macro-invertebrates) in the stream still appear to be recovering after 5 years. Olympic fails to take into account the life stages of the fish resources present. If a spill occurs in a small stream with resident trout, several age classes of trout will be affected. If a large enough segment of the population is destroyed, the population may take several years to recover to pre-spill population levels. If a spill were to take place in Griffin Creek during the winter coho eggs and juveniles would be affected, several age classes of trout would be affected, and potentially four age classes of steelhead would be affected (adults, eggs, one and two year olds). Volumes of the size that can go undetected can have a serious impact on small streams where resident trout and coho are found.

5.3 Toxicological Impacts to Fish

The Revised Application fails to meaningfully evaluate the toxicological effects (acute or chronic) of petroleum product releases on fish and other aquatic resources. Refined petroleum products carried by the pipeline are highly toxic. The toxic components of this product are at least partially soluable in water (Natural Resources Consultants (NRC) 1999, Cross-Cascade Pipeline Ecological Toxicity Report). Many small streams in western Washington are important fish producers, including Griffin Creek and Harris Creek - both crossed by the pipeline. Acute and chronic toxicological impacts on fish resources can therefore be reasonably anticipated.

5.3.1 Acute Impacts

Small leaks (< 1% of flow) can have devastating impact to small streams (< 2 cfs) and to fish resources they contain. Because a small stream has much lower flows, and are shallower and more turbulent, a small leak can result in fish kills. See the Spencer Creek and Camas Creek case studies, below.

The acute toxicity level stated for rainbow trout is approximately 50 ppm for refined petroleum products. NRC (1999) (Ecological Toxicity Report). Moles et al. (1979) exposed Alaskan freshwater salmonids to Prudhoe Bay crude oil, and found acute toxicity to range from 2.7 to 4.4 ppm, in 96-hr LC_{50} tests. Refined oils are usually more toxic than crude oil because they are richer in the more toxic aromatic fraction (Rice et al. 1977)

Acute toxicity to invertebrates and algae are discussed in Markarian et al. (1992). Acute toxicity of dissolved hydrocarbon from a petroleum product to invertebrates and algae varies from 6.6 mg/l to 50 mg/l.

5.3.2 Chronic Impacts

When refined oil products enter a stream or river, salmon will also respond through avoidance. Avoidance concentration (Al_{50}) levels involving crude oil have been reported of 2.0 ppm, 1.7 ppm, 0.7 ppm, for presmolt coho salmon exposed to toluene, benzene, o-xylene, respectively. Maynard (1980) (Northern Tier case). These same compounds are also found in refined product. Based on these results, Maynard suggested that half of the coho salmon exposed to oil would avoid it, and the other half would remain. Folmer (1976) reported rainbow trout avoided concentrations of xylene between 0.1 ppm and 0.01 ppm.

Chronic exposure of fish to lower amounts of refined product can affect growth, swimming ability, and morphological effects. Woodward et al. (1983) reported a concentration of 39 parts per billion (ppb) adversely affecting growth and gill physiology. Woodward et al. (1983) reported other physiological effects found by other studies, including gill lesions, liver damage, and caudal fin erosion - any or all of which can lead to delayed mortality or reduced production. Studies reported by NRC (1999) place sub-lethal concentrations within a range of 24 - 39 ppb for cutthroat trout. Sub-lethal concentrations were reported for weeks and months after a diesel spill on Camas Creek (see case study, below). A fish kill reported on Camas Creek three months after the spill could very well have been the result of chronic exposure.

Chronic, long-term impacts to fish exposed to petroleum products spills are not described in the Revised Application. To suggest, as Olympic does, that chronic impacts will be less significant due to naturally occurring mechanisms in the environment (i.e., dispersion) is inappropriate. Due to the lack of information in the Revised Application regarding aquatic toxicology, dispersioin modelling, scour analysis, fish and other aquatic resources' presence, and the sensitivity to petroleum products of those resources, a much more conservative approach to evaluating fish impacts from pipeline construction and operation is warranted. A pipeline project that is permitted in the face of uncertain or undisclosed impacts to fish and habitat should incorporate project mitigation or avoidance measures as follows:

- redundant leak detection capabilities (e.g., hydrocarbon sensing cables along sensitive stream corridors and crossings, increased monitoring after flood events, more frequent ultrasonic "smart pig" inspections);

- pipeline construction characteristics that prevent rupture or leakage (i.e., .5" and/or double-walled pipe and/or concrete coating for negative buoyancy in all stream crossings and adjacent corridors and floodplains) and minimize spill volumes (additional block and check valves at sensitive stream crossings)

- selection of route alternatives which use bridged or aerial stream and river crossings wherever possible

- selection of route alternatives whose crossings are easily accessible for spill response, maintenance and monitoring

5.4 Camas Creek Petroleum Spill

The following information is based on information provided by tribal staff with the Confederated Salish and Kootenai Tribes, a site visit, an annual monitoring report by Maxim Technologies Inc. (1997) and a natural resources damage assessment report (Duffield 1993).

On January 14, 1993 a leak in the Yellowstone Pipeline owned and operated by Conoco Inc. was discovered on the Flathead Indian Reservation. The release involved a combination of gasoline, jet and diesel fuels, and occurred approximately 10 feet from Camas Creek. The time elapsed between initial release to detection is unknown, but a conservative estimate by the parties was 45 days. Conoco estimated approximately 30-72 barrels of fuel were released. The product seeped through the soils reaching the creek where it was carried down the creek several miles.

Camas Creek in the vicinity of the spill site has a gradient of approximately 2%. The stream varies from confined to unconfined, and has annual daily discharge of approximately 1 to 2 cfs. The stream substrate is cobble, gravel, sand, and silt. A narrow band of wetlands commonly borders the unconfined portions the stream. The dominant fish species present were westslope cutthroat trout and redside shiner. The upper two miles of Camas Creek, where the spill occurred, was estimated to support as many as 1470 resident cutthroat trout. A substantial portion of this habitat was impacted from the spill. A fish kill in a pond adjacent to Camas Creek located more than one mile downstream was reported by tribal biologists on March 24, 1993. Between 256 and 392 dead westslope cutthroat and redside shiners were recovered. Tissue samples showed high concentrations of aromatic hydrocarbons indicating petroleum contamination. Post-spill fish monitoring six months later (June 1993) found the sections contaminated by the spill devoid of trout. The westslope cutthroat trout at the site were an isolated population. The kill raised a concern that the remaining population may be too small to maintain the genetic diversity within the population leading to an eventual loss of the entire population. Aquatic invertebrates, a major food source, were eliminated or reduced in the stream for approximately a mile. The loss of riparian vegetation, a major source of detrital materials utilized by aquatic invertebrates, was also reduced, resulting in a potential delay to recovery of Camas Creek.

Surface water samples taken on January 15, 1993 (the day after detection of the release) until February 24, 1993, indicated the presence of toxic components such as benzene (407 ug/l on 1/15/93) and toluene (3100 ug/l on 1/15/93) far in excess of federal drinking water standards. Water from the stream is not used by residents for drinking, but is used by campers, wildlife and domestic livestock. Several cattle from a herd downstream of the spill site aborted their calves in response to the spill (Duffield 1993). Benzene was detected in household wells downstream of the site, but was not above federal drinking water standards. Vegetation immediately along the creek was impacted, as evidenced by die off for approximately one mile below the site of the pipeline leak.

The natural resources damage assessment report estimates that the recovery time for the macro-invertebrate population would be approximately 5 years. This estimate was base on a report by Pontasch and Brusven (1985). However, the recovery time for the trout population was uncertain. Recovery time was dependent on a number of factors; how long it would take the macro-invertebrate population to reestablish, what the size of the remaining spawning population was; and the affect of the petroleum products trapped in the organic sediments and the impact their slow release over time may have on the aquatic resources to recover.

Four years after the petroleum spill, the stream still appears to be recovering. Beginning in 1995 environmental monitoring was conducted on Camas Creek. Monitoring results are documented in a series of annual monitoring reports (Maxim Technologies Inc. 1995, 1996, and 1997). Monitoring included aquatic vegetation surveys, macro-invertebrate communities, domestic water supplies, surface water, groundwater and streambank sediments. Key findings from monitoring in 1997 found the macro-invertebrate community approaching full recovery. Petroleum hydrocarbons were detected in 1 of 11 domestic well samples, in 6 of 23 samples taken from 5 groundwater monitoring wells, and were present (as evidenced by visible sheens) in streambank sediments. Petroleum products are still being released from bank sediments today.

5.5 Fish Impacts - Tolt River Spill Scenario

Please refer to the spill scenario involving a rapid release of diesel product into the Tolt River (Cascade Columbia Alliance, 1999). In that scenario, diesel concentration in the Tolt was estimated at 1658 mg/l and 245 mg/l in the Snoqualmie River, 2.5 miles downstream. Both concentrations significantly exceed the acute toxicity levels reported for rainbow trout. Assuming other salmonids like coho and chinook have the same acute toxicity levels, significant levels of mortality should be expected to all salmon and trout species, and macro-invertebrates within the Tolt River and portions of the Snoqualmie. Because of the high river velocities (2 – 3 ft/sec) in the Tolt River and Snoqualmie River the diesel would be dispersed over several miles potentially causing an extensive fish kill.

To put into perspective the impact that a spill in October on the Tolt River would have, the species and age classes present have to be discussed. At that time of year adult chinook are actively spawning. Adult steelhead will be holding in the pools or where there is cover. During odd years, if not already spawning, adult pink salmon will also be holding in the deeper pools. Subyearling salmon present would include coho, chinook, steelhead, and cutthroat. Yearling steelhead and cutthroat would be present, as well as adult cutthroat. If petroleum spill occurred and the diesel concentrations reached the level estimated in the Tolt River scenario. Most if not all the salmon and trout within the lower 2.5 miles of the Tolt River would be killed or had avoided the product by moving downstream into the Snoqualmie River. However, because of low flow conditions, movement by fish within the Tolt River may be restricted making avoidance more difficult. The chinook eggs and developing embryos in the constructed redds more than likely suffer a very high mortality rate. Fish not immediately killed by the diesel may die later from the sublethal physiological effects.

Diesel concentrations in the Snoqualmie (245 mg/l) would lead to salmon mortality in the Snoqualmie River as well. However, because size, depth, uneven mixing, and flow patterns it is unlikely the mortality levels would be as high. It is likely that the depth and width of the Snoqualmie River would provide a means of escape for some adult and larger juveniles. Chinook embryos and other salmonid fry may still suffer significant mortality because of their higher sensitivity and lack of mobility. In addition, higher levels of fine sediment and organics in the Snoqualmie River, that the toxic components of the diesel can adhere to, provide conditions where sublethal concentrations may persist, leading to latent mortality. Latent mortality could also occur from the loss of food organisms that were destroyed during the spill.
Any reduction in the survival of chinook and other salmonids (e.g. steelhead, coho, and cutthroat) would be felt over several cycles of that year class. In other words, chinook fry that emerge from a redd, and survive to maturity, will return to spawn as two year olds, some will return to spawn as three year olds, four year olds, and five year olds. A reduction in the number of returning adults in subsequent years could perpetuate the decrease. A petroleum product spill during odd years when pink salmon spawn would be particularly devastating. Pink salmon return only as two year olds, no overlap of year classes occurs, a reduction in population size caused by a petroleum spill would last for a significantly longer period. The mortalities caused by the spill would eventually be felt in the harvest of adults.

5.6 Spill Impacts to Chinook Spawning and a Terminal Area Fishery: An Example

Using the Tolt River spill scenario, impacts to chinook spawning and a terminal area fishery (Puget Sound and within the river) can be put into perspective. In the section of the Tolt and Snoqualmie Rivers where the spill takes place chinook spawner surveys are conducted by the state on an annual basis. During 1997, 22 chinook redds/mile and 44 redds/mile were observed in the Tolt and Snoqualmie Rivers, respectively. (Curt Kramer, personal

communication). Assuming the diesel spill kills 90% of the developing embryos in the Tolt River, and 50% of developing embryos over an additional two miles of the Snoqualmie River. The distance and the mortality figures used were based on the assumption that evaporation, sorption on to fine sediment, and uneven mixing would decrease the impact on developing chinook embryos. If each female chinook deposits approximately 5,000 eggs, and a total of 99 redds suffer 90% mortality, 445,500 developing chinook will be killed. Using a 11% survival rate to smolt (Major and Mighell 1969), the spill would result in a loss of approximately 49,005 smolts. Using a 3% overall survival rate (Kit Rawson, personal communication) to the time chinook enter the Terminal Area Fishery, 1470 fewer chinook will be available to fisherman and the spawning grounds. This represents a significant economic and cultural loss to tribal, sport, and nontribal commercial fisherman.

The impacts from the Tolt River spill scenario focused on chinook, specifically chinook eggs or embryos. If a spill occurred, mortality to yearling chinook, steelhead fry and yearlings, and coho fry are also likely. If the spill occurred on an odd year, pink salmon embryos would also be affected. All four species are also harvested or could potentially be harvested by sport and commercial fisherman, leading to additional economic and cultural losses.

5.7 Cathodic Protection

The Revised Application provides no discussion on the affects of cathodic protection on fish or macro-invertebrates. Electrical current is often used for collection purposes during fish resource investigations. The effect of cathodic protection on fish and macro-invertebrates is not described in the Revised Application or DEIS. Literature or research sources on this subject are not known.

6 Additional Proposed Mitigation Measures for Stream Crossings

6.1 Construction

The effectiveness of the erosion control measures depends to a significant extent on site conditions. If the site conditions are unknown, and fish presence is unknown at certain locations, effectiveness of mitigation measures and the potential impact on fish at some locations will be unknown. Alternative stream crossing locations or stream crossing methods are *strongly* recommended for Cherry Creek, Harris Creek, Griffin Creek, and Tolt River crossings (see Stream Crossing recommendations above). In addition to the mitigation measures suggested in the Revised Application, and in addition to any posed by other resource agencies or parties, the following additional mitigation measures are strongly recommended. In addition, modification of several of mitigation measures are included:

- The construction window should be stream specific.
- Trees must be planted along the stream corridors. The pipeline will be well below rooting depth. Aerial and ground reconnaissance can still take place.
- The glacial till materials commonly found within the Snoqualmie Basin generate considerable fine sediment. Traditional means to remove fine sediment will most likely not work. More elaborate filtration procedures will be required.
- At all stream crossings where feasible fish should be removed before construction begins.
- The withdrawal and discharge of hydrostatic testing water should not be allowed in small streams. Sources of water and discharge points should be the three sources and discharge points discussed in section 2.5.
- Mitigation should also require the replacement of stream habitat degraded by pipeline construction at a minimum 2:1 ratio.

- All culverts that are undersized, (based on a 100 to 200 year event), are blockages, or are in poor condition should be replaced.

- The preparation of site specific construction plans should be required prior to permitting for stream crossings that contain salmon and trout, or at stream crossings where salmon or trout can be found just downstream (1000 ft), as well as crossings that are sensitive to scour. This should be a standard procedure subject to peer and regulatory review, and should not be considered a mitigation measure.

- The design of site specific crossing plans and mitigation measures should be coordinated through state, tribal, and federal agencies, and incorporated as legal requirements into subcontractor plans and bid specifications.

- Riparian losses should be mitigated through the purchase and restoration of streambanks at another location at a 2:1 ratio.

- More accurate description of stream crossing conditions, fish utilization, nearest fish population, slopes, bed control points, and valley wall stability must be reported.

- Approaches to stream crossings should be spanned or matted to reduce impacts to the riparian areas and stream banks.

- Concrete coated pipe in addition to .5" pipe and/or double-walled pipe should be required at all stream crossings and should extend across all floodplains as defined by appropriate regulatory agencies.

- Water that leaves the site should filtered and must not exceed applicable water quality standards

- Additional block or check valves must be placed on either side of the stream in the vicinity of mileposts 17, 20 and 27, and should be added at all other sensitive stream crossings

- Olympic states they are using the state of the art in spill detection technology (page S-6) which is not entirely true. Much of the technology is 20 years old. New technology like hydrocarbon vapor monitors could be installed to improve the spill detection capabilities. Additional leak detection technology (Mastendrea (1999) Risk Assessment Report) designed and built into the system would greatly increase the safety of the pipeline.

6.2 Operation and Maintenance

The prevention of impacts during the operation of the pipeline relies to a significant extent on monitoring. It must be recognized that monitoring has limitations, simply inspecting a crossing to insure problems will be corrected may be inadequate. Problems at stream crossings may not happen in a manner that is detectable by monitoring. Monitoring will not mitigate problems that arise quickly and catastrophically. What follows are some recommended mitigation or impact avoidance measures relating to pipeline operation and maintenance:

- A detailed monitoring plan with performance standards and reporting requirements should be developed and a contract entered into with Olympic and/or appropriate resource agencies for its execution

- The pipeline should be hydrostatically tested in sensitive areas every 2 years.

- The pipeline should be tested annually using ultrasonic pigs.

- Scour monitoring should be conducted using relocatable cross sections and/or scour chains.

- The pipeline should be inspected on a weekly basis by walking.
- Inspectors should be equipped with hydrocarbon monitoring devices.
- Independent oversight with stop-work authority during construction and operation should be required under the monitoring plan

7 Conclusions

7.1 The Revised Application Is Inadequate

The Revised Application does not present a complete or accurate description of aquatic resources present within the Snohomish/Snoqualmie Basin. It does not provide enough information on the resources and site condition present at stream crossings to meaningfully evaluate project impacts. Olympic does not present a complete picture of the potential types, severity, or magnitude of impacts. The organization of the Revised Application makes it cumbersome to evaluate the impacts the proposed project may have on fisheries resources. Potential impacts to aquatic resources are discussed in several sections of the Revised Application, making it very difficult to review. Perhaps more importantly, the organization of the document splits up the assessment of impacts so that each are evaluated independently, indirectly minimizing the level of resource impact - including impacts to fish and habitat. Pipeline impacts in one section are not clearly conveyed to other relevant sections. Olympic does not attempt to discuss cumulative effects, nor does the Revised Application provide meaningful discussion on toxicological impacts. As a result, the proposed project appears to have a minimal impact on aquatic resources when in fact impacts can and will be far more severe than the proposal indicates.

The Revised Application also presents an unclear picture of the types of mass wasting processes present within western Washington and their proximity to and the effects they can have on aquatic resources. Mass wasting poses a significant threat to the pipeline and associated aquatic resources. The lack of construction detail in the Revised Application leaves reviewers with inadequate information to evaluate the impact of construction activities (or mitigation effectiveness) on landslides, mass wasting and debris torrents. The proposed pipeline route is located on three or more deep-seated failures and crosses more than a dozen streams that are prone to debris torrents. Olympic has not shown that a pipeline can be constructed in these locations without major impacts to fish and aquatic resources.

7.2 The Pipeline Proposal Poses Significant Risks to Salmon in the Snoqualmie Basin

Pipeline construction and operation pose a substantial threat to fish resources and habitat within the Snoqualmie drainage. The construction of the pipeline will degrade fish habitat by reducing the quality and quantity of rearing and spawning habitat, resulting in reduced fish production in the project area. Petroleum product spills during the operation of the pipeline present a significant risk to fish and fish habitat. In western Washington, fish resources are at a particularly high risk because, at many stream crossings, mass wasting processes are active within and adjacent to the stream channels. This places the hazard very near the pipeline and the fish resources of concern. As a result the rupture or leak of the pipeline from mass wasting activities can impact fish resources quickly and catastrophically.

Chinook salmon in the Snoqualmie have been proposed for listing under the ESA during the coming year. Millions of dollars are being spent on salmon recovery and habitat restoration. The salmon recovery plan for the Snohomish watershed will likely consist of additional land use restrictions, costly salmon habitat restoration projects, and further tribal and nontribal harvest restrictions on take of pacific salmon.

In sum, the Cross-Cascade Pipeline project poses a significant direct threat to fish and habitat in the Snoqualmie Basin, and represents a significant cumulative impact to these resources as well.

References

Bahls P., and M. Ereth, 1994. Stream typing error in Washington water type maps for watershed of Hood Canal and the southwest Olympic Peninsula. Point No Point Treaty Council Technical Report TR 94-2., Kingston WA. pp. 13.

Benda, L.E. and T.W. Cundy. 1990. Predicting deposition of debris flows in mountain channels. Canadian Geotechnical Journal, 27:409-417.

Bisson, P.A. and R.E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. American Journal of Fisheries Management 4:371-374.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. In: Meehan, W.R., Ed. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Publication No. 19.

Booth, D.B. 1990. Stream-channel incision following drainage-basin urbanization. Water Resources Bulletin 26:407–417.

Booth, D.B., K. Bell, and K.X. Whipple. 1991. Sediment transport along the South Fork and mainstem Snoqualmie River. King County Surface Water Management Division, Seattle, Washington.

Cascade Columbia Alliance. Feb. 1999. Prehearing Report, GeoSphere LLC. Seattle WA.
Mastendrae, J.R. 1999. Risk Assessment Report. Protank, Inc., Torrance CA.

Cascade Columbia Alliance. 1998. Preventing Oil Leaks: A Citizens Guide to Pipeline Safety. Seattle, WA.

Conroy S.C. 1998. Habitat Lost and Found. Washington Trout Technical Report, Duvall WA. pp 18.

Conroy S.C. 1998. Personal communication, Washington Trout.

Cordone, A.J. and D.W. Kelley. 1961. The influence of inorganic sediment on the aquatic life in streams. California Fish and Game 47(2):189-228.

Dragovich, J.D., M.J. Brunengo, and W.J. Gerstel. 1993. Landslide inventory and analysis of the Tilton River-Mineral Creek area, Lewis County, Washington. Washington Geology, Washington Department of Natural Resources, Division of Geology and Earth Resources. Olympia WA, 21:18-30.

Duffield, J.W. 1993. Estimate of Natural Resource Damages at Camas Creek. Bioeconomics, Inc. for the Confederated Salish and Kootenai Tribes, Polson, MT.

FEMAT. 1993. Forest Ecosystem Management Assessment Team. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Interagency Working Group, U.S. Department of Agriculture, Forest Service, Portland OR.

Folmer, L.C. 1976. Overt avoidance reaction of rainbow trout fry to nine herbicides. Bulletin of Environmental Contamination and Toxicity 15: 509-514.

Furniss, M.J., T.D. Roelofs and C.S. Yee. 1991. Road construction and maintenance. American Fisheries Society Special Publication 19:297-323.

Gall B, 1999. Personal communication, USFS

GeoEngineers, Inc. 1992. Geotechnical investigation, Deforest Creek slide stabilization project, near Arlington, Washington. Unpublished report to the Stillaguamish Tribe of Indians and Washington Department of Ecology.

Karr, J.R. 1991. Biological Integrity: A long neglected aspect of water resources management. Ecological Applications 1(1):66-84.

Kramer, C. 1999. Personal communication, WDFW.

Naimen, R.J., T.J. Beechie, L.E. Benda, D.R. Berg, P.A. Bisson, L.H. MacDonald, M.D. O'Connor, P.L. Olson, and E.A. Steel 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest Coastal Ecoregion, In: Watershed Management. (eds) Naimen R.J., Springer-Verlag. New York pp. 127-188.

Nakamura, F. and F.J.Swanson. 1993. Effects of coarse woody debris on morphology and sediment storage of a mountain stream system in western Oregon. Earth Surface Processes and Landforms 18:43-61.

Major, R.L. and J.L. Mighell. 1969. Egg to migrant survival of spring chinook salmon (*Oncorhynchus tshawytscha*) in the Yakima River, Washington. Fish Bull. (U.S.) 67:347-359.

Markarian, R.K,, J.P. Nicolette, T.R. Barber and L.H. Giese. 1992. A critical review of toxicity values and evaluation of the persistence of petroleum products for natural resource damage assessments. Prepared for the American Petroleum Institute by ENRIX, Inc., December 18.

May, C.W. 1996. Assessment of Cumulative Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion: Implications for Salmonid Resource Management. PhD Dissertation, University of Washington. Seattle WA.

Maynard, D.J. 1980. Prefiled testimony of Desmond Joseph Maynard for Island County. Before the State of Washington Energy Facility Site Evaluation Council.

Maxim Technologies Inc. 1997. 1997 Annual Monitoring Report Camas Creek Site, Sanders County, Montana. Submitted to Yellowstone Pipe Line Company, Houston TX.
Moles, A., S.D. Rice, and S. Korn. 1979. Sensitivity of Alaskan freshwater and anadromous fishes to Prudhoe Bay crude oil and benzene. Transactions of the American Fisheries Society 108: 408-414.

Natural Resources Consultants, 1999, Cross Cascade Pipeline Ecological Toxicity Report, for the Council for Environment. Olympia WA.

Newcombe, C.P.and D.D. MacDonald. 1991. Effects of suspended sediment on aquatic systems. North American Journal of Fisheries Management 11:72-82.

Noggle, C.C. 1978. Behavioral, physiological, and lethal effects of suspended sediment on juvenile salmonids. Masters Thesis. University of Washington, Seattle WA.

Pacific Fishery Management Council, 1997. Puget Sound salmon stock review group report. Portland OR.

Perkins, S. and B.D. Collins. 1997. Lanslide and Channel Response Inventory for the Stillaguamish Watershed, Snohomish and Skagit Counties, Washington. Unpublished report to the Stillaguamish Tribe of Indians, Washington Department of Ecology, Snohomish County Public Works, and the Tulalip Tribes Natural Resources Department.

Pontasch, Kurt W. and M.A. Brusven. 1985. Effects of a Catastrophic Gasoline Spill on the Benthic Communities of

Wolf Lodge Creek, Idaho. Project Completion Report (submitted to Conoco, Inc.). College of Agriculture, Department of Plant, Soil and Entomological Sciences, University of Idaho. Moscow, ID.

Rawson, K., 1999, Personal communication. Tulalip Tribes

Rice, S.D., J.W. Short and J.F. Karinen 1977. Comparative oil toxicity and cmparative animal sensitivity. In D.A. Wolfe ed. Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. New York, Pergamon Press.

Sigler, J.W., T.C. Bjornn and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society. 113:142-150.

Snohomish River Basin Work Group, 1996. Snohomish River Basin fish mapping workshop, August 16, 1995. Marysville WA.

South Fork II Inc. 1983. Weeks Falls Hydroelectric Project: Application for License for a Major Water Power Project of 5 megawatts or less, North Bend, WA.

Stober, Q.J., C.R. Steward, and F. Winchell. 1983. Tolt River fisheries and instream flow analysis. Final Report. Department of Water. Seattle, WA.

Swaney, W., 1998. Personal communication, Confederated Salish and Kootenai Tribes

Swanston, D.N., and F.J. Swanson. 1976. Timber harvesting, mass erosion, and steepland forest geomorphology in the Pacific Northwest. In: Geomorphology and Engineering. (ed.) D.R. Coates, Dowden, Hutchinson, and Ross, Stroudsburg, PA, pp. 199-221.

United State Department of Agriculture, Forest Service, Mt. Baker-Snoqualmie National Forest, 1995. South Fork Snoqualmie Watershed Analysis, North Bend Ranger District, Mount Lake Terrace, WA.

Washington State Department of Fish and Wildlife (1995) Washington Rivers Information System Resident and Anadromous Fish Data (WARIS).
Washington Department of Fisheries, 1985. Fishery Management Report 85-2. Proposed Management of the Snoqualmie River above Snoqualmie Falls. Bob Pfeiffer, Area Fisheries Biologist.

Washington State Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes (SASSI). 1994. 1992 Washington State salmon and steelhead stock inventory.

Washington Forest Practices Board. 1997. Standard methodology for conducting watershed analysis under Chapter 222-22 WAC (version 4.0)

Washington Department of Natural Resources, Water typing system (Data96).

Weyerhaeuser Company. 1993. Tolt watershed analysis report. Tacoma, WA.

Weyerhaeuser Company. 1995. Griffin-Tokul watershed analysis report. Tacoma, WA.

Williams, D.T., S. Carreon, Jr. and J.B. Bradley. 1992. Evaluation of erosion potential at pipeline crossings. Proceedings of the Hydraulic Engineering Sessions at Water Forum, Saving a Threatened Resource – Search for Solutions. Marshall Jennings and Nani G. Bhomik (eds.) 689-694. New York, NY.

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. Catalog of Washington streams and salmon utilization. Volume 1. Washington Department of Fisheries, Olympia WA.

Woodward, D.F., R. G. Riley and C.E. Smith. 1983. Accumulation, sublethal effects, and safe concentration of a refined oil as evaluated with cutthroat trout. Archives of Environmental Contamination and Toxicology. 12:455-464.