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GeoEngineers

MEMORANDUM

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TO:	Jefferson County
FROM:	Bruce Stirling, Senior Environmental Scientist Fiona McNair, Staff Environmental Scientist
DATE:	November 19, 2008
FILE:	12060-001-01
SUBJECT:	Draft Data Gap Analysis for the Marine Water Quality Element Pit-to-Pier Project

INTRODUCTION

This draft memorandum presents our Data Gap Analysis of the available information prepared for the Fred Hill Materials (FHM) proposed Pit-to-Pier Project (the project) pertaining to the Marine Water Quality element of the Draft Environmental Impact Statement (DEIS). The Marine Water Quality Data Gaps Analysis (the gap analysis) is based on information provided by FHM that has already been prepared for the project and/or for the earlier related Mineral Resources Land Overlay (MRLO) application and the Public Scoping Comments (the public comments) provided and summarized as of October 29, 2007 by Jefferson County (the County). The gap analysis was initiated prior to preparation of the DEIS document because a considerable body of technical information is needed in order to proceed with characterizing potential impacts associated with the actual project. The approach to the gap analysis is described in GeoEngineers' *Pit to Pier DEIS Gap Analysis Framework Memo* of October 25, 2007 and was designed to provide the following information:

- Identify materials reviewed,
- Identify substantive issues to be addressed,
- Provide an evaluation of whether or not existing technical studies cover both the geographic extent of the required analysis and the required scope of analysis,
- Provide comment on the appropriateness of technical study methodology,
- Determine whether or not conclusions reached in previous technical studies are adequately supported and current, in light of changing conditions and regulations,
- Identify additional work that will be required to prepare the DEIS, and
- List and describe "Red Flags" discovered during the gap analysis process.

A review of project information and the scoping phase public comments indicates that the following primary project elements should be assessed for potential impacts on marine water quality:

- Construction, operation and maintenance of the conveyor and loading pier facility within near shore, intertidal and subtidal zones; and
- Barge and ship transport of sand and gravel to local, regional, intrastate, and interstate markets.

The adequacy of the information reviewed was based on the current requirements of local, state and federal permitting agencies to evaluate the proposed action for required permits and environmental review. The gap analysis assumes the project is grandfathered under the 2000 Jefferson County Criteria Areas regulations (Title 18.15).

The adequacy of the studies were also evaluated in light of the phasing, size and potential impacts of the proposed project and the historical and expected intensity of scrutiny from the public and resource agencies as identified in the scoping phase comments. Scoping phase public comments associated with marine water quality were evaluated as to their validity based on our understanding of the project. A complete list of the scoping phase public comments are provide in Attachment A. Those issues that were considered relevant to project activities are summarized in Table 1 below as well as discussed in more detail in the sections that follow. References to specific reports, pages and/or sections where information has been (or will be) used are noted.

Table 1. Water Quality Issues

Water Quality Issue	Potential Causes/Sources[1]	Likelihood of Incident/Action Occuring[2]	Likelihood of Potential Impact[3]	Supporting Literature/Studies
Turbidity	Prop wash due to intermittent and ongoing boat/barge traffic	**Likely** – Prop wash from tugs and boats has a high probability of occurring during routine docking, undocking and loading in the vicinity of the pier.	**0 to 10 inches** **Unlikely** - Because the sediment grain size down to 10 inches depth in the area of the proposed conveyor and pier loading facility is medium to fine sand particles, disturbed sediments will settle to the bottom quickly and should not create damaging levels of turbidity.	Anchor 2003; [4]Coast and Harbor 2008
			Deeper than 10 inches **Unknown** - The presence of fine particles that could be resuspended from sediments below 10 inches are currently unknown. Quantitative data on grain size and composition of subsurface sediment below 10 inches is needed to determine that potential impact of disrupting and redistributing deeper sediment is unlikely.	

Table 1. Water Quality Issues (Continued)

Water Quality Issue	Potential Causes/Sources[1]	Likelihood of Incident/Action Occuring[2]	Likelihood of Potential Impact[3]	Supporting Literature/Studies
Turbidity	Increased stormwater runoff from the pier loading facility and conveyor in the nearshore area.	**Likely** – Stormwater runoff from new impervious surfaces as a result of the pier loading facility, conveyor and associated structures has a high probability of occurring.	**Unknown** – Quantitative data on frequency and magnitude of occurrence of stormwater runoff is needed to determine that potential impact is unlikely.	[4]Coast and Harbor 2008
	Incidental spills of gravel from the conveyor and pier structure.	**Unknown** – Incidental spills from the conveyor and pier structure	**Unknown** – Quantitative data on frequency and magnitude of occurrence of incidental spills as well as the expected pH and turbidity of gravel material being loaded is needed to determine that potential impact is unlikely.	
	Temporary pier and nearshore conveyor construction activities	**Likely** – Temporary construction activities have a high probability of occurring with all marine (in-water) construction projects.	**Likely** – Sediment disturbance will occur during construction of the conveyor piers and associated pile support structures.	Pentec 2003; Jones and Stokes 2000; [4]Coast and Harbor 2008
Metals/Organotins	Leaching of metals and tributyltin from coatings on boat/barges that are in direct contact with the water column.	**Likely** – Almost all marine vessel hauls in contact with the water are coated with anti-fouling paints containing various levels of metals that are designed to prevent growth of marine organisms. Tributyltin has historically been used for this but is slowly being replaced by other metals (lead, copper) because of its high toxicity to marine organisms and persistence in the marine environment.	**Unlikely** – Very little information was available to support the likelihood of this potential impact. However, in general, only heavy shipping sites (shipping lanes, busy ports and harbors or marinas) seem to be areas of concern with regard to exceeding toxicity thresholds of metals and organotins in sediment or water.	Sandberg et al. 2007; Schottle and Brown 2007; Seligman *et al*. 2004; Strand and Jacobsen 2000

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Table 1. Water Quality Issues (Continued)

Water Quality Issue	Potential Causes/Sources[1]	Likelihood of Incident/Action Occuring[2]	Likelihood of Potential Impact[3]	Supporting Literature/Studies
Petroleum Hydrocarbons	Oil and gasoline/diesel spills due to accidents.	**Unlikely** – The probability of a catastrophic spill as a result of boat or barge collisions and/or accidents is low.	**Unknown** – Quantitative data on frequency and magnitude of occurrence is needed to determine that potential impact is unlikely.	[4]PB Americas 2009
	Incidental oil and gasoline/diesel leaks and contaminated rainwater runoff from boat/barges.	**Likely** – Incidental oil/grease and gasoline/diesel coming from precipitation runoff from boat/barge surfaces or small leaks or spills has a high probability of occurring.	**Unknown** – Quantitative data on frequency and magnitude of occurrence is needed to determine that potential impact is unlikely.	[4]PB Americas 2009
	Increased discharge of petroleum or exhaust products from idling automobile traffic on Hood Canal Bridge during bridge closures for barge/boat traffic.	**Unlikely** – Barge/boats will disrupt automobile traffic on the Hood Canal Bridge very infrequently when compared to the total amount of time the bridge is open to traffic.	**Unlikely** – Automobile traffic will release insignificant levels of oil/grease if idling on the Hood Canal Bridge as a result of barge/boats passing through the canal.	[4]PB Americas 2008
Nutrients/Bacteria Exotic Species	Release of gray water (sewage) from vessels creating potential inputs of nitrogen/phosphorus and bacteria into Hood Canal which is already limited for dissolved oxygen (DO) concentrations. Discharges of untreated ballast water introducing exotic species to Hood Canal.	**Unlikely** – Restrictions on the discharge of sewage and gray water and tidal currents at the site will minimize risk of localized nutrient or bacteria pollution problems. Accidental releases may occur but would be expected to be unlikely. It is illegal to discharge untreated ballast water in Washington State.	**Nutrients/Bacteria: Unknown** – Additional data on frequency and magnitude of occurrence is needed to determine that potential impact is unlikely.	Pentec 2003; WAC 2001; RCW 2000; Foss et al. 2007
			Exotic Species: Likely - Any illegal discharges of untreated ballast water from international or out-of-state vessels would likely harm the ecosystem of Hood Canal at any level of frequency.	

Notes:
[1] Water quality data gaps assessment did not evaluate potential long-term marine water quality impacts due to upland land use changes or activities within the Hood Canal watershed that may occur in the future if this project is approved.
[2] **Likely**: Sufficient existing information to conclude that activity or action has a high probability of occurring. **Unlikely**: Sufficient existing information to conclude that activity or action has a low probability of occurring. **Unknown**: Insufficient existing information to conclude that activity or action has a low probability or high probability of occurring.
[3] **Likely**: Sufficient existing information to conclude that impact from that activity or action is probable and therefore this potential impact should be evaluated in the EIS. **Unlikely**: Sufficient existing information to conclude that activity or action has a low probability of occurring and that impact is improbable OR that there is not precedent for addressing this impact for a project with this scale and scope and therefore this potential impact should not be evaluated in the EIS. **Unknown**: Insufficient existing information to determine likelihood of impact and therefore this impact should be evaluated in the EIS after collection of more data and/or information.
[4] Studies were still being developed as of the date of this memo.

BASELINE MARINE WATER QUALITY

The shape, bathymetry and water circulation of Hood Canal are typical of a fjord-type estuary. Hood Canal is a long and thin embayment of Puget Sound with deep waters in the central and southern sections (100-150m) and shallow sills at the mouth (75m) (near Port Ludlow) and at South Point (50m) (~3.5 miles SW of the Hood Canal bridge) (Paulson 1993). The project site sits approximately within the central portion of the Canal. Landward of the Great Bend, depths are less than 50m (Paulson 1993). Flows in Hood Canal are typical of an estuary with saltier water flowing into Hood Canal at depth and lighter, less salty water flowing out of Hood Canal at the surface. The sills prevent the free flow of seawater into the central basin allowing only periodic renewal of bottom waters by strong flows (intrusions) from the Strait of Juan de Fuca (Paulson 1993). Even though surface currents are strong in Hood Canal, there is little advective transport (e.g., movement of nutrients and oxygen via currents) and little vertical mixing (Paulson 1993). These circulation patterns can result in vertical stratification creating a pattern of increased nitrogen and phosphorus and decreased oxygen at depth (especially in the central and southern portions of Hood Canal) (Newton 2008, Paulson 1993). The Washington State Aquatic Life Dissolved Oxygen (DO) Criteria for Marine Waters of extraordinary quality is 7.0 mg/L (lowest 1-day minimum) (Ecology 2003). Minimum oxygen concentrations of 1-2 mg/L have been observed in Hood Canal since the early 1990s (Newton 2008). Low levels of DO in Hood Canal are a concern for the health and survival of aquatic life. Fish kills have been documented in Hood Canal since the 1920s (Newton 2008). The unique circulation and lack of frequent flushing in Hood Canal contributes to the low DO problem as do loadings of nitrogen and carbon. Phytoplankton growth in Hood Canal is limited by nitrogen, so algal growth is particularly sensitive to inputs of this nutrient (Newton 2008). The increased growth of algae leads to an increase in organic matter sinking to deeper waters where decomposers break this organic matter down, using up oxygen in the process (Newton 2008, Paulson 1993). Additional data on the issue of low DO in the vicinity of the proposed project will be collected by Pentec and included in the final affects analysis for marine water quality as it becomes available.

Marine water quality information in the vicinity of the proposed project was researched to provide a general basis from which to establish a baseline of water quality. With the exception of DO, it appears that marine water quality in the vicinity of the project is exceptional. Hood Canal marine waters are rated by the Washington Department of Ecology as having extraordinary quality for aquatic life uses (WAC 173-201A-612, Ecology 2006). Extraordinary quality aquatic life uses are described as: salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; and crustaceans, and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning (WAC 173-201A-610, Ecology 2006). Marine waters designated as having extraordinary quality for aquatic life uses have stricter water quality standards for turbidity, dissolved oxygen (DO), pH, and temperature (WAC 173-201A-210, Ecology 2006).

The *Thorndyke Resource Operations Complex Central Conveyor and Pier Project Biological Evaluation* (Pentec 2003) states that background water quality samples have not been collected in the vicinity of the project area but that because the area is relatively undeveloped, marine water quality is expected to be excellent. The Washington Department of Ecology Puget Sound Assessment and Monitoring Program (PSAMP) has collected water quality samples at two stations near the project site (PSAMP 2008a, HCB006/008 – King Spit, Bangor Naval Reserve and PGA001 – Port Gamble-Inner Harbor). Water quality parameters measured include temperature, dissolved oxygen, fecal coliform, salinity, ammonia, nitrate, nitrite, phosphorus, pH, Secchi depth, and light transmission (PSAMP 2008a). In addition, in early 2008, the Port Gamble S'Klallam Tribe in Kingston, WA started a marine water monitoring program near the Hood Canal Bridge (Rose 2008).

Two sites in Hood Canal across from the project site have been listed on the Washington Department of Ecology's 303(d) List of impaired waters for dissolved oxygen (Ecology 2008, Listing ID 38380 and 38384).

In 1996 and 1998, marine waters in Thorndyke Bay and Squamish Harbor met the Washington State water quality standards for fecal coliform (Ecology 2008).

PSAMP has collected in the past and continues to collect sediment and tissue samples in Hood Canal as part of a program to assess the health of Puget Sound and to develop health advisories related to consuming seafood from Puget Sound (PSAMP 2008b). Sediment and tissue samples are analyzed for toxic substances (e.g., PCBs and DDT), total organic carbon and grain size (PSAMP 2008b). Because some portion of contaminants released into the water adsorb to particles and settle on the bottom, sediment samples can serve as an indicator of marine water quality. Therefore, sediment samples from stations near the project site could serve to evaluate the potential long-term impacts of the projects on marine water quality with respect to toxic substances. On September 26 2008, GeoEngineers collected three surface sediment samples (0 to 10 inches) from three locations with 10-foot increments of depth (10 feet MLLW, 20 feet MLLW and 30 feet MLLW) in the vicinity of the proposed aggregate loading facility. As shown on Figure 1, sieve analysis indicates that the samples were composed primarily of medium to fine sand. Previous sediment grain size analyses of sediment samples from a 1997 study collected at a nearby station (PSAMP 2008b, sediment monitoring station #10, Thorndyke Bay) had results of 12 percent clay, 58 percent silt and 26 percent sand. Sample depths from this study were not reported. It is likely that sediment grain size in Thorndyke Bay is smaller than at the pier site due to different source materials. Thorndyke Bay receives inputs of fine material from Thorndyke Creek, while the pier site receives inputs of sand from sloughing of adjacent bluffs.

MARINE WATER QUALITY ISSUES

Baseline marine water quality of Hood Canal could potentially be impacted by project related activities associated with both the construction and the operation and maintenance of the conveyor and the pier facilities and vessel traffic to and from the completed pier structure. Marine water quality issues that were considered pertinent to the project were organized into four primary elements as follows:

- Turbidity
- Metals/Organotins
- Petroleum Hydrocarbons
- Nutrients/Bacteria and Exotic Species

References of existing studies, documents and other related information that were used in the preparation of this memo are cited throughout with a complete citation provided in the references section.

TURBIDITY

Turbidity is a measure of the amount of suspended particles in the water column. Washington State defines turbidity as “the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter” (WAC 173-201A-020, Ecology 2006). Other measures of the amount of suspended material in the water column are percent light transmission using a transmissometer, total suspended solids (a measure of the mass, in milligrams, of dissolved and particulate matter in a liter of water) and Secchi depth (the depth, in meters, to which a black and white disk is still visible from the surface of the water). Turbidity is typically thought of as a measure of suspended inorganic or organic particles, however the ability of the water to transmit light can also be impacted by the amount of phytoplankton (unicellular algae in the water column) and zooplankton (small animals in the water column) in the water.

Turbidity is measured as an indicator of water quality because the ability of the water column to transmit light can impact photosynthesis for phytoplankton and submerged vascular plants and algae (Thom et al. 1996). In addition, suspended sediments can impact fish and invertebrates by affecting behavior and interfering with gill ventilation, by covering benthic organisms or by stirring up contaminants in the bottom sediments, increasing exposure for organisms (Simenstad et al. 1999).

The Thorndyke Resource Biological Evaluation (BE) states that short term impacts on turbidity are anticipated from pier construction and boat prop wash (Pentec 2003). It was assumed that tidal fluctuations and tidal currents would mitigate for temporary impacts on water quality through dilution and advection (Pentec 2003). The Thorndyke Resource BE also states that no long-term direct or indirect effects to marine water quality are anticipated from the project (Pentec 2003). One study reporting observed levels of suspended materials from dredging events was cited and it was stated that levels from boat prop wash at the project site would be much lower (Pentec 2003). No supporting documentation or quantitative analyses for this statement were provided.

The action at the project site that could have potential long-term impacts on turbidity is boat traffic and the resulting prop wash. Propellers of tug boats create currents known as prop wash. These currents can disturb bottom sediments and stir them up into suspension in the water column increasing turbidity (Ebbesmeyer et al. 1995, Hamill et al. 1998). Prop wash may disturb project site sediments when tug boats are entering and exiting the pier area. The amount of sediment resuspension and the time it takes for those particles to settle depends on part on the sediment grain size at the site that will be disturbed. On September 26 2008, GeoEngineers collected three surface sediment samples (0 to 10 inches) from three locations with 10-foot increments of depth (10 feet MLLW, 20 feet MLLW and 30 feet MLLW) in the vicinity of the proposed aggregate loading facility. As shown on Figure 1, sieve analysis indicates that the samples were composed primarily of medium to fine sand. As part of an evaluation of longshore sediment transport and shoreline processes (Anchor 2003) the potential for vessel propeller wash to scour shoreline bed sediments at the Project pier site was investigated using a PROPWASH model (Blaauw and van de Kaa 1978, Verhey 1983). The model estimated that a maximum of 3.5 and 19 inches of bottom scour would occur for water depths of 50 and 40 feet. respectively at a horizontal distance of 150 feet from the propeller. Because it was assumed that tug boats are likely to work in 50 feet of water or greater these results were interpreted as indicating minimal scour (Anchor 2003). Potential problems with the modeling approach and assumptions made for the PROPWASH model include:

- Actual water depths at a horizontal distance of 150 feet from tugboat propellers may be less than 50 feet if tugs are perpendicular to the shore and facing away from the shore. Figure 9 of the *Longshore Sediment Transport and Shoreline Processes* report (Anchor 2003) shows that the pier is 150 feet (horizontal distance) from the propellers of tugs numbered 2 and 3. The site plan in the BE shows that the pier is at approximately 45 feet MLLW (Pentec 2003). These discrepancies can potentially under-estimate scour velocities.
- Increased velocities that occur at the sediment surface were not modeled in the PROWASH model (Simpson 2008). This could omission could potentially under-estimate scour velocities.
- Tugs with 5000HP were assumed, however tugs with 3000Hp are more likely to be used at this site due to cost and availability (Simpson 2008). The difference could potentially over-estimate scour velocities.

The PROPWASH study indicated a potential maximum scour depth of 19 inches (for water 40 feet deep at a horizontal distance of 150 feet from the propeller) (Anchor 2003). Sediment grain size of disturbed sediments was estimated as fine sand but grain size is only known definitively and quantitatively to a depth of ten

inches. Scour velocities were potentially over-estimated if grain size is larger or under estimated if grain size is smaller as a result of this data gap. The proposed orientation of tugs in Figure 9 of the *Longshore Sediment Transport and Shoreline Processes* report (Anchor 2003) would result in less scour and therefore less potential turbidity effects than if tugs operated in more shallow water (especially if propellers were oriented towards shore). In order to ensure that this assumption remains true for day-to-day operations of the pier site, a requirement for tugs to operate as depicted in Figure 9 (or another arrangement demonstrated to have even smaller scour velocities) should be written into the design and operational code of the pier.

After eight years of operation large ships, in addition to tugs, are expected to work at the pier. An assumption made in the *Longshore Sediment Transport and Shoreline Processes* report (Anchor 2003, page 29) is that vessels are not expected to dock under their own power, but will have tug assist. In order to ensure that this assumption is true for day-to-day operations at the pier site, a requirement for no use of ship bow thrusters at the pier should be written into the design and operational code of the pier.

In addition, because the PROPWASH model study was intended to investigate shoreline scour and not turbidity of marine waters, the model did not provide estimates of turbidity levels for comparison with marine water quality criteria. Analysis of sediment grain size below ten inches during future geotechnical explorations would be useful in determining potential impacts to turbidity from prop wash that may disturb sediments at depths greater than 10 inches, however Coast and Harbor scientists expressed confidence in the assumption that sediment grain size would be the same or larger below 10 inches depth due to the source material (sloughing of adjacent bluffs).

A Final Environmental Impact Statement for the Glacier Northwest Gravel Mine stated that prop wash could affect nearshore organisms by stirring up bottom sediments thus increasing turbidity (Jones and Stokes 2000). It was stated that suspended sediments from prop wash could impact an adjacent eelgrass patch and other marine plant communities at the site (Jones and Stokes 2000). A Final Environmental Impact Statement and BE by the Port of Everett for their Satellite Rail/Barge Transfer Facility stated that construction activities (e.g., pile driving in the harbor) would create temporary increases in turbidity (Pentec 2004, Port of Everett 2004). Prop wash from tugs was not evaluated as a potential project action that could impact turbidity of marine waters, however it was stated that scour from prop wash would not affect eelgrass because "…tug propellers will always be the length of the barge and the length of the tug away (250 feet or more) from existing eelgrass and in water depths exceeding 50 feet." (Port of Everett 2004).

It is likely that some prop wash will occur at the site, especially during vessel departure when the most engine power will be needed to move a fully loaded vessel. The total amount of sediment resuspension over the life-time of the project will depend in part on the depth that tugs and ships operate in and their orientation to the shore (propellers create the greatest disturbance/turbulence at a given point away from the propeller), the sediment grain size (up to the depth of expected scour), sediment transport and deposition processes, speed and size of the vessel, duration of the propeller activity, and characteristics of the propeller(s) (e.g., size and angle). In addition, the number of ship visits is important information for evaluating the length of time that turbidity levels may be elevated. A memo evaluating the potential for vessel induced turbidity in Rozelle Bay, Australia cited several studies indicating that silt (sediment particles approximately 2-50 µm) would not be resuspended from the bottom if boat propellers were 3-5m above bottom sediments (Patterson Britton and Partners 2006, Hill and Beachler 2002). The studies did not indicate if large transport vessels (e.g., tugs and barges) were used in the studies.

In order to accurately evaluate the potential for the project to impact turbidity, existing conditions at the site (e.g., sediment grain size below 10 inches and existing water column turbidity levels) may need to be characterized or, at a minimum, estimated using data from nearby undeveloped sites. The characterization of

coastal processes currently being conducted by Coast and Harbor Engineering (2008) seems to indicate that the large sediment grain size will allow rapid settling of disturbed particles and that tidal currents (maximum flows of 0.55 m/s or 1.8 ft/s) at the site will carry away and dilute small suspended particles thereby minimizing long-term impacts on turbidity. The *Longshore Sediment Transport and Shoreline Processes* report indicates that the pier will be used up to 300 days per year with a maximum of six barges per day (average of 3 barges a day) (Anchor 2003). Depending on size, barges will take from one to eight hours to load. If sediments at the pier site are resuspended during tug-assisted placement of barges there is still not enough information to determine what resulting turbidity levels will be and how long they will last. With up to six barge visits per day, water quality criteria for turbidity at the site could be exceeded often and potentially for extended periods of time. It would be helpful if future analyses of prop wash by Coast and Harbor included estimates of turbidity levels and a measure of duration for when those levels would be above water quality criteria for Hood Canal.

METALS/ORGANOTINS

The hulls of ships are typically coated in paints containing biocides (e.g., tributyltin and copper thiocyonate) which slowly leach out from the paint and prevent the growth of organisms (Sandberg et al. 2007). Tributyltin (TBT) is an organo-metal compound that is toxic to aquatic life (EPA 2004). It is an endocrine-disrupting chemical that causes reproductive effects in aquatic organisms (EPA 2004, Fent 1996). Mollusks are particularly sensitive to tributyltin (EPA 2004). Imposex (irreversible masculinization of the female snail reproductive tract) was observed in 38 to 67 percent of female whelks in shipping channels near Portland, Maine (Sommer *et al*. 2000). A new study reports that pesticides, including DDT and tributyltin (TBT), have been found in deep-sea squids and octopods (Reported on June 12, 3008, www.beyondpesticides.org accessed November 17, 2008). The International Maritime Organization (IMO) also notes that TBT "persist(s) in the water, killing sea life, harming the environment and possibly entering the food chain… [TBT] has been proven to cause deformations in oysters and sex changes in whelks" (Reported on September 12, 3008, www.beyondpesticides.org accessed November 17, 2008).

Copper is an essential micronutrient with background concentrations in marine waters of 0.5 to 6 nM (Millero and Sohn 1992). Copper is toxic to aquatic life at elevated concentrations (EPA 2007). These biocides leach into the water, adsorb to particles and settle to the bottom (Clark et al. 1988, Laughlin and Linden 1987). Because copper is an essential nutrient, organisms have mechanisms to excrete it making it less persistent in the environment (Campbell et al 1988). Tributyltin breaks down slowly and tends to bioaccumulate in organisms and biomagnify up the food chain. Over time, tributyltin could accumulate at the site unless water currents, sediment scour or burial remove it from the system. The use of antifouling paints is considered necessary because marine invertebrates colonize ship hulls reducing the streamlining of the vessel and potentially damaging the hull. Antifouling paints can serve to protect local marine resources by reducing the introduction of non-native species from ship hulls. A study of commercial ships in Hamburg, Germany found that ship hulls contained 49 percent non-native species (Gollasch S. 2006).

Through the NPDES permit program, Washington State limits discharges of copper from shipyard dry docks on Puget Sound (Showalter and Savarese 2005). In addition, Washington State has established surface water (freshwater and marine) criteria for copper (WAC 173-201A-240, Ecology 2006). EPA has established water quality criteria for tributyltin (EPA 2004) and copper (EPA 2007) and regulates the sale of antifouling paints containing organotin compounds (Showalter and Savarese 2005). Washington State has not established water quality criteria for tributyltin.

Studies conducted as part of the Thorndyke Resource Operations Complex Central Conveyor and Pier Project did not address potential impacts to water quality from antifouling paints (FHM 2006, Anchor 2003, Pentec

2003). Potential effects of boat antifouling paints were not addressed in the *Final Environmental Impact Statement for Maury Island Glacier Northwest Gravel Mine* (Jones and Stokes 2000) or the *Port of Everett Final Environmental Impact Statement for the Proposed Satellite Rail/Barge Transfer Facility* (Port of Everett 2004). In general, sites where concentrations of anti-fouling paint biocides in sediment or water are an issue with regard to exceeding toxicity thresholds include heavy shipping lanes, busy ports and harbors or marinas (Schottle and Brown 2007, Seligman *et al*. 2004, Strand and Jacobsen 2000). Several studies provide methods of estimating leaching rates from ships hulls (Sandberg et al. 2007).

PETROLEUM HYDROCARBONS

Actions at the project site listed as having a probable likelihood to affect marine water quality with respect to levels of petroleum hydrocarbons are oil and fuel spills or leaks from vessels entering and leaving Hood Canal and the pier loading facility. Petroleum-derived diesel is composed of approximately 75% saturated hydrocarbons (e.g., paraffins including n, iso, and cycloparaffins), and 25% aromatic hydrocarbons (including polycyclic aromatic hydrocarbons [PAHs] such as benzo[a]pyrene and chrysene)) (ASTDR 1995). PAHs are the most potentially toxic fraction of diesel fuel (EPA 2008). PAHs are a group of greater than 100 chemicals formed from chemical processes in natural crude oil and coal deposits and during incomplete burning of oil and gas, coal, garbage, and other organic substances (ATSDR 1996). Most PAHs have low solubility in water and therefore are commonly found associated with suspended or bottom sediments (ATSDR 1996). Understanding the toxicity of PAHs to aquatic life is difficult because PAHs exist as complex mixtures of many different compounds (EPA 2008). Effects of PAHs on benthic invertebrates include inhibited reproduction, delayed emergence and mortality (EPA 2008). Fish exposed to PAHs exhibited fin erosion, liver abnormalities, cataracts, and reduced immune function (ATSDR 1996). EPA regulates PAHs in marine waters through the establishment of water quality criteria for individual PAHs (EPA 2008).

The Thorndyke Resource BE states that fuel spills during construction and operation of the conveyor are possible (Pentec 2003). Short term increases in concentrations of petroleum hydrocarbons can be expected if fuel spills or leaks occur. The Thorndyke Resource BE also indicates that because fueling of vessels will not occur at the site the volume of the spill(s) will be limited to that contained in the vessel and therefore "potential impacts to water quality from small spills or leaks are possible, but are unlikely to have long-term impact" (Pentec 2003).

The *Port of Everett Final Environmental Impact Statement for the Proposed Satellite Rail/Barge Transfer Facility* (Port of Everett 2004) and the *Port of Everett Rail/Barge Transfer Facility. Biological Evaluation* (Pentec 2004) acknowledge the potential for fuel spills to occur and concludes that these spills would only have temporary effects on marine water quality. At the time of the Port of Everett reports, existing water quality at the proposed Everett transfer facility site was already impacted by groundwater contamination and commercial vessel use (Port of Everett 2004). Additional information from the *Final Environmental Impact Statement for Maury Island Glacier Northwest Gravel Mine* indicates that "Normal operations of the vessels do not result in significant spillage of petroleum products. As with any boat, tugs would release oil and diesel into the water from their exhausts. The small amounts would disperse quickly. Currents would move and dilute such inputs and any one area is unlikely to be impacted repeatedly." (Jones and Stokes 2000).

Although diesel fuel would likely be the primary petroleum product spilled from boats and other related equipment, understanding the fate of an oil spill in the marine environment (especially the saturated and aromatic hydrocarbon components) can help inform the fate of diesel in that environment. Within ten minutes of oil spilling into marine waters, the oil will disperse quickly into a 1 cm film (Stanislav 1999). The film continues to spread until it is thinner than 1mm. In the first few days after a spill, the light and volatile components of the oil transform into the gaseous phase and water soluble components of the oil dissolve into

the water (Stanislav 1999). If an oil spill occurs close to shore it can soak into shoreline and intertidal sediments where it can persist for years depending on sediment composition and exposure to waves and weathering (Sauer et al. 1998).

The study being conducted by PB Americas to evaluate the risk of boat accidents and the resulting nature of the spills will help to estimate the potential frequency and magnitude of fuel spills from barge and ship/barge traffic coming and going from the pier. The fate and transport of fuels, once they enter into marine waters in the vicinity of the project site has not yet been evaluated.

NUTRIENTS/BACTERIA AND EXOTIC SPECIES

The 1992 Clean Vessel Act (US Code 1992) identifies untreated vessel sewage discharges as "a substantial contributor to localized degradation of water quality in the United States." Compared to sewage treatment plant discharges, the concentrated waste in boat holding tanks can have as much as 1000 times the amount of bacteria in the same volume of sewage (Kitsap County 2005). Gray water also contains high levels of bacteria as well as nutrients and organic matter that stimulate growth of aquatic algae and create a demand for oxygen (Kitsap County 2005). The State of Washington prohibits the discharge of any *"…organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the department, as provided for in this chapter."* (RCW 1987). Discharge of sewage or gray water by boats at the project site are unlikely to impact levels of fecal coliform, nutrients and organic matter in marine waters near the pier site due to the anticipated low frequency of these discharges. The Thorndyke Resource BE states that "plumes of (potentially discharged) gray water are expected to disperse quickly in the substantial currents present in this portion of the canal, and no short-term acute or chronic effects on biota are likely" (Pentec 2003). No supporting documentation or quantitative analyses for this statement were provided.

The Final Environmental Impact Statements for the *Port of Everett Proposed Satellite Rail/Barge Transfer Facility* and *Maury Island Glacier Northwest Gravel Mine* did not address potential impacts from discharges of sewage or gray water (Jones and Stokes 2000, Port of Everett 2004).

The characterization of coastal processes currently being conducted by Coast and Harbor Engineering (2008) seems to indicate that tidal currents (maximum flows of 0.55 m/s or 1.8 ft/s).at the site will carry away and dilute discharges of sewage or gray water thereby minimizing long-term impacts on levels of nutrient and bacteria at the site.

Ballast water is not likely to be a significant source of nutrients or harmful bacteria like *Escherichia coli*, however ballast water from international or out-of-state vessels can potentially contain exotic species of marine organisms which may include the larvae of fish and benthic invertebrates. Large vessels can carry more than 200,000 m^3 of ballast water and hundreds of millions of live organisms (Foss et al. 2007). The State of Washington prohibits the discharge of ballast water from vessels unless there has been an open sea exchange of water or the ballast water is treated to ensure removal of ninety-five percent of zooplankton organisms and ninety-nine percent of phytoplankton and bacteria (WAC 2001, RCW 2000). Potential illegal discharges of untreated ballast water from foreign vessels at the site would likely negatively impact the marine ecosystem of Hood Canal if any exotic species were to become established.

SUMMARY

Several water quality issues were considered by the public to be important to the short and long-term health of marine water quality in Hood Canal (Attachment A). The public comments were evaluated for relatedness to

the project. Marine water quality issues considered to be appropriate for the DEIS were then assessed and the availability of studies associated with these issues researched.

Public comments were focused into the following four primary water quality issues:

- Turbidity/pH,
- metals/organotins,
- petroleum hydrocarbons, and
- nutrients/bacteria/exotic species.

The results of the data gaps analysis reveal some deficit of supporting quantitative information from which to definitively conclude that project related actions are, or are not, likely to degrade marine water quality in Hood Canal over either the short or long-term. The primary sources of project-specific documentation (FHM 2006, Anchor 2003, Pentec 2003) on a whole, lack quantitative data, citations of scientific literature and quantitative analyses to support definitive statements such as "potential impacts to water quality from small spills or leaks are possible, but are unlikely to have long-term impact". With the exception of regional (and on-going) DO issues, baseline marine water quality in Hood Canal is considered exceptional. Because baseline water quality in Hood Canal is rated at such a high level, any impact to water quality from the project could be perceived as detrimental to the long-term health of the canal.

Of the four primary issues identified, turbidity appears to have attracted the most discussion considering both site-specific documentation and other similar pier projects including the proposed Port of Everett and Maury Island facilities (Jones and Stokes 2000, Port of Everett 2004). The potential for spills and leaks of petroleum hydrocarbons were mentioned as a "potential impact" without any accompanying qualitative or quantitative discussion or documentation. The remaining water quality issues including the potential for leaching of metals/organotins and the discharge of nutrients/bacteria/exotic species were neither mentioned nor discussed in the site-specific information that was reviewed.

Within the programmatic-level DEIS process, the necessary level of understanding of marine water quality issues has not been established at this time. Assuming there is a need for further evaluation of the potential impacts of the proposed project on marine water quality, we recommend that the following studies, analyses and data be obtained:

- During future geotechnical or sediment explorations, conduct grain size analysis below 10 inches depth in the vicinity of the proposed conveyor and pier loading facility.
- For future analyses of prop wash request that Coast and Harbor provide estimates of turbidity levels relative to water quality criteria for Hood Canal using realistic scenarios based on proposed tug and boat types, numbers and orientation to the barges. In addition, future analyses of prop wash should provide estimates of the duration for which turbidity levels will exceed water quality criteria using realistic scenarios based on proposed frequency of tug visits to the pier loading facility.
- Conduct turbidity (and pH) analysis on random gravel/aggregate samples that will be transported to the pier loading facility.
- Develop quantitative estimates of the frequency and magnitude of the following:
  - incidental gravel/aggregate spills in the nearshore area and at the pier loading facility;
  - impervious stormwater runoff from the over-water conveyor and pier loading facility;

- sewage and ballast water discharges from barge/boats;
- incidental petroleum hydrocarbon spills from barge/boats; and
- catastrophic accidents associated with boat/barge collisions within Hood Canal.

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Enclosures: Figure 1. September 26, 2008 Sieve Analysis
Attachment A – October 29, 2007 - Scoping Phase Comments

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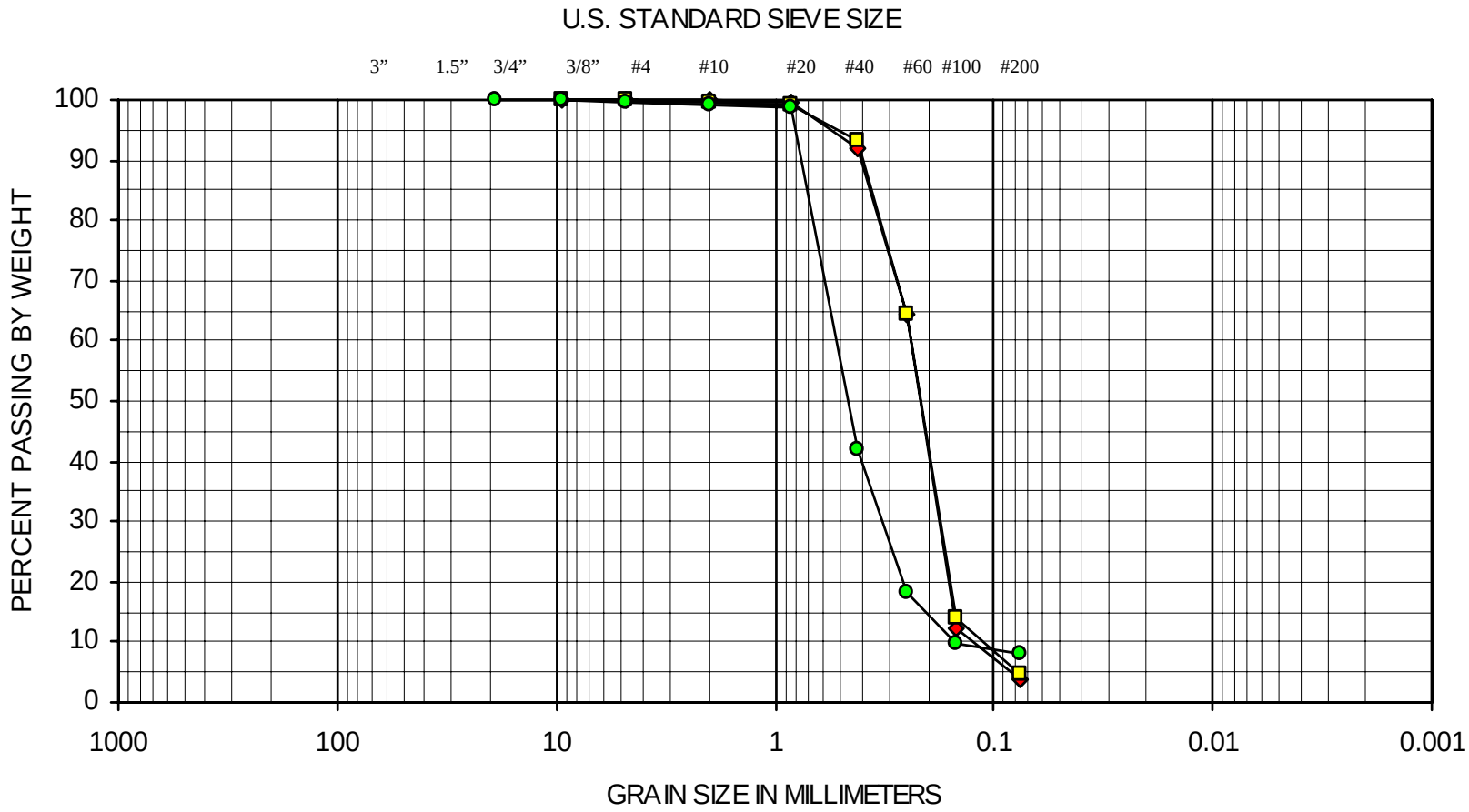
GeoEngineers

FIGURE 1

SIEVE ANALYSIS RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	EXPLORATION NUMBER	DEPTH (in)	MOISTURE (%)	SOIL CLASSIFICATION
◆	N/A	10	37.9	Gray sand (SP)
■	N/A	20	54.3	Gray sand (SP)
●	N/A	30	30.4	Gray sand with silt (SP-SM)

ATTACHMENT A
SCOPING PHASE PUBLIC COMMENT SUMMARY

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SCOPING PHASE PUBLIC COMMENT SUMMARY

The italic text below is the paraphrased summary of specific subjects that were brought forth during the public comment on the scoping phase of the EIS. We have attempted to identify which subjects in the list have been addressed, need to be addressed, or are not of concern. Our responses are in regular text.

WATER

Aquifers/Groundwater (Addressed in the November 8, 2007 Memorandum)

1. *Impacts of mining adjacent to Bridge Haven (BH) wells and aquifer – leakage & pollution, – from mining and from conveyor. Previous studies not persuasive.*
2. *Impact of in-water piling/construction on BH aquifer.*
3. *Impact to water resource storage system, in-stream flows. Change to recharge and baseflow to creeks. Impacts to aquifer/Thorndyke Lake runoff and surface springs (drinking water).*
4. *Impact to neighborhoods using groundwater.*
5. *Used water purification (?)*
6. *Water quality problems at hard rock mines.*
7. *Impact on water supplies – Peninsula and J County.*
8. *Increase in Industrial water consumption, impact on existing aquifers.*
9. *Who will monitor groundwater supplies for area?*
10. *If water shortage, how can FHM consumption be limited?*
11. *How will water used for dust control be handled? Impacts?*
12. *Impact of construction accidents.*
13. *New water right permit required?*
14. *Possibility of salt water intrusion?*

Surface Water (Addressed in the November 8, 2007 Memorandum)

15. *Impacts to wetlands.*
16. *Impacts to streams.*
17. *Disturbance of marshy uplands.*
18. *Impact to sphagnum bog south of proposed pit from mining operations.*
19. *Alteration to natural hydrology of the land (permanent).*
20. *Past problem of mines not meeting WQ standards, although predicted to - #256.*
21. *Impact on regional aquifers leads to impact on salmon streams.*
22. *Potential impact to wetlands and Thorndyke Creek, and estuary (one of last undisturbed watersheds). Thorndyke Bay – currently undisturbed (creek, bay).*

Marine Water Quality

23. *Turbidity and sedimentation impacts from on-going operations and gravel spills (Nisqually problems).*

24. *Impacts to entire Hood Canal from potential pollution.*

25. *Cumulative impacts to HC, operational safeguards, enforcement, public involvement.*

26. *Effect of adding nitrogen & other contaminants to HC.*

27. *Oil spills due to barge or bridge allisions, or leaks/seepage.*

28. *Possibility of oil spill, impacts to shellfish, what will be done to avoid spill, who will respond to spill, who pays, timing of emergency response (also as compared to a truck accident). Small and large spills. HC has strong wings and currents, minimal water circulation. Navy will not be primary response to spill. Area rated by DNR as at highest risk of long-term damage if oil spill.*

29. *Accidents happen, even with proper equipment – Point Wells oil spill.*

30. *Oil & fuel leakage from standing traffic during more frequent bridge openings*

31. *Local "Hot Spot" due to leaking fluids when traffic stopped for HCB opening – also effects streams on Kitsap side*

32. *Will project exacerbate Dissolved Oxygen problem in HC. There is a lack of understanding re. dissolved oxygen – why take a further risk with the marine ecosystem*

33. *Look at long-term health of HC.*

34. *Don't sacrifice present health of HC*

35. *Impact from barges/ships seeping sewage.*

36. *Proper disposal of construction debris*

37. *There are no rules re ballast. EPA must treat it as pollution*

38. *Dumping of oil, water – illegally*

39. *Biocides and heavy metals leach from anti-foulants. Quantity? Regs?*

40. *Impact of construction accidents*

41. *Chemical spills?*

42. *Impacts to already degraded HC. How does proposal fit in with larger plan of saving Puget Sound.*

43. *Impacts to Thorndyke Creek & estuary*

Stormwater (Addressed in the November 8, 2007 Memorandum)

44. *Will NPDES be required? TESC?*

45. *Impacts from increased storm water runoff, new impervious surfaces (change to natural drainage patterns, loss of natural soil). As stated above, stormwater BMPs, stormwater management (Drainage and Erosion Control Plan) and the Grading Plan required under the MRLO appear to provide adequate protection for surface water quality. The Stormwater Pollution Prevention Plan (SWPPP) appears to provide adequate protection for surface water and groundwater. Regular monitoring of stormwater quality should be conducted according to the SWPPP, NPDES*

permit, MRL Ordinance and other regulatory conditions. In our opinion, and the opinion stated in the Project studies, the water quality should be protected by adhering to these conditions.

46. *Impacts from large-scale clearing of the forest canopy and removal of topsoil. See 3 above. The potential impacts to surface water and groundwater quality and quantity should be investigated in detail in future studies.*