*Biological Assessment Addendum*
*Thea Foss and Wheeler-Osgood*
*Waterways Remediation Project*
*Commencement Bay*
*Nearshore/Tideflats Superfund Site*
*Tacoma, Washington*

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THEA FOSS WATERWAY

Tacoma

*Prepared for*
*City of Tacoma*

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*7853-00*

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## TABLES



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## ACRONYMS

| | |
|---|---|
| AMT | Adaptive Management Team |
| BA | Biological Assessment |
| BMP | Best Management Practice |
| BOD | Biological Oxygen Demand |
| CB/NT | Commencement Bay Nearshore/Tideflats |
| CDF | Confined Disposal Facility |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CFR | Code of Federal Regulation |
| DAR | Design Analysis Report |
| dB | Decibel |
| DO | Dissolved Oxygen |
| EFH | Essential Fish Habitat |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESD | Explanation of Significant Differences |
| ESU | Evolutionarily Significant Unit |
| MAMP | Monitoring and Adaptive Management Plan |
| MHHW | Mean Higher High Water |
| MLLW | Mean Lower Low Water |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NOAA | National Oceanic Atmospheric Administration |
| NTU | Nephelometric Turbidity Unit |
| OMMP | Operations Management and Monitoring Plan |
| PFMC | Pacific Fishery Management Council |
| PSDDA | Puget Sound Dredged Disposal Analysis |
| RA | Remediation Area |
| ROD | Record of Decision |
| RPM | Reasonable and Prudent Measures |
| SQO | Sediment Quality Objectives |
| SSMA | Superfund Sediment Management Area |
| TOC | Total Organic Carbon |
| WDFW | Washington Department of Fish and Wildlife |
| WSDOT | Washington State Department of Transportation |
| USFWS | U.S. Fish and Wildlife Service |

# BIOLOGICAL ASSESSMENT ADDENDUM
# THEA FOSS AND WHEELER-OSGOOD WATERWAYS REMEDIATION PROJECT
# COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE
# TACOMA, WASHINGTON

## 1.0 INTRODUCTION

### *1.1 General*

This biological assessment (BA) is provided as an addendum to the BA prepared by the U.S. Environmental Protection Agency (EPA) for the entire Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site (EPA 2000a). This addendum specifically evaluates the potential effects of the proposed Thea Foss remedial actions to federally listed species within the CB/NT Superfund Site, Tacoma, Washington. The two work areas subject to the remedial actions are located in the Thea Foss and Wheeler-Osgood Waterways, along the City of Tacoma waterfront. The City of Tacoma's Work Area extends from the mouth of the Thea Foss Waterway (Station 0+00) to Station 70+10. The Utilities' (PacifiCorp Environmental Remediation Company and Puget Sound Energy) Work Area begins at Station 70+10 and extends to the head of the waterway (Station 80+00). This document covers the long-term impacts of both work areas and the short-term impacts within the City's Work Area. Short-term impacts in the Utilities' Work Area are covered in a separate document.

On May 24, 1999, the National Marine Fisheries Service (NOAA Fisheries) formalized the listing of Puget Sound chinook salmon *(Oncorhynchus tshawytscha)* as threatened under the Endangered Species Act (ESA). This species occurs in Commencement Bay. A detailed analysis of data from 16 years of sampling conducted in Commencement Bay indicates that the peak abundance of juvenile chinook salmon occurs in late May or early June (Port of Tacoma and Puyallup Tribe of Indians 1999). Since the project and action areas are nearer to the mouth of the Puyallup River, significant use of these areas has been documented in April. Very few data are available prior to the beginning of April.

The U.S. Fish and Wildlife Service (USFWS) announced the listing of coastal-Puget Sound bull trout *(Salvelinus confluentus)* as threatened on October 28, 1999. Bull trout occur in the Puyallup River drainage and Commencement Bay. Based on the results of six separate sampling efforts in the bay, only four bull trout (or the closely related Dolly Varden char) were captured (Dames & Moore 1981; Duker et al. 1989; PIE 2000; Port of Tacoma and Puyallup Tribe of

Indians 1999; Ratte and Salo 1985; Pentec 2003a). These adults were captured in April, May, and June, which is within the marine residence period of char in Puget Sound (Pentec 2002). USFWS also listed the bald eagle *(Haliaeetus leucocephalus)* in the State of Washington as threatened on February 14, 1978 (USFWS 1986). No bald eagle nests are located in the action or project areas, but the species has been documented to flyover the Commencement Bay region.

This BA addendum also includes an analysis of the effects of remedial actions on designated critical habitat and essential fish habitat (EFH). It should be noted, however, that on March 11, 2002, NOAA Fisheries rescinded the critical habitat designation for all West Coast salmon and steelhead populations to craft a new designation based on sound science and an analysis of economic impacts.

Consistent with EPA's CB/NT BA (EPA 2000a) and its August 2000 Explanation of Significant Differences (ESD, EPA 2000b), the assessment of the potential project-related effects, as detailed in the BA addendum, focuses on the areas of most importance to juvenile salmonids while in the estuarine environment, i.e., intertidal and shallow subtidal (littoral) habitat. Littoral habitat (–10 to +14 feet mean lower low water [MLLW]) is used during critical estuarine life stages of outmigrating juvenile chinook salmon. This same habitat range also represents important habitat for bull trout.

Other listed species that could occur in the action area include the Steller sea lion *(Eumetopias jubatus)*, humpback whale *(Megaptera novaeangliae)*, leatherback sea turtle *(Dermochelys coriacea)*, and marbled murrelet *(Brachyramphus marmoratus)*. These species have been documented in Puget Sound or Washington waters, but their occurrence is considered rare and very unlikely (EPA 2000a). Because of their unlikely occurrence, particularly in high traffic urban embayments such as Commencement Bay, this BA addendum concludes that the proposed Thea Foss remedial activities will have **no effect** on these four species. No further discussion of these species is provided in this BA addendum.

## *1.2 Existing Habitat Conditions*

### 1.2.1 Thea Foss and Wheeler-Osgood Waterways

The Thea Foss Waterway is the southernmost waterway in Commencement Bay, created around the turn of the century by dredging and filling activities (Figure 1). The entrance to the Thea Foss Waterway lies a little over one-half mile southwest of the mouth of the Puyallup River (Figure 2). The waterway is approximately 1.5 miles long, with an irregular shoreline, and is between 394 and 745 feet wide. Mid-channel water depths range from less than 10 feet at the head of the waterway to approximately 36 feet at the mouth. The Wheeler-Osgood Waterway is an extension of the Thea Foss Waterway eastern shoreline and is approximately 1,480 feet long and 225 feet wide (EPA 2000a).

### 1.2.2 St. Paul Waterway

The St. Paul Waterway is located at the southeastern end of Commencement Bay, immediately southwest of the Puyallup River (Figure 2). The waterway covers an area over 16 acres and is approximately 2,500 feet long, between 395 and 590 feet wide, and between less than 10 feet to greater than 33 feet deep mid-channel. Remediation was completed east of the mouth of the waterway in 1988, and a thick-layer cap was installed to confine contamination in place. A habitat restoration area was constructed over and around the cap (Weiner 1991). A 10-year post-construction chemical and biological monitoring effort was completed in 1999 (Parametrix 1999). Monitoring data indicated that both chemical containment and habitat restoration were successful. The previous remedial activities will not be affected by the proposed use of the waterway as a disposal site (EPA 2000a).

### 1.2.3 Middle Waterway

The Middle Waterway is located adjacent to the St. Paul Waterway at the southeastern end of Commencement Bay (Figure 2). The waterway is approximately 3,600 feet long and between 220 and 450 feet wide. The waterway is shallow, with nearly the entire inner (southern) half composed of intertidal mudflats. Two mudflat, saltmarsh, and riparian zone remediation projects have been constructed in the inner portions of the waterway.

# 2.0 PROJECT DESCRIPTION

## *2.1 Remedial Actions*

The entire superfund remedial project area was subdivided into 68 unique Superfund Sediment Management Areas (SSMAs). For constructability, the SSMAs were combined into 24 Remedial Areas (RAs). The City will be responsible for remediating RA 1 through RA 22. An evaluation of physical, chemical, and biological data was performed to confirm that the proposed remedial activities for each RA achieved the design objectives of removing or isolating sediment with concentrations of toxic chemical constituents exceeding EPA's Sediment Quality Objectives (SQOs).

Remediation in the Thea Foss and Wheeler-Osgood Waterways (Figure 2) is composed of the following remedial actions:

- No Action;
- Natural Recovery;
- Enhanced Natural Recovery (Thin Cap);
- Dredging;
- Capping (Thick Cap);
- Slope Rehabilitation; and/or
- Confined Disposal Facility (CDF) in St. Paul Waterway.

Table 1 and Figure 1 summarizes remedial actions to be carried out in Thea Foss and Wheeler-Osgood Waterways. This BA addendum evaluates the potential effects of natural recovery, enhanced natural recovery, dredging, capping (both thick and thin caps), slope rehabilitation, and nearshore CDF disposal on ESA-listed salmonids and the bald eagle.

### 2.1.1 No Action

Portions of the waterways that have chemical constituent concentrations below SQOs will have no remedial action. No action occurs in approximately 37.3 acres of the project area, primarily at the mouth and along the shorelines.

### 2.1.2 Natural Recovery

Portions of the waterways that have chemical constituent concentrations that slightly exceed SQOs with low enrichment ratios and minor or no adverse effects in bioassay testing have been designated for natural recovery. Natural recovery is applicable to areas where surface sediments are predicted to recover to SQO concentrations levels within 10 years following completion of remedial activities within the waterways. Chemical and biological monitoring will be the only remedial activity and will be used to verify the effectiveness of this approach in terms of reducing concentrations of chemical constituents of concern. Natural recovery is proposed for approximately 21.2 acres of the project area.

### 2.1.3 Enhanced Natural Recovery (Thin Cap)

Enhanced natural recovery is the placement of a thin layer (usually 6 inches) of clean sediment above the existing sediment surface to assist in the natural recovery of those sediments with minor exceedances of SQOs. Enhanced natural recovery has been demonstrated to be effective in the intertidal regions of Eagle Harbor (Bainbridge Island, Washington) and is expected to be similarly effective in Commencement Bay. The objective of thin-layer capping is not to isolate the surface sediments, but to augment the natural sedimentation rate by introducing clean sand. Natural processes, such as bioturbation, will mix the sand with the underlying material, reducing chemical concentrations in the biologically active zone with minimal disruption of the existing benthic community.

Thin layer capping will occur at RA 7, which occupies approximately 4.0 acres between the shoreline and the pierhead line (Figure 1). A thin channel cap will be placed at Foss Waterway Marina (RA 7). This will consist of a single thin lift with a minimum thickness of 6 inches placed either hydraulically or by clamshell dredge. If the latter form of placement occurs, the cap material will come from an approved upland source. Pre- and post-placement hydrographic surveys will confirm that the specified depth of cap material has been placed.

### 2.1.4 Dredging of Sediments

Portions of the waterways containing sediments with concentrations above SQOs will be remediated either by dredging to a specified elevation and capping, or dredging to a specified elevation to remove all chemical constituents above SQOs. Dredging elevations are based on chemical data from subsurface cores and navigational requirements (authorized navigational project depths and current or anticipated future waterfront development-related required water depths). In areas where dredging removes all occurrences of SQO exceedances, backfilling may be necessary to match the area with the surrounding grade for ecological purposes. In areas where dredging does not remove all occurrences of SQO exceedances, capping is necessary to contain the remaining contaminated sediments. Access to sediments located under existing marinas may require temporary removal of boats, docks, floats, and pilings with subsequent replacement, including a limited number of pilings (Section 2.2.9).

Approximately 590,000 cubic yards (cy) of contaminated sediments over 46.6 acres will be dredged as part of this action. Specific dredging requirements include dredging to a specified elevation and placement of a thick cap in channel areas RAs 17, 18, 21, and 22 (20,800 cy over 4.0 acres) and in non-channel areas RAs 19A, 19B, and 20 (requires 58,350 cy of capping material and cover nearly 9.8 acres) (Figure 1). Dredging to a specified elevation and backfilling to a specified elevation will occur in RAs 2 and 4. All contaminants will be removed to a specified elevation in RAs 1A, 1B, and 5.

Remedial dredging will be conducted with both an 8- to 12-cy mechanical clamshell dredge and a 26-inch hydraulic dredge depending on dredging conditions and the stage of the CDF construction. Channel dredging will mostly be accomplished with the hydraulic dredge and a floating pipeline will be placed in the Thea Foss Waterway to a point north of the 11th Street Bridge where it will come ashore and will be pumped overland along the 11th Street right of way. At the Middle Waterway, it will again transition to a floating pipeline leading to the St. Paul CDF. The pontoons, which draw about 18 inches of water, will ground at the lowest tides. To minimize impacts to the Middle Waterway, the pipeline will be securely anchored to the pontoon, which will ground at the same location each time. When the pipeline is removed, the bottom of the waterway will be inspected. Any indentations in the soft bottom will be restored to surrounding grade with a silty sand material.

Channel dredging (430,000 cy) in the Thea Foss Waterway will vary from –24 feet MLLW at the southern end to –31 feet at the northern limit, while in the Wheeler-Osgood Waterway the dredging depth will slope from approximately –2 feet to –8 feet MLLW at the entrance. Sediment chemical sampling will be conducted in dredged areas where channel capping will not occur to confirm that contaminated sediments have been removed.

Where clamshell dredging is employed, dredge material shall be placed in a sealed, bottom-dump scow, and transported to the CDF for disposal. In confined areas near marinas and other structures and along side slopes, the mechanical dredge may be used. Slope dredging (up to 90,000 cy) will generally occur in those areas where it is necessary to create a minimum 2 foot horizontal to 1 foot vertical slope from the finished channel depth to the top of the waterway bank in those areas where contaminated sediments are to be capped. In general, dredging will proceed from south to north. Dredging activities will conform to the EPA Water Quality Monitoring criteria (Clean Water Act Section 401, and other substantive requirements) or modifications will made according to established protocols to dredging rates, bucket size, tidal cycle timing, etc.

### 2.1.5 Thick Layer Capping

Thick layer caps are typically 3 feet or more in thickness. They are used to isolate problem sediments from the water column and the biologically active zone of the sediments. Palermo et al. (1998) demonstrated that an isolation cap of clean silty sand at a thickness of 1.5 feet can isolate the majority of benthic organisms from contaminated sediments, prevent the bioaccumulation of contaminants, and effectively prevent contaminant flux over the long term. Depending on the material's source and composition, seeding of the benthic community and rapid recolonization are possible. In some areas, a thick layer cap will be placed *in situ* to contain and isolate sediments with concentrations exceeding the SQOs from the overlying water column and habitat. The cap will be thick enough and armored as necessary to resist erosion, wave action, or burrowing organisms.

For channel areas, material is anticipated to come from the beneficial reuse of a portion of the previously dredged silty sand from the St. Paul Waterway CDF that had been placed on the Puyallup River delta (Section 2.1.7). It will be hydraulically dredged, pumped by a 26-inch floating and overland pipeline to the Thea Foss and Wheeler-Osgood Waterways. The EPA will allow the City to recover no more than two-thirds of the material from the St. Paul Waterway dredging (Section 2.1.7) for capping in the Thea Foss and Wheeler-Osgood channels, the St. Paul Beach habitat, and initial capping of the CDF. Prior to the removal of any material from the Puyallup River delta, the City will collect samples of the material at the proposed site for removal in accordance with Puget Sound Dredge Disposal Analysis (PSDDA) protocols to determine whether the material is suitable chemically and physically for beneficial reuse as capping. Material will be hydraulically dredged from the approved site and pumped in the reverse direction through the same pipeline used to deposit material from the Thea Foss into the CDF in combination with the pipeline used to originally deposit the clean CDF material to the delta (Section 2.1.7).

The cap will be placed with a diffuser barge to minimize turbidity and more accurately control its placement. In the Thea Foss Waterway channel (RAs 18, 21, and 22) approximately 100,000 cy will be placed in two 18-inch lifts; however, a 1-foot overplacement will be allowed so that the thickness may be as much as 4 feet. Cap verification sampling is to be conducted upon the completion of each 18-inch lift and before placement of the next lift. If insufficient quantity of material for channel capping is unavailable from the delta or if delta sampling indicates the material is not suitable for reuse, other clean off-site sources of capping material can be used (employing a clamshell) so long as it meets the EPA's remedial criteria. In addition to the approximately 100,000 cy of material to be dredged and placed as thick layer capping in the Thea Foss and Wheeler-Osgood Waterways, 25,000 cy of recovered material will be used for completion of the North Beach Habitat, and up to 100,000 cy for the initial capping of the CDF above +9 feet MLLW.

Slope capping will use approximately 76,000 tons of tested and approved upland source slope cap material, quarry spalls, and light riprap; these will be placed by a clamshell in a 3-foot configuration over contaminated sediments on the slopes of Thea Foss Waterway. Following the slope capping installation, approximately 6,800 tons of habitat mix will be uniformly placed over the capped surface to dress the surface on top of riprap between –10 feet and +13 feet MLLW so as to fill the interstices of the larger stones for habitat enhancement. Where habitat mitigation credit is claimed, the habitat mix should be placed to a depth so that 1 foot of material remains 1 week after stabilization. Existing stormwater outfalls will be extended to match the face of the new slope cap and riprap spill pads will be constructed to prevent erosion below the outfalls. Mechanical equipment (clamshell bucket) may be used to spread the materials on confined slopes and in marina areas

Remedial areas, including RAs 1A, 1B, 3, and portions of RA14, were recently capped as part of the 2002 activities (NMFS Tracking Nos.: 2002/01386, 01387, and 01390). Since dredging would be problematic along the steeper slopes of RA 8, which have SQO exceedances, a thick cap will be placed over these areas (2.0 acres). Several of the RAs require some form of capping subsequent to dredging.

Capping in the Thea Foss and Wheeler-Osgood Waterways will generally follow dredging as soon as it is feasible following hydrographic survey confirmation of dredge depth and sediment verification sampling and analysis have been accomplished and the results are in compliance with the Contract Documents. As noted above, channel capping material will be sandy material dredged from the Puyallup Delta in accordance with an EPA-approved design. Capping material recovery will be based upon hydrographic surveys and sediment sampling to be conducted in the early summer of 2004. Material will be returned to the Thea Foss via a hydraulic pipeline following the same alignment as the disposal pipeline to the CDF and Puyallup Delta (Section 2.1.7). If sampling of the Puyallup Delta material indicates that it will not meet the SQOs, sandy capping material imported from an approved upland source will be used.

Slope capping sections will vary in the Thea Foss depending on exposure to wave conditions and the ability to access the slope with a variety of equipment. Thick Slope Capping, consisting of an 18-inch layer of filter material overlain with an 18-inch layer of riprap and 25 tons of habitat mix per 1,000 square feet (sf) of riprap surface, will be placed at Colonial Fruit Warehouse (RA 7A), City Marina (RA 15), Alber's Mill Dock (RAs 19A and 19B), and City Dock Marina (RA 20) as shown in EPA-approved project plans and specifications.

Quarry spall cap, consisting of an 18-inch-thick layer of filter material overlain with an 18-inch layer of quarry spalls will be placed at Martinac (RA 14). A riprap slope key will be placed at the bottom of slope. Habitat mix will be placed at a rate of 25 tons per 1,000 sf over the quarry spalls between elevations −10 feet and +13 feet MLLW. Hydrographic surveys are to be conducted after the placement of each lift of material to confirm specified thickness prior to the placement of the next lift. Approximately 83,000 tons of filter material, riprap, quarry spalls, and habitat mix will be placed in the Thea Foss for channel slope capping.

Capping in the Wheeler-Osgood Waterway (RAs 9 and 12) and near Totem Marine in the Thea Foss (RAs 2 and 4) will be completed either by hydraulic dredge or by clamshell. Capping materials will meet the specified requirements for clean channel cap. These areas are to be capped to the elevation of the adjacent waterway bottom.

To minimize lateral transport of dense non-aqueous phase liquid contaminants from the south and east uplands, approximately 6,500 square yards of 6-inch-thick grout-filled mat will be placed over the channel slope surface within RA 19. The Uniform Section Mat (USM) will be anchored in place and then pumped full of grout to create uniformly capped surface from a minimum upper elevation of −1 foot MLLW to a lower elevation of −23 feet MLLW. The USM will be overlain with a 12-inch layer of imported channel cap material. A containment boom will surround the work area until the mat installation has been completed.

### 2.1.6 Slope Rehabilitation

Several no action and natural recovery areas with sediment concentrations near or below SQOs will require construction to maintain stability of slopes. The banks and slopes in these areas, which are adjacent to remedial activities including dredging and capping, will require grading to achieve stable slope angles. The Contractor does not need to differentiate between remedial dredging and capping, versus slope-related construction activities in the no action (or natural recovery) areas. Roughly 1,900 linear feet of the Wheeler-Osgood Waterway (RAs 10, 11, and 13) were rehabilitated and restored in 2002 under an informal NOAA Fisheries Section 7 consultation (NMFS Tracking No. 2002/01389).

Slope capping sections in the Thea Foss Waterway will vary depending on exposure to wave conditions and the ability to access the slope with a variety of equipment. Thick Slope Capping, consisting of an 18-inch layer of filter material overlain with an 18-inch layer of riprap and 25 tons of habitat mix per 1,000 sf of riprap surface, will be placed at Colonial Fruit Warehouse (RA 7A), City Marina (RA 15), Alber's Mill Dock (RAs 19A and 19B), and City Dock Marina (RA 20) as shown in EPA-approved project plans and specifications.

Quarry spall cap, consisting of an 18-inch-thick layer of filter material overlain with an 18-inch layer of quarry spalls will be placed at Martinac (RA 14). A riprap slope key will be placed at the bottom of slope. Habitat mix will be placed at a rate of 25 tons per 1,000 sf will be placed over the quarry spalls between elevations –10 feet and +13 feet MLLW. Hydrographic surveys are to be conducted after the placement of each lift of material to confirm specified thickness prior to the placement of the next lift. Approximately 83,000 tons of filter material, riprap, quarry spalls and habitat mix will be placed in the Thea Foss Waterway for channel slope capping.

### 2.1.7 Construction and Disposal in the St. Paul CDF

Contaminated sediment dredged from the Thea Foss and Wheeler-Osgood Waterways will be placed in a CDF constructed at the head of the current St. Paul Waterway. The location of the St. Paul Waterway and configuration of the CDF are shown on Figures 2 and 3. Approximately 510,000 cy of material will be dredged from the St. Paul Waterway to create the CDF. The dredging will occur in two dredging phases. First, approximately 105,000 cy will be removed from the upper 5 feet by clamshell dredge and transported by bottom dump scow to the Commencement Bay PSDDA open-water disposal site (NMFS Tracking No. 2003/01120). During both phases, a silt curtain will be placed across the mouth of the waterway and opened as necessary to allow the passage of dump scows and other floating equipment.

With completion of the Phase I dredging, a 760-foot-long offset berm will be constructed in the southeast corner of the St. Paul Waterway to prevent settlement of adjacent, onshore clarifier tanks. Approximately 45,000 cy of select fill and riprap will be placed by clamshell bucket between elevations –12 and +21 feet MLLW to construct the berm.

Once the offset berm is complete, the approximately 465,000 cy of clean material from the CDF will be dredged to a final elevation of approximately –60 feet MLLW. This second phase will be accomplished by hydraulically dredging the material and pumping it approximately 0.5 mile through a 26-inch-diameter floating discharge line for disposal on the Puyallup River Delta. This material will be deposited so as to augment natural delta forming processes and is expected to enhance desirable delta building processes leading to salmonid recovery (Simenstad 2000). The discharge pipe will be directed onto the expanding neodelta of the river and the previously deposited bedload sand pumped from the St. Paul Waterway will be deposited on the face of the delta between –20 and –50 feet MLLW. Discharge at these locations will be by way of a "diffuser" barge that will allow the sands to be placed more accurately in the deeper water. In no case will the material be placed in water deeper than 50 feet. Once every 3 days, a hydrographic survey will be taken of the delta to accurately measure the accretion of disposal material.

At the mouth of the St. Paul Waterway, a 370-foot-long rock and select fill containment berm will be constructed to an ultimate elevation of +8 feet MLLW to contain the contaminated sediments removed from the Thea Foss and Wheeler-Osgood Waterways. An opening to an approximate elevation of –4 feet MLLW will be left in the center of the berm to initially allow the passage of dump scows from slope dredging activities in the Thea Foss to dispose of sediments in the CDF.

Once the slope dredging in the Thea Foss Waterway has been completed and the sediments placed in the CDF, the containment berm will be closed and two outfall weirs installed to control the settlement time and effluent discharge rate for the hydraulically dredged channel material from the Thea Foss and Wheeler-Osgood Waterways. It is anticipated that channel dredging will occur 12 hours per day, 6 days per week. At the conclusion of dredging each day, the sediment-laden water will be allowed to stand for several hours in the CDF until sufficient settlement has occurred to permit controlled release into the bay through the outfall structures. The effluent from one day's dredging will be completely discharged and the weirs closed before pumping more contaminated dredged material the next day. Water quality sampling and analysis will confirm there are no exceedances that could be detrimental to listed species; if water quality criteria are exceeded, changes can be made to the dredging and settling rates.

Contaminated dredged material will be deposited in the CDF no higher than elevation +9 feet MLLW. Following the completion of dredging, the outfall structures will be removed and the confined material will be capped with up to

165,000 cy of clean material from several possible sources. Sources include possible beneficial reuse of material previously deposited on the Puyallup River Delta, if available; material excavated from the Middle Waterway Tideflat Habitat construction, if suitable; or an approved source of import material. The material used will be advanced from the south and west sides of the CDF in lifts of sufficient thickness to bridge the underlying wet sediments to allow construction equipment to work on top to complete and grade the cap to a maximum elevation of +20 feet MLLW.

In the event that the contaminated dredge quantity exceeds the capacity of the CDF or some dredging must occur before completion of the CDF, dredged material may be brought ashore and placed directly into a sealed container or sealed truck. The material may also be placed directly into a lined holding cell for dewatering and then hauled to an approved landfill or transferred to the CDF when that facility is completed.

## *2.2 Mitigation/Restoration Efforts*

Several mitigation/restoration efforts will be undertaken within Commencement Bay to mitigate for short-term loss of function resulting from waterway remediation, to fully compensate for losses of shallow intertidal and subtidal habitat acreage resulting from sediment disposal, and to provide affirmative conservation measures that will contribute to restoration of habitat for listed species. A summary of proposed mitigation and restoration efforts is presented below. A detailed Monitoring and Adaptive Management Plan (MAMP) is provided in the project Operational Monitoring and Maintenance Plan (OMMP). The OMMP defines the Adaptive Management Team (AMT) that will oversee the construction and monitoring of the mitigation actions described and dictate the implementation of contingency action in the event that mitigation performance goals are not met.

### 2.2.1 North Beach Habitat Areas

The North Beach Habitat Area (Figure 4) restoration and enhancement will be a part of the mitigation to offset losses of marine habitat from the development of the St. Paul Waterway CDF. The habitats will be composed of two contiguous areas, the St. Paul Beach and the Peninsula, located between the mouth of St. Paul Waterway and the entrance to Middle Waterway (Figure 4).

#### 2.2.1.1 St. Paul Beach

Approximately 6,500 cy of blended riprap and select fill material will be placed by clamshell to create a habitat berm 375 feet north of the CDF containment berm. The 280-foot-long habitat berm will be constructed from an initial elevation of –20 feet MLLW to a finished elevation of –4 feet MLLW. This berm will provide the base on the north side for the St. Paul Beach habitat fill that will be placed shoreward to the CDF containment berm. After all dredge material has been placed in the CDF, the beach fill will be hydraulically placed with material recovered from the delta. It will range from elevation –5 to +12 feet MLLW. Following placement of this dredge material, approximately 60,000 tons of light and heavy riprap, quarry spalls, slope cap material, rounded river rock, and habitat mix will be placed in accordance with final approved plans to complete the habitat areas. These material will be placed either from a barge with a clamshell or with land-based equipment during low tides.

The completed St. Paul Beach will be composed of 1.65 acres of low-gradient, fine-grained beach habitat. The beach will slope at a low angle (10H:1V or flatter) to approximately +8 feet MLLW and be composed of habitat mix. The beach will then slope more steeply upward (approximately 3H:1V), meeting the CDF berm at an elevation of approximately +13.5 feet MLLW. Beach surface in this area will be comprised of habitat mix and rounded cobbles like the nearby Olympic View Resource Area beach. The containment berm face and the top 20 feet will be planted with native plants to form a riparian buffer.

#### 2.2.1.2 The Peninsula

The Peninsula will be composed of 5.06 acres of restored littoral habitat including a continuation of the shallow-water habitat contours of the St. Paul Beach. Over 1,900 creosote-treated piles have been removed from this area so that the existing contours can be covered with sand ranging in depth from 0.5 foot to several feet. The Peninsula will allow for development of an undulating band of marsh habitat at an elevation of +10 to +12 feet MLLW, above the steeper transition between elevation +8 and +10 feet MLLW. The upper beach will slope to a relatively low pass across the central area of the Peninsula. This pass will allow juvenile salmonids moving across the face of the St. Paul Beach at tides above MLLW to continue their migration in relatively protected shallow water into the entrance of Middle Waterway. North of the pass, the Peninsula habitat will rise to an offshore shoal or reef at +12 feet MLLW. This shoal will shelter areas to the south and east from waves from the northwest (Figure 4). Existing uplands at the tip of the Middle/St. Paul peninsula will be cut back and excavated to provide approximately 0.25 acre of new marine habitat area at the southwest corner of this habitat area. Several nodes of marsh species appropriate for lower and upper saltmarsh elevations will be planted on a pilot basis in this habitat area. Large woody debris (up to 40-foot trees with root wads) will be added to the southwest corner of this habitat area to increase habitat complexity and protective cover for juvenile salmonids.

### 2.2.2 Middle Waterway Restoration Efforts

The Middle Waterway Corridor, Middle Waterway Marsh/Mudflat/Channel, and freshwater source will be additional mitigation/restoration efforts to compensate for filling the St. Paul Waterway for the CDF.

#### *2.2.2.1 Middle Waterway Corridor*

The Middle Waterway Corridor is 0.85 acre along a narrow shoreline that connects the North Beach habitat area to the north with the broad mudflats and brackish marsh in the southern portion of Middle Waterway (Figure 5). Along about 250 feet of the 1,800-foot-long east shore of the Middle Waterway, an existing stacked concrete bulkhead will be removed and the slope protected with a thick slope cap and habitat mix. The design of the corridor is to provide shallow-water, fish-passable shoreline access to and from the inner Middle Waterway habitats during most tidal conditions. Existing concrete rubble will be removed and replaced with a gradually sloping, gravel-cobble beach. Large woody debris (up to 40-foot trees with root wads) will be added to the corridor to increase habitat complexity and protective cover for juvenile salmonids. Industrial activities (i.e., Simpson's relocated log haulout) are designed to minimize the over-water shading above –10 feet MLLW so as to minimize interference with juvenile salmonid fish passage along the enhanced corridor habitats.

#### *2.2.2.2 Middle Waterway Marsh/Mudflat/Channel*

The Middle Waterway Marsh with its associated mudflats and tidal channel will be constructed of 6.9 acres of excavated uplands and 3.02 acres of existing tideflat along approximately 1,450 linear feet of the 1,800-foot-long east shoreline of the Middle Waterway (Figure 6). This major new habitat is immediately to the north of the existing Trustees/Simpson pilot restoration project site along the southeast side of the waterway, and across from the City of Tacoma's NRDA settlement restoration project.

The habitat area will be excavated from elevations of +18 feet down to about 0 feet MLLW. A meandering tidal channel will be excised down to –4 feet

MLLW at the north end, rising to –2 feet draining the south end. The upper shoreline between +13 and +18 feet MLLW will be enhanced with a minimum of 6 inches of topsoil for riparian plantings.

The marsh site will be buffered from adjacent industrial activities with a 10- to 25-foot riparian habitat planted with native tree and shrub species. The brackish marsh is expected to range from 10 to as much as 60 feet in width in the 10- to 13-foot MLLW elevation range and will be supported by a freshwater distribution system. The system will follow the 12.5-foot contour and will be designed to feed the intertidal plant root zone to reduce sediment pore water salinity to near 10 part per thousand over 50 percent of the contour between +11 and +12.5 feet MLLW (measured 2 hours after tide has fallen below this elevation). At least eight nodes of brackish marsh species will be planted in this zone. It is anticipated that the introduced brackish marsh plants will establish a seed source allowing expansion between the initial planting nodes. Soil amendments will be used to enhance the initial plantings and to encourage subsequent plant expansion over the site. Extensive long-term adaptive management efforts is specified in the OMMP.

### 2.2.3 Puyallup River Side Channel

As part of the compensatory mitigation for the St. Paul Waterway CDF, the Puyallup River Side Channel will provide 4.17 acres of off-channel habitat intended for use by juvenile salmonids for rearing and refuge during their outmigration to the estuary, as shown on Figure 7. The project will be designed to merge an existing 1.92-acre isolated wetland and an adjacent 2.25-acre parcel that will be excavated to –2 feet MLLW from existing uplands, into a single off-channel habitat area. The existing dike will be breached to allow the river and the associated tidal hydrology to enter. The excavated channel and reconfigured existing wetland will contain water during most tides. A substantial area will be left between about +6 and +13 feet MLLW to allow development of brackish marsh and riparian assemblages that provide prey for juvenile salmonids and organic matter for export to the greater Commencement Bay. This area on the inside of the existing Puyallup River dike will be planted with riparian vegetation as detailed in Appendix P of the DAR. The mudflat areas below OHW will be left for natural colonization by native brackish marsh species (as occurred at the Gog-Li-Hi-Te site just across the river).

Approximately 140,000 cy of upland fill will be excavated to create this new shallow-water estuarine habitat. The work behind the existing levee can be constructed "in the dry" any time of the year. The new levee will be constructed along the full western and northern limit of the habitat area. Once the habitat area and new levee are complete, the existing levee will be breached to connect it to the Puyallup River. The breach will be armored with approximately 10,500 tons of filter material, riprap, and quarry spalls overlain with approximately 600 tons of habitat mix. The breaching can occur only after July 15 and before February 15. Once breached, the old levee will be excavated down to +15 feet and the banks above +13 feet MLLW planted with native riparian plants.

### 2.2.4 Pick's Cove Marina Habitat

The slope remediation just north of Pick's Cove Marina will be part of the overall Thea Foss Waterway mitigation plan. The remedial action for the area includes dredging and placement of a thick quarry spall cap. The quarry spall cap consists of an 18-inch-thick layer of filter material overlain with an 18-inch-thick layer of quarry spalls. Habitat mix will be placed at a rate of 15 tons per 1,000 sf over the quarry spalls between elevations –10 and +13 feet MLLW.

Approximately 1,060 sf of overwater structure, an old timber access pier and brick foundation, will be demolished and removed from the marine environment. In addition, six large woody debris, between 8 and 20 feet in length will be placed on the beach between elevations +11 and +12 feet MLLW.

### 2.2.5 Foss Waterway Marina Habitat

The slope remediation at the former Steam Plant property, just north of the Foss Waterway Marina, will be part of the overall Thea Foss Waterway mitigation plan. The remedial action for the area includes dredging and placement of a thick slope cap. The thick slope cap consists of an 18-inch-thick layer of filter material overlain with an 18-inch-thick layer of riprap. Habitat mix will be placed at a rate of 25 tons per 1,000 sf over the riprap between elevations –10 and +11 feet MLLW.

Approximately 35 treated timber piling, a 12- by 14-foot concrete vault, and anthropogenic debris along the shoreline will be removed prior to dredging and capping of the area. A 2-step log (10- to 12-inch-diameter) transition will be constructed between elevation +11 and +13 feet MLLW, where a small 3-foot bench will be constructed using 18 inches of filter material overlain with an 18-inch-thick layer of quarry spalls. Habitat mix will be placed at a rate of 15 tons per 1,000 sf over the quarry spalls.

### 2.2.6 Alber's Mill Marina Habitat

The slope remediation at the Alber's Mill Marina will be part of the overall Thea Foss Waterway mitigation plan. The remedial action for the area includes dredging and placement of a thick slope cap. The thick slope cap consists of an 18-inch-thick layer of filter material overlain with an 18-inch-thick layer of riprap. Habitat mix will be placed at a rate of 25 tons per 1,000 sf over the riprap between elevations –10 and +13 feet MLLW. In addition, approximately 200 feet of old timber bulkhead along the shoreline will be removed and properly disposed of.

### 2.2.7 Head of Thea Foss Waterway

The remedy for the head of the Thea Foss Waterway, south of Station 70+10, will be completed by the Utilities. As part of the overall Thea Foss Waterway mitigation plan, approximately 0.03 acre along the eastern shoreline will be cut back to create aquatic habitat below the ordinary high water level. An 8-foot by 175-foot cut will be made at the Berg Scaffolding site. At the Standard Chemical site on the western side of the waterway, six large woody debris will be anchored on the slope between elevation +11 and +12 feet MLLW.

### 2.2.8 Johnny's Seafood Habitat

The slope remediation south of Johnny's Seafood will be part of the overall Thea Foss Waterway mitigation plan. The remedial action for the area includes dredging and placement of a thick slope cap to elevation 0 feet MLLW and placement of a thick quarry spall cap from elevation 0 to +15 feet MLLW. Habitat mix will be placed at a rate of 25 tons and 15 tons per 1,000 sf over the riprap and quarry spalls, respectively, between elevations –10 and +13 feet MLLW. In addition, six large woody debris, between 8 and 20 feet in length, will be placed on the sloped beach between elevations +11 and +12 feet MLLW.

### 2.2.9 Removal and Reinstallation of Pilings

Before dredging and capping operations can occur, all portions of the Johnny's Dock Marina, Pick's Cove, City Marina, and the Foss Waterway Marina must be removed and temporarily stored, starting systematically at the south end of the waterway. These marinas will then be replaced as remedial operations progress to the north. Overall, roughly 180 creosote-treated timber piling will be removed during temporary relocation of existing marinas on the Thea Foss. The treated timber piles will be disposed of in accordance with state regulations. The contractor plans to use a 50-ton crane barge with a vibratory extractor.

When the marinas are reinstalled, timber piling will be replaced with either steel or concrete guide piling. If hollow steel piling are used and are driven with an impact hammer, an approved air bubble curtain will be employed around each pile during the full time of impact driving.

### 2.2.10 Removal and Reconstruction of Over-Water Structures

Three new marinas (some are replacements for marinas decommissioned several years ago during the development of the Thea Foss Esplanade) will be constructed using precast concrete float units. The Alber's Wharf, City View, and 17th Street Marinas will provide moorage for approximately 75 boats, as well as initially providing the temporary storage for the existing eastside marinas during remedial dredging. The marinas will use 73 new 18-inch-diameter steel piles.

At Alber's Wharf, an existing timber and concrete deck wharf was demolished and removed in a previous project. In this project, approximately 180 creosote-treated timber piles were removed along the moorage floats from a prior marina on the site. The proposed project will replace the previous wharf with a new concrete wharf approximately half the size supported on 36 new 20-inch-diameter concrete piling. A new marina at this location will require the installation of new concrete moorage floats and the driving of 49 new 18-inch-diameter steel pipe guide piling. If the steel piles are driven with an impact hammer, an approved air bubble curtain will be employed full time during impact driving.

At 17th Street, 13 new 20-inch-diameter concrete piling will be driven for a new marina access pier. The installation of the new marina will include new concrete moorage floats and driving 24 new 18-inch-diameter steel pipe guide piling. If the steel piles are driven with an impact hammer, an approved air bubble curtain will be employed full time during impact driving.

At Martinac Shipyard, and possibly at the timber portion of the waterfront Esplanade at the Foss Marina, some over-water creosote-treated timber structures may need to be temporarily removed so the existing waste stockpiles beneath the structures can be extracted and then to place surface capping material. If this occurs, the area will be completely enclosed with a floating containment berm to capture any wood debris resulting from the demolition or reconstruction of those structures.

Two sheet pile walls will be installed at Johnny's Dock Marina to allow dredging and capping along the contaminated shoreline. The wall on the south side of

Johnny's Dock Restaurant will be 265 feet long and the wall north of the restaurant will be 290 feet long. Approximately 120 feet of the north wall will be buttressed with 45 18-inch-thick steel piles. If any of the wall is driven with an impact hammer, a bubble curtain will be employed in the area around the pile.

On the Middle Waterway, numerous existing creosote-treated timber dolphins will be permanently removed along with the remains of an old timber pier. Approximately 600 timber piles will be removed from the St. Paul Peninsula. In all cases, the work area will be enclosed with a floating containment boom to collect any floating debris or creosote sheen that may result from the operation. All floating debris will be removed daily and properly disposed of.

Outside the mouth of the St. Paul Waterway, an existing creosote-treated timber fuel dock owned by the Simpson Paper Company will be modified. The work includes the removal of a portion of the existing timber fuel dock, timber walkway structure, and three timber dolphins, consisting of 35 creosote-treated timber and eight steel piles. These will be replaced with an expanded pier and three new dolphins, constructed with 9 steel and 27 concrete 24-inch-diameter piles below elevations of –10 feet MLLW. The reconstruction will move the fuel dock farther offshore and provide separation of the berthing area from the St. Paul Beach. The impacts of increasing over-water shading by 0.03 acre is partially offset by the removal of timber piles and by moving the structure beyond –10 feet MLLW.

A new log haul-out ramp will be constructed for the Simpson Timber Company's sawmill on the east shore of the Middle Waterway. This will replace a similar structure to be demolished at the head of the St. Paul Waterway prior to CDF construction. A paved log transfer road will also be necessary to transfer logs from the haul-out location to the sawmill. The design will minimize impact to nearshore habitat (the Middle Waterway Corridor Habitat) with as much of the structure placed over the subtidal (deeper than –10 feet MLLW) as practical. Log rafts will be positioned offshore at similar water depths to assure they will not ground out on low tides. The easy lift type equipment minimizes damage to logs, usually still bundled, thereby reducing bark loss in accordance with BMPs. Simpson Timber Company has agreed to BMPs, monitoring, and an adaptive management/contingency plan in Appendix Z of the Final Thea Foss Round 3 Data Evaluation and Pre-Remedial Design Evaluation (Parametrix 2000).

Intertidal impacts from the log haul-out include the installation of a 36-inch-diameter concrete stormwater outfall at –4 feet MLLW with a check valve and a riprap splash pad. The ramp is supported by two 24-inch hollow steel pipes, which will be driven with an impact hammer and employing a protective air bubble curtain. The log raft area and floating walkway includes the installation of 22, 16-inch hollow steel piles for the gangway access ramp and 300- by 5-foot floating walkway as well as 23 steel piles to hold and guide the floating log booms along the shoreline.

### 2.3 Mitigation/Restoration Summary

Restoration, mitigation, and conservation measures that will be implemented to offset adverse effects of remediation and sediment disposal are summarized below.

In total, project remediation and sediment disposal in the CDF will result in a loss of 12.0 acres of waters of the United States (0.22 acre in Thea Foss Waterway and 11.78 acres in St. Paul Waterway; Table 2). No significant areas of saltmarsh or brackish marsh will be impacted by these activities, and the general quality of habitats impacted by remediation and sediment disposal is poor to mediocre. To offset these losses or changes in existing habitat functions, the project will provide 11.42 acres of new littoral habitat by excavation of uplands around the Thea Foss Waterway, in Middle Waterway, and in the Puyallup River Side Channel. In addition, filling of deeper water off the mouth of the St. Paul Waterway will provide a net increase of 1.66 acres of littoral habitat. Resulting net changes in various measures of habitat area include the following (Table 2):

- A net loss of 0.58 acre in tidal (below –10 feet MLLW) habitat (all depths; Table 2);
- Provision of nearly 13 acres of new, moderate to high quality littoral habitat and a net gain of 3.62 acres of moderate to high quality littoral habitat;
- A net gain of 1.29 acres of planted riparian habitat; and
- Improved sediment quality over nearly 60 acres of benthic habitat in Thea Foss and Wheeler-Osgood Waterways.

The 0.58-acre net loss of marine habitat is considered significant by EPA and the trustees, given the large historical losses of marine and estuarine habitat in Commencement Bay. Therefore, the City of Tacoma, in a letter to EPA dated October 24, 2003, committed to no net loss of aquatic habitat as part of the Thea Foss and Wheeler-Osgood Waterways remediation plan. Three options for honoring the commitment were identified:

- The City of Tacoma will pursue constructing additional mitigation acreage or modifying planned mitigation acreage to ensure that the overall remediation project achieves no net loss in aquatic habitat.

- If building new habitat or modifying existing habitat plans to meet the commitment proves unfeasible, the City will pursue purchasing an equivalent number of acres at an already planned restoration site within the Commencement Bay watershed.

- If the above options do not satisfy the commitment and/or prove unviable, the City is willing to pay the Trustees $425,000 per acre toward future planned habitat restoration projects.

The City has also committed to working with the appropriate agencies on the design and scope of this additional habitat construction.

### *2.4 Duration and Timing*

The in-water elements of EPA's selected remedy will occur between the Fall of 2003 and Winter of 2005. To be protective of juvenile salmonids, NOAA Fisheries, USFWS, and the Washington Department of Fish and Wildlife have specified in-water construction windows for Commencement Bay. In-water construction in the waterways will be allowed from July 16 through February 14, except for dredging or disposing of contaminated sediments, which will not start until August 16. In-water construction during the first construction season will temporarily cease before February 15, 2004. In the second construction season, in-water work will began again on July 16, 2004, for marina construction and capping (contaminated dredging can not start until August 16 of any year) and all in-water work will temporarily cease before February 15, 2005. In the third construction season, in-water work for marina construction and capping will began again on July 16, 2005 and will be completed by December 2005. If unforeseen circumstances require, any of the project elements could be delayed for one year.

A project of this magnitude requires careful sequencing of activities to complete the remedial activities in a timely and cost-effect manner, all subject to the above discussion of in-water construction windows. Habitat construction will start on the Puyallup River Side Channel behind the existing dike which will not be breached until the first in-water construction window occurs. Simpson's log haul-out structure and support facilities including a log road, stormwater drainage, and lighting must be operational before dredging of the St. Paul can be completed. The Middle Waterway Corridor Habitat north of the log haul-out will be completed before the end of the first dredging season. Then the St. Paul CDF will be constructed with clean material being hydraulically dredged to the mouth of the Puyallup River Delta. Approximately 90,000 cy of materials will be dredged from the slopes of the Thea Foss Waterway and placed in the CDF by barge before berm closure. When the shoreline and marina areas are remediated, some of the smaller habitat sites can be constructed and planted. Once the berm is closed, the St. Paul Beach Habitat can be constructed in phases. And hydraulic dredging of the channel areas can occur with disposal in the CDF, followed by hydraulic capping using materials from the Puyallup River Delta. The Middle Waterway Marsh/Mudflat Habitat area will be completed later in the sequence since some of the excavated material will be used for surface capping of the CDF.

## 3.0 DESCRIPTION OF THE ACTION AREA

The effects of the project are described within a broader setting of the Action Area to provide a context for evaluating the impacts of the project. The Action Area will distinguish it from the project areas, which are the specific areas where construction activities would occur (Figure 2). An action area is defined by NOAA Fisheries regulations (50 CFR Part 402) as "all areas to be affected directly or indirectly by the Federal activities and not merely the immediate area involved by the activities." The Action Area for the project includes all portions of the Commencement Bay shoreline from midway between Browns Point and Hylebos Waterway to the southern boundary of the Asarco site at depths less than –60 feet MLLW and Puyallup River downstream from the I-5 bridge (Figure 2). This Action Area corresponds to that defined in the BA prepared for remediation of the entire CB/NT Superfund Site (EPA 2000a). Section 4 of the CB/NT BA includes a detailed description of the historical and current conditions in the Action Area and should be referenced for this information.

## 4.0 BASELINE CONDITIONS IN COMMENCEMENT BAY

### *4.1 Baseline Habitats*

The environmental baseline represents the current conditions to which the effects of the proposed action would be added. The term "environmental baseline" means "the past and present impacts of all federal, state, or private activities and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private activities which are contemporaneous with the consultation in process" (50 CFR 402.02).

Numerous activities affect the present environmental baseline conditions in the Action Area, including expanding urban development, railroads, shipping, logging, agriculture, and other industries. The present port area of Tacoma was created during the late 1800s and early part of the 1900s by filling and dredging channels through the tidal marsh that had developed on the shelf of the Puyallup River Delta. Continuing habitat alterations such as dredging, relocation, and diking of the Puyallup River; dredging/construction of the waterways for purposes of navigation and commerce; steepening and hardening formerly sloping and/or soft shorelines with a variety of material; and the ongoing development of the Port of Tacoma and other entities has resulted in substantial habitat loss (Sherwood et al. 1990; Simenstad et al. 1993).

Historically, this area comprised the estuarine delta of the Puyallup River. With the growth and development of Tacoma, its port, and the surrounding region, the delta has been subjected to dramatic environmental changes, primarily from dredging and filling to create the waterways. Past development activities along the shorelines of Commencement Bay have affected, and future activities may affect, the habitat and the fish that use it (Duker et al. 1989). It has been estimated that of the original 2,100 acres of historical intertidal mudflat, approximately 180 acres remain today (Corps et al. 1993). Fifty-five acres of the 180 acres of low-gradient habitat is located near the mouth of the Puyallup River, 20 acres is the Milwaukee Waterway habitat area, 18 acres is located bayward of the East Eleventh Street Bridge in the Hylebos Waterway, 54 acres are located in the rest of the Hylebos Waterway, 46 acres are present along the shoreline from the mouth of the Hylebos to Browns Point, and 8 acres are located in the Blair Waterway (PIE 2001). Graeber (1999) states that 70 percent of Commencement Bay estuarine wetlands and over 98 percent of the historical Puyallup River estuary wetlands have been lost over the past 125 years.

The historical migration routes of anadromous salmonids into off-channel distributary channels and sloughs have largely been eliminated, and historical saltwater transition zones are lacking (Kerwin 1999). Additionally, the chemical contamination of sediments, in certain areas of the bay, has compromised the effectiveness of the habitat (Corps et al. 1993; USFWS and NOAA 1997).

In 1981, the EPA listed Commencement Bay as a federal Superfund site. As a result of this, the cleanup of contaminants has been a high priority and has resulted in 63 of 70 sites remediated (Kerwin 1999). In 1993-1995, the entire Blair Waterway navigation channel was dredged as part of the Sitcum Waterway

Remediation project. Contaminated sediments were removed and capped in the Milwaukee Waterway nearshore confined disposal site. After the completion of the dredging, the EPA deleted the Blair Waterway and all lands that drain to the Blair Waterway from the National Priorities List (PIE 2001).

The shorelines of Commencement Bay have been highly altered by the use of riprap and other materials to provide bank protection. Bulkheads cover 71 percent of the length of the Commencement Bay shoreline. Based on shoreline surveys and aerial photo interpretation of the area, approximately 5 miles, or 20 percent of the Commencement Bay shoreline, is covered by wide over-water structures (Kerwin 1999). These highly modified habitats generally provide poor habitat for salmon (Spence et al. 1996).

From 1917 to 1927, most of the habitat alteration (162 acres of mudflat, 72 acres of marsh) resulted from dredging the various waterways and from filling to build uplands for piers, wharves, and warehouses (USFWS and NOAA 1996). Currently, natural aquatic habitats are highly fragmented and dispersed across the delta and bay with few natural corridors linking them. Fish preferentially occupy shallow-water areas, and have been documented in mitigation and restoration sites (Miyamoto et al. 1980; Duker et al. 1989; PIE 1999) both north and south of the river mouth, although perhaps tending more to the north (Simenstad 2000). Commencement Bay is a documented rearing and migration corridor for chinook salmon (PIE 1999; WDFW and WWTIT 1994; Duker et al. 1989; Simenstad et al. 1982; Simenstad 2000). Some modified and relic habitats and most mitigation habitats along the delta front and in the waterways still support juvenile salmon by providing attributes such as food and refuge. However, negative impacts to salmon from their migration through and residence in the delta-bay system have not been quantified (Simenstad 2000).

At present, salmonid habitat within Commencement Bay shorelines is gradually increasing in acreage because of habitat restoration projects and natural processes. Approximately 50 acres of intertidal and shallow subtidal habitat have been created through previous restoration activities.

The environmental baseline is significantly degraded. Ninety-eight percent of historically available intertidal marsh and mudflat habitat, necessary for estuarine lifestage (smoltification) of juvenile salmonids, has been lost due to the above-described human activities. The remaining 2 percent of estuarine habitat is seriously degraded by the presence of toxic and hazardous contaminants in the sediments, which is the habitat for the prey organisms of juvenile salmonids. The baseline conditions of the action area are a significant factor in the current depressed status of Puget Sound chinook.

## 4.2 Biological Resources

Sections 5 and 6 of the CB/NT BA include detailed descriptions of the biological resources in the action area, including life history and habitat requirements of the species of concern (EPA 2000a).

## 4.3 Species Status

### 4.3.1 Puget Sound Chinook Salmon

Puget Sound chinook salmon was listed as threatened under ESA on March 24, 1999 (64 Fed. Reg. 14308). The species status review identified as causes for the rangewide decline in stocks the high level of hatchery production that masks severe population depression in the Evolutionarily Significant Unit (ESU), as well as severe degradation of spawning and rearing habitats, and restriction or elimination of migratory access (NOAA Fisheries 1998a and 1998b). Within the Puyallup River basin, most salmon spawn in the Puyallup River basin itself, outside of Commencement Bay. The naturally spawning chinook population in the Puyallup River is comprised of an unknown mix of natural and hatchery origin fish.

Juvenile chinook migrating through the Puyallup River Delta and Commencement Bay originate from three basic stocks: White River spring chinook, White River summer/fall chinook, and Puyallup River fall chinook (WDFW and WWTIT 1994). Juvenile salmon use estuaries for physiological adaptation, foraging, and refuge. As described by Simenstad (2000), some aspects of the early life history of juveniles in estuaries are obligatory, such as the physiological requirement to adapt from fresh water to salt water. Generalized habitat requirements of juvenile chinook in estuaries include shallow-water, typically low-gradient habitats with fine, unconsolidated substrates and aquatic, emergent vegetation; areas of low current and wave energy; and concentration of small epibenthic invertebrates (Simenstad et al. 1985).

Artificial propagation programs likely provide most of the numbers of chinook in the Puyallup River. The White River spring chinook population, which is considered critical by state and tribal fisheries managers, depends largely on artificial projection (WDFW and WWTIT 1994). The White River spring chinook have lately experienced a tenuous rebound as escapement gradually has increased from the historical lows of the 1980s. In 2000, nontagged returns of adults was 1,732 fish, the largest return in 30 years. This increase in consistent with larger numbers of chinook in the Columbia basin during 2000, indicating good ocean survival (NOAA Fisheries 2001).

The White River summer/fall chinook stock is considered wild and classified by co-managers as distinct based on geographic distribution. The glacial melt waters, typical of the Puyallup River, cause poor visibility during spawning season, and, hence, stock status is unknown (WDFW and WWTIT 1994).

Numbers of Puyallup fall chinook have recently been compiled by the Puyallup Tribe of Indians for the Washington State Shared Strategy. According to these data, the current number of spawners is 2,400. The Washington State Shared Strategy is a voluntary and collaborative effort that is developing goals for recovery planning ranges and targets. The intent of the Shared Strategy is to build upon existing efforts of local governments, watershed groups, and various state, federal, and tribal entities to produce a viable recovery plan. Targets relating the quality and capacity of chinook habitat to population response associated with recovered habitat indicated a range of 5,300 to 18,000 spawners for a recovered system (Puyallup Tribe of Indians 2002).

Field observations of Puget Sound chinook in the Action Area revealed that habitat use differs between the mouth and the head of waterways and also between the locations of the waterways in relation to the Puyallup River. The Puyallup Tribe of Indians conducted beach-seine sampling between the years 1980 and 1995 (however, no data were available in 1988, 1989, and 1990). Duker et al. (1989) conducted an extensive beach-seine juvenile sampling effort in 1983 at many of the same beach-seine sampling locations as the tribe's efforts, plus tow-net sampling to investigate distribution in the open-water habitats of Commencement Bay. In addition, sampling of salmonid distribution has been conducted at a number of sites during the course of impact assessment and/or mitigation site planning. Some general conclusions from these studies are the following:

- Juvenile chinook are present in low numbers in March, peak in late May or early June, and drop to low numbers again by July 1;

- Progeny of naturally spawned chinook of varying lengths arrive in the estuary throughout this period;

- Offshore catches of chinook peak about 2 weeks later than shoreline catches; and

- All shorelines are used but catches are typically higher near the mouths of the waterways than near the heads (Kerwin 1999).

Hooper (in USFWS 2001) compiled catch per unit effort of chinook salmon at sites close to and farther away from the Puyallup River. These data indicated that the catch per unit effort averaged 20.4 in the Milwaukee Waterway, 2.93 in the Blair Waterway, and 1.99 in the Hylebos Waterway. The catch per unit was higher in the waterways closest to the river (USFWS 2001).

### 4.3.2 Bull Trout

On December 1, 1999, the USFWS listed bull trout throughout its range as a threatened species under ESA (Federal Register Vol. 64 No. 210:58,909-58,933). The rationale for listing bull trout in Puget Sound and coastal drainages of Washington includes the following:

- Available data suggest that populations of this species have substantially declined from historical levels;
- Remaining populations are severely fragmented, increasing the probability of local extinction;
- Bull trout habitat has been degraded over time by land-use activities, urbanization, and hydropower development;
- Populations have been and continue to be affected by recreational fishing and poaching;
- Conservation and recovery efforts implemented to date have been insufficient to improve population levels and widen the distribution of this species; and
- Many populations continue to be affected by introductions of non-native fish, including brook trout (Pentec 2002).

Bull trout have a variety of life histories, one of which is anadromous, seasonally migrating to marine areas after their juvenile stage. The status and occurrence of anadromous populations of bull trout in Puget Sound are subject to some scientific debate; separation of anadromous bull trout from the closely related anadromous Dolly Varden char *(S. malma)* is very difficult and can only be accomplished using electrophoretic techniques (Leary and Allendorf 1997). Until further resolution is possible, WDFW has made a decision to manage all Puget Sound stocks as if they were a single bull trout/Dolly Varden complex (WDFW 2000).

Bull trout spawn annually during the fall in streams containing clean gravel and cobble substrate and gentle slopes, with cold unpolluted water. Bull trout require long incubation periods (4 to 5 months) compared with the other salmonid species. Fry hatch in late winter or early spring and remain in the gravel for up to 3 weeks before emerging (USFWS 1998; Brown 1992). Newly emergent fry rear near spawning areas; growing juveniles adopt a variety of life strategies. A portion of the population remains in headwater areas, adopting a resident life history. The remaining juveniles may move downstream looking for foraging opportunities, and depending on the rearing habitats that they select, are considered fluvial (found in river areas), adfluvial (found in lake areas), or anadromous (migrate annually to marine areas) (Kraemer 1999).

Very little is known about the anadromous form of bull trout. Limited data and anecdotal information from larger stocks, such as those in the Snohomish and Skagit basins, indicate that char have annual migrations to marine areas beginning in late winter, peaking in spring and continuing through late summer. It is believed that larger subadult and adult bull trout migrate to marine areas occupying shallow nearshore habitats (adults are reproductively mature and subadults are immature fish that have migrated to salt water). Anecdotal information in central Puget Sound suggests that some bull trout aggregations are associated with surf smelt spawning beaches, presumably to feed on this forage species. Most anadromous bull trout move back to fresh water by late summer. Most mature adults migrate to upper river spawning grounds beginning in late May and continuing through mid-July. Subadults may remain in marine areas as late as September before migrating to lower river freshwater habitats, where they reside during the winter months (Kraemer C., WDFW, personal communication, April 4, 2000).

Small bull trout eat terrestrial and aquatic insects. Large bull trout are primarily fish predators, eating whitefish, sculpins, and salmonids in fresh water and forage species in marine waters (USFWS 1998). Bull trout are more sensitive to changes in temperature, poor water quality, and low-flow conditions in fresh water than many other salmon because of their life history requirements (USFWS 1998).

The bull trout population in the Puyallup River has been separated into three stocks: the Puyallup River, White River, and Carbon River stocks. Although there are no genetic data available to determine whether these stocks are distinct, WDFW considers them distinct stocks due to the probable geographic isolation of their spawning populations (WDFW 1998). Timing of spawning and specific spawning locations are unknown for these three stocks. Information to determine the status of the three stocks is insufficient, but these three stocks are native and maintained by wild reproduction (WDFW 1998).

Historical accounts indicate anadromous bull trout entered the three drainages in "vast numbers" in the mid-1800s (Suckley and Cooper 1860). Recently, USFWS classified the lower Puyallup sub-population as depressed, based on fewer than 500 spawning adults and a decline in general abundance (50 CFR Part 17). In the Puyallup River (lower Puyallup sub-population), native char are occasionally caught by steelhead anglers. In the White River, counts of upstream migrating char at the Buckley diversion dam have averaged 23 adults since 1987. Although trapping effort has varied during the past 11 years, annual counts have generally been poor to moderate, ranging from a low of 8 to a high of 46 adult native char (WDFW 1998).

As reported, based on the results of six separate sampling efforts conducted in the bay since 1980, only four bull trout (or the closely related Dolly Varden char) were captured, none of which were in the Thea Foss, Wheeler Osgood, Middle, or St. Paul Waterways (Dames & Moore 1981; Duker et al. 1989; PIE 2000; Port of Tacoma and Puyallup Tribe of Indians 1999; Ratte and Salo 1985; Pentec 2003a). These adults were captured in April, May, and June, which is within the marine residence period of char in Puget Sound.

### 4.3.3 Bald Eagle

USFWS listed the bald eagle *(Haliaeetus leucocephalus)* in the State of Washington as threatened on February 14, 1978 (USFWS 1986). Bald eagles are found along the shores of marine areas and freshwater lakes and rivers. In Washington, breeding territories are located in predominantly coniferous, uneven-aged stands with old-growth components. Territory size and configuration are influenced by a variety of habitat characteristics, including availability and location of perch trees for foraging, quality of foraging habitat, and distance of nests from waters supporting adequate food supplies. Habitat models for nesting bald eagles in Maine show that the eagles are selecting areas with (1) suitable forest structure, (2) low human disturbance, and (3) highly diverse or accessible prey (Rodrick and Milner 1991).

Bald eagles typically build nests in mature old-growth trees, which are generally used in successive years. In Washington, courtship and nest-building activities generally begin in January and February. Egg laying begins in March or early April, with eaglets hatching in mid-April or early May. Eaglets usually fledge in mid-July and often remain in the vicinity of the nest for another month (Rodrick and Milner 1991). Review of the WDFW Priority Habitats and Species Database indicates that there are 11 bald eagle nesting territories located in the vicinity of the project area. There are, however, no known nests within a 2-mile radius of the project area. The closest nests are located 4 to 6 miles from the project site, and are found just northeast of Dash Point and at Neill Point on the southern tip of Vashon Island (WDFW Priority Habitat and Species Program). Bald eagles typically perch, roost, and build nests in mature trees near water bodies and available prey. Most nesting occurs within 250 feet of open water.

Eagles often depend on dead or weakened prey, and their diet may vary locally and seasonally. Various carrion—including spawned salmon taken from gravel bars along wide, braided river stretches—are important food items during fall and winter. Waterfowl often are taken as well. Anadromous and warmwater fishes, small mammals, carrion, and seabirds are consumed during the breeding season (Rodrick and Milner 1991).

### 4.3.4 Forage Fish

Forage fish documented in the action area of Commencement Bay include Pacific herring *(Clupea pallasi)*, sand lance *(Ammodytes hexapterus)*, and surf smelt *(Hypomesus pretiosus)*. Information on forage fish species are included in this BA addendum because of their importance to the diet of Puget Sound chinook salmon and bull trout during their adult marine residence periods.

No spawning of forage fish species occurs in the project area or other waterway portions of Commencement Bay. The WDFW Priority Habitats and Species database has documented surf smelt spawning near Browns Point and sand lance spawning along beaches of Ruston Way. The nearest Pacific herring spawning area is in Quartermaster Harbor on Vashon Island.

# 5.0 EFFECTS ANALYSIS

## *5.1 Habitat Indicators*

The effects of the proposed Thea Foss and Wheeler-Osgood Waterways Remedial Actions are evaluated through a discussion of how activities associated with the environmental cleanup will contribute to the improvement, maintenance, or degradation of habitats used by listed salmonids. Habitats within the action area can be described through a set of ecological pathways by which listed salmonids may be affected by changes in the estuarine environment. The ecological pathways considered as part of the cleanup project are water quality, estuarine habitat condition, and biological habitat quality. The existing baseline condition is described through indicators, or specific attributes, of the ecological pathways. The following is a list of indicators relevant to juvenile salmonids for each of the identified ecological pathways.

Indicators of water quality are:

- Turbidity;
- Dissolved oxygen (DO);
- Water quality; and
- Sediment quality.

Indicators of estuarine habitat condition are:

- Estuarine area, diversity, and accessibility;
- Salt/freshwater mixing patterns and location;
- Shoreline armoring; and
- Current patterns.

Indicators of biological habitat quality are:

- Epibenthic prey availability; and
- Forage fish community.

A primary factor reducing the risk of impact to juvenile salmonids is the restriction of in-water construction to periods when few juveniles will be present in the work area.

## *5.2 Direct Effects*

Direct effects are the immediate effects of the project on the species or its habitat. Direct effects result from the agency action and include the effects of interrelated and interdependent activities. Future federal actions that are not a direct, interdependent, or interrelated effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated (50 CFR 402.02).

The direct effects of the project derive from the nature, extent, and duration of the construction activities in the water and whether the fish are migrating and rearing at that time. Direct effects of the project also include immediate habitat modifications resulting from the project. In the proposed project, immediate positive effects include the removal of highly contaminated materials from the intertidal area that juvenile salmonids use. Negative effects may occur during various construction activities, including the dredging of highly contaminated sediments and the disposal of the dredged sediments into the St. Paul Waterway CDF. However, these effects are of limited duration.

The construction of new and enhanced intertidal habitats in the Thea Foss Waterway, Middle Waterway, the St. Paul Waterway mouth, and the Puyallup River side channel will have immediate and long-term direct positive effects on salmonid population health and fitness.

### 5.2.1 Dredging

Approximately 46.6 acres of contaminated sediments will be dredged from the Thea Foss and Wheeler-Osgood Waterways as part of remedial activities. Direct effects to fish from dredging can include injury by entrainment, and behavioral effects such as temporary avoidance of areas of higher turbidity and lower DO. The potential mechanisms by which turbidity could affect salmonids include direct mortality, sublethal effects (stress, gill damage, and increased susceptibility to disease), and behavioral responses (disruptions to feeding or migration) (PIE 2001). Long-term ecosystem effects of dredging generally include changes in the volume and area of habitat, periodic changes to primary and secondary production (food-web effects), and changes in hydrodynamics and sedimentology (Nightingale and Simenstad 2001).

As reported, either mechanical or hydraulic dredging will be conducted in Thea Foss and Wheeler-Osgood Waterways, as determined by the dredging contractor and approved by EPA and NOAA Fisheries. It is generally accepted that clamshell dredges do not have the potential to entrain pelagic fish such as salmonids. Specifically, the clamshell bucket descends to the substrate in an open position. The force generated by the descent drives the jaws of the bucket into the substrate, which "bite" the sediment upon retrieval. During the descent, the bucket cannot trap or contain a mobile organism because it is totally open. Based on the operation of the clamshell dredge bucket, it is concluded that the proposed project would not entrain juvenile, subadult, or adult salmonids, or forage fish, although some entrainment of demersal fish and epibenthic invertebrates (e.g., crab) may occur. Therefore, no short-term direct effects due to mechanical dredging are anticipated.

Hydraulic dredging in shallow-water habitats in Puget Sound has been shown to entrain fish with a propensity to burrow into the sediments, such as snake prickleback *(Lumpenus sagitta)* (Pentec 1990, unpublished data). Hydraulic dredging has a low capacity for entrainment of pelagic fish as shown by monitoring of surf smelt in the La Conner Marina (Kyte and Houghton 1994).

Because of pelagic habitats used by salmonids in the project area and because of their innate escape responses, there is virtually no risk of a direct take by entrainment or injury of salmonids during hydraulic dredging, although some entrainment of demersal fish and epibenthic invertebrates (e.g., crab) may occur.

Dredging will cause temporary and localized impacts to water quality in the vicinity of active dredging. Preremedial design studies predicted that hydraulic and open clamshell dredging would create 500 and 1,100 mg/L of suspended solids at the point of dredging, respectively (City of Tacoma 1999). The increase in turbidity that will occur during dredging activities will take place in a limited mixing zone around active work areas. Elevated turbidity plumes may occur in localized areas near active dredging but are not expected to persist. In-water work will be conducted during specified work windows when few, if any, juvenile salmonids are present.

Juvenile salmon have been shown to avoid areas of unacceptably high turbidities (Servizi 1988), although they may seek out areas of moderate turbidity (10 to 80 NTU), presumably as cover against predation (Cyrus and Blaber 1987a and 1987b). Feeding efficiency of juveniles is also impaired by turbidities in excess of 70 NTU, well below sublethal stress levels (Bisson and Bilby 1982). Reduced preference by adult salmon homing to spawning areas has been demonstrated where turbidities exceed 30 NTU (20 mg/L suspended sediments). However, chinook salmon exposed to 650 mg/L of suspended volcanic ash were still able to find their natal water (Whitman et al. 1982). Based on these data, it is unlikely that the locally elevated turbidities generated by the proposed activities would directly affect juvenile or adult salmonids that may be present.

Mechanical dredging could cause reductions in DO, although most research indicates that dredged-induced DO reductions are a short-term, localized phenomena and do not cause problems in most estuarine systems (Slotta et al. 1974; Smith et al. 1976). During dredging activities, DO will be monitored at the mid-point and the point of compliance boundary, and operational changes as necessary will be made to comply with water quality criteria.

Based on the EPA's (2000a) analysis of the effects of increased suspended sediment concentrations on salmonid species (see Section 7.1 of the CB/NT BA) and the results of dredged material modeling, the dredging of this proposed action would not produce suspended sediment concentrations dangerous to salmonids. In addition, the contractor will be responsible for submitting a Construction Control Plan, which will present the system through which the contractor assures compliance with the proposed action's Water Quality Standards. Further, turbidity will be monitored in the vicinity of dredging operations during and for specific times before and after construction. If exceedance of Water Quality Criteria occurs at the compliance boundary, the contractor will be required to modify the operations. Such modifications may include slowing the dredging rate.

Dredging will eliminate nonmobile benthic and epibenthic species over the bottom of those areas dredged, resulting in a temporary reduction in abundance and diversity of benthic organisms. However, substantial areas (over 60 acres) of the waterway that do not require remediation or that will be remediated by natural recovery will provide local larval sources for recolonization. Where recolonization sources are nearby, newly exposed sediments are expected to quickly recolonize by infauna and epifauna (McCauley et al. 1977; Richardson et al. 1977; Romberg et al. 1995; Wilson and Romberg 1995). Since the remediated bottom sediments may be lower in fines and organic material than sediments currently present in much of the waterways, initial productivity of infauna may be below current levels for one or more years. Based on information on recolonization of the Simpson Cap in St. Paul Waterway, new sandy sediments are expected to provide epibenthic prey quality and quantity for salmonids exceeding those now provided within 1 to 2 years of placement. Longer periods (i.e., 3 or more years) may be required before the benthic assemblages reach levels of stability, productivity, and community structure fully comparable to those in similar habitats and at similar depths in Commencement Bay.

During the time required for development of a robust infauna and epibiota in these areas, food availability for juvenile salmonids may be reduced. However, this reduction in benthos will only be a negative impact until prey availability and quality surpasses that present before remediation; this condition is expected to occur within 1 or 2 years. Because of their greater mobility and because they exploit organic material falling to the sediment surface from plankton, epibenthic crustaceans particularly important to the diet of juvenile salmonids are expected to recolonize more rapidly than infauna.

In some areas of the inner waterway, the existing sediments and prey base may contain chemical constituent concentrations that are harmful to benthic feeders and to animals that have direct contact with sediments. In these areas, removal of sediments exceeding SQOs and benthos will have an immediate positive effect; species not finding adequate prey for feeding in these areas may be forced to move to other areas where they may face increased competition for food, but they will be consuming uncontaminated prey and will be in contact with uncontaminated sediments.

Temporary relocation of marina and other in-water facilities, including the removal and replacement of pilings, is necessary to provide access for proposed dredging activities. Noise impacts from impact pile driving activities may have adverse affects to fish in the vicinity of the pilings and to bald eagles that are known to flyover the action area.

Dredging activities within Thea Foss and Wheeler-Osgood Waterways will not significantly alter fresh/saltwater mixing patterns and current patterns. Dredging will have no effect on the presence, number, or configuration of overwater structures, nor will it increase or decrease the extent of armored shorelines.

Based on the preceding discussion, the effects of dredging will be localized and temporary and will have minimal effects on juvenile salmonids, bull trout, or bald eagles. Any short-term effects will be greatly outweighed by the positive benefits of contaminant removal.

### 5.2.2 Capping

Capping of contaminated areas within the waterways will require approximately 136,000 cubic yards of clean, fine sands, probably hydraulically dredged from the Puyallup River Delta. Approximately 19.7 acres of channel areas within the waterway will be capped to provide chemical isolation of contaminants. The direct effects of waterway capping are similar to those of dredging. Placement of capping material will cause temporary periods of turbidity as the cap material sinks through the water column before settling onto the bottom. Temporary decreases in DO may occur during the sinking of capping material if the materials have significant biological oxygen demand (BOD) levels from total organic carbon (TOC) concentrations. However, the cap material will consist of an assortment of clean, fine sands with low organic content, and thus are not expected to result in a change in BOD (and resulting DO reduction) during transport through the water column. The coarse nature of the cap materials will produce lower turbidity for a shorter period of time in comparison to turbidity caused during dredging operations. Research by MEC Analytical (1997) indicates that fine sand and larger particles sank to the bottom within minutes. In addition, capping will take place in less than 35 feet of water and material will be placed in a controlled manner to minimize the free fall distance. All capping material will settle out quickly, with the majority of the material being contained on the overall cap footprint.

During placement of the cap, juvenile salmonids, forage fish, and other fish species would likely avoid the area of capping activity until after settlement. This will likely be within a day after activities were completed. Capping activities also will take place during specified work windows during which juvenile salmonids would not likely be present in the area. Forage fish spawning areas are not present in the project area.

Placement of capping material will cause the burial of the existing benthic and epibenthic community and can be considered eliminated. As discussed in Section 5.2.1, recolonization of epibenthic and benthic communities will occur rather rapidly, usually within 1 or 2 years of capping, depending on the source of capping material.

The dredging and capping of slopes along waterway shorelines will cause a net decrease in area of marine habitats within Thea Foss and Wheeler-Osgood Waterways. The dredging and capping of the waterways will cause a net decrease of 2.55 acres below –10 feet MLLW but will largely be balanced with a 2.29-acre gain in the more productive littoral elevations. Juvenile chinook salmon are dependent on littoral habitats and shorelines for longer periods and at smaller sizes than the other salmonid species (Simenstad et al. 1982; Levy and Northcote 1982; Levings 1982). Deeper-water habitats are used by juvenile chinook primarily at larger sizes near the end of the outmigratory period as fish begin their seaward movements (Healy 1991).

Littoral slopes requiring capping will be protected with riprap or quarry spalls for slope stabilization. However, shoreline armoring will be enhanced by covering with habitat mix to fill interstices, aid in water retention, and foster the development of epibenthic prey for juvenile salmonids. Habitat mix will be most effective at these functions below about +4 feet MLLW and where the slope is protected from wave action. Above about +9 feet MLLW, these materials may support growth of saltmarsh vegetation.

Capping activities within Thea Foss and Wheeler-Osgood Waterways will not significantly alter fresh/saltwater mixing patterns or current patterns.

Based on the preceding discussion, the effects of capping will be temporary and will have minimal effects on juvenile salmonids. The slight loss in total marine habitat due to capping activities will be more than offset by the gains in important littoral habitats. Overall, effects will be greatly outweighed by the positive benefits of contaminant isolation.

### 5.2.3 Natural Recovery

For specific portions of the Thea Foss and Wheeler-Osgood Waterways, EPA's 1989 Record of Decision (ROD) and 2000 ESD selected natural recovery as the preferred remedial approach. Natural recovery is applicable to RAs where surface sediments are predicted to recover to SQO concentrations levels within 10 years following completion of remedial activities within the waterways. As specified in the ROD, natural recovery is only applicable to marginally impacted sediments—defined by EPA as those with chemical concentrations less than the second lowest Apparent Effects Threshold value, or those with biological test results that do not exceed the minimum cleanup level values under the Washington State Sediment Management Standards.

EPA believes that reliance on natural recovery for these RAs does not constitute an impact on listed species; however, such natural recovery sites will be monitored as part of the long-term operations management and monitoring plan. If future performance monitoring results confirm the predicted reduction in concentrations of contaminants in the 10-year period, no further remedial activities are planned.

### 5.2.4 Enhanced Natural Recovery

Enhanced natural recovery is the placement of a thin layer (usually 0.5 foot) of clean sediment above the existing sediment surface to assist in the natural recovery of those sediments with minor exceedances of SQOs. The impacts will be similar to those discussed in the capping section (Section 5.2.1) but generally of lower intensity and for a shorter period of time, due to the reduced quantity of material; for instance, some epibenthic and benthic organisms may survive to repopulate the new surface.

### 5.2.5 St. Paul Waterway CDF

Disposal of Thea Foss and Wheeler-Osgood Waterways dredged sediments in the St. Paul Waterway CDF may minimally, and temporarily, elevate suspended sediment and lower DO concentrations within the CDF. Effects will be minimized by using a closure berm at the entrance of the CDF, largely isolating these areas from the remainder of the Action Area. Following project completion, the contaminated material will be physically isolated from Commencement Bay. Moreover, turbidity and DO levels will be monitored during disposal, and operational changes, as necessary, will be implemented to comply with Water Quality Criteria at the compliance boundary. Thus, suspended sediment and DO concentrations are not expected to reach levels dangerous to salmonids.

Construction of the St. Paul Waterway CDF will result in a loss of 11.78 acres of existing marine habitat (which includes 11.68 acres of littoral habitat) in

Commencement Bay. The mitigation/restoration activities discussed in Section 2.3 will be conducted to offset this unavoidable loss of habitat. The North Beach, Middle Waterway, and Puyallup River Side Channel mitigation activities will provide 11.42 acres of replacement habitat. In addition, the combination of remediation and pocket habitat restoration in Thea Foss Waterway will reduce the loss from slope capping to a slight net loss of 0.22 acre in habitat, leaving a total habitat deficit of 0.58 acre. This deficit will be met as described in Section 2.3.

Construction or presence of the St. Paul CDF will alter the existing shoreline geomorphology and bathymetry. This will result in a loss of intertidal habitat area in close proximity to the mouth of the Puyallup River but will not significantly affect area available for osmoregulatory adjustment since the St. Paul Waterway has a salinity structure that is similar to that in the adjacent Middle Waterway. The project will not significantly affect fresh/saltwater mixing patterns.

Hydraulic dredging to increase CDF capacity and placement of St. Paul sediments on the Puyallup River Delta for delta augmentation would create a concentrated plume of sediment-laden water that would flow with the prevailing river and tidal currents. Sand fractions would settle from the water column quickly, leaving a plume that is still very high in finer suspended sediments. Areas where sediment deposits on the delta platform or face are expected to be naturally dynamic, constantly shifting sand and to have minimal epibenthic production, especially during the proposed period of deposition (November through January). Thus, only minimal loss of epibenthic productivity would result.

If placement occurs on the delta platform during high tide, plume distribution will be dependent in large measure on tidal currents; because the plume will consist of a high density of solids in saline water, it will be more dense than the river plume (that may contain a significant density of solids but in freshwater). Thus, the plume will descend in the water column and move with subsurface currents over the surface of the delta platform. During low tides, plume distribution will be more dependent on river currents and the plume will meander across the delta in a constantly changing channel pattern. High sediment loads will result in shifts in channel location as channels fill in with sand deposited from the discharge, causing the water to deflect to other areas. Water flow from the river and from the hydraulic discharge will generally transport the sediments, along with the river-borne sediments toward the delta edge. Along and below the edge, accumulations on the steep delta face will constantly slough downslope, contributing to the natural delta accretion. Placement of sediments directly on the delta face will have minimal impact on the delta platform and a similar effect on the delta face (continual sloughing down slope).

When discharge is occurring onto the delta platform or onto the delta face, the area of the delta directly influenced by the plume at any point in time will constitute a relatively small percentage of the water cross section at the river mouth and would occur for only a portion of each day. Juvenile salmon have been shown to avoid areas of unacceptably high turbidities (Servizi 1988), although they may seek out areas of moderate turbidity (10 to 80 NTU), presumably as cover against predation (Cyrus and Blaber 1987a and 1987b). Feeding efficiency of juveniles is also impaired by turbidities in excess of 70 NTU, well below sublethal stress levels (Bisson and Bilby 1982). Reduced preference by adult salmon homing to spawning areas has been demonstrated where turbidities exceed 30 NTU (20 mg/L suspended sediments). However, chinook salmon exposed to 650 mg/L of suspended volcanic ash were still able to find their natal water (Whitman et al. 1982).

Based on these data and the winter timing of delta discharges, it is unlikely that the locally elevated turbidities generated by the proposed action would directly affect juvenile or adult salmonids that may be present. It is highly probable that adult chum salmon and steelhead seeking to enter the often naturally turbid Puyallup River during their upstream migrations will simply avoid the plume or swim through it. No significant delay in migrations is expected. Thus, it is concluded that no significant short-term adverse impacts to listed salmonids will result from the placement of sediment on the delta platform or face.

Likewise, subsequent hydraulic recovery of a large proportion of the sediments placed on the delta will have a minimal effect on habitat for ESA-listed species or EFH. Although there would be a short-term loss of benthos in areas dredged, benthic species on the delta are adapted to rapid recolonization of disturbed areas and are expected to recolonize dredged areas quickly (McCauley et al. 1977; Richardson et al. 1977; Romberg et al. 1995; Wilson and Romberg 1995). Probability of salmonid entrainment during hydraulic recovery of sediments is low.

Based on the preceding discussion, the effects of CDF construction will be temporary and will have minimal effects to juvenile salmonids. The losses in total marine habitat due to the CDF will be more than offset by mitigation/ restoration activities composed of a suite of habitat creation/restoration/ enhancement projects. In addition to offsetting project impacts, these activities will provide affirmative conservation measures that will contribute to the restoration of ESA-listed salmonids (see discussion in DAR Section 6.5).

### 5.2.6 Slope Rehabilitation

Slope rehabilitation will be an integral part of remediation of the littoral zone within the waterway. Slope rehabilitation in a given RA may include the following activities:

- Piling and debris removal;
- Removal of contaminated sediment;
- Regrading of the slope; and/or
- Slope protection with riprap or quarry spalls.

Rehabilitated slopes will then receive a surface covering of habitat mix. The impacts of slope rehabilitation will thus be similar to those for other remedial activities discussed above. Debris, piling, and sediment removal will result in short-term and localized increases in turbidity; some of the sediments suspended may contain contaminants and/or organic materials that could result in slight decreases in DO levels in the immediate vicinity. Placement of slope protection and habitat mix, to the extent that it is accomplished during high tides (i.e., through the water column) will also result in temporary increases in turbidity, however, since these materials will be low in organics, no effects are anticipated on DO levels.

Rehabilitated slopes are expected to be quickly recolonized by organisms suited to the elevations, exposures, and substrates provided.

### 5.2.7 Habitat Construction

The North Beach Habitat will be constructed by filling portions of the mouth of the St. Paul Waterway and the construction of the protective face on the north end of the Middle Waterway peninsula. Using recognized Puget Sound industry nearshore filling methods, suspended sediment concentrations are not expected to reach levels dangerous to salmonids, and any effects on water quality would be temporary. The contractor will be responsible for modifying operations, especially relating to the scheduling of substrate placement during incoming or slack tides, to decrease the potential for water quality exceedances. Turbidity will be monitored during filling, and operational changes implemented as necessary to comply with water quality criteria at the mixing zone boundary.

To compensate for the unavoidable loss of 11.78 acres of littoral habitat being converted to upland during the filling of the St. Paul Waterway, the Middle Waterway Beach and Brackish Marsh and the Puyallup River Side Channel mitigation element will convert an equivalent upland or isolated wetland acreage to littoral habitat. This mitigation would yield increases in quality of littoral habitat and provide habitats that reverse past cumulative losses in the bay through the further enhancement of a number of small habitat features in the Thea Foss and Wheeler-Osgood Waterways. These pocket habitat sites will be constructed concurrent with remedial activities at Pick's Cove Marina, Foss Waterway Marina, Alber's Mill Marina, at the Head of Thea Foss, and Johnny's Seafood. In total, the replacement of the St. Paul Waterway with equivalent acreage at Middle Waterway and the Puyallup Side Channel combined with the geographically disperse pocket littoral habitats should satisfy not only the substantive Sec. 404 evaluation but compensate for temporal losses during cleanup, uncertainty in creating new littoral habitats, and the EPA's affirmative conservation [ESA Sec. 7(a)(1)].

Habitat quality will improve in the Action Area through removal or isolation of contaminants and through the application of habitat mix over littoral surfaces, especially existing hardened (riprap) shorelines. Creosote-treated wood piles and anthropogenic debris will be removed and where possible the steepened slopes of littoral shorelines will be reduced for the benefit of listed species. Further, the addition of large woody debris cover structures and native riparian plantings along the shorelines will also improve the baseline conditions by increasing habitat complexity and promoting accretion of finer grained materials.

The combination of the gentle slope, fine substrates, and increased acreage and function at the habitat mitigation sites and the remediated waterway channel and shoreline areas will increase epibenthic prey organism productivity and subsequently the habitat value for juvenile salmonid feeding and rearing. Epibenthic organisms would be eliminated in the St. Paul Waterway and disturbed in certain areas on the existing littoral habitats. However, new intertidal and shallow subtidal acreage on the face of the berm and the new intertidal and shallow subtidal acreage constructed as part of the mitigation actions will increase the acreage that will support epibenthic production. Based on monitoring of constructed mitigation habitats at the Blair Waterway Slip 5 (Jones & Stokes 1988, 1991a, and 1991b) and the Milwaukee Habitat Area (Parametrix 1996; PIE and Parametrix 1998), it is expected that the new habitats in the nearby Middle and Thea Foss Waterways will be rapidly colonized by epifauna.

Because construction would occur during a season when juvenile salmonids are present only in very low numbers, the habitat would have time to recolonize prior to the following spring outmigration season. The project and the associated mitigation (which is expected to be of much higher quality than the habitat affected) would result in an increase in the overall production of epibenthic prey for salmonids within Commencement Bay compared to existing conditions. Overall, the remedial actions in the Thea Foss and Wheeler-Osgood Waterways are expected to improve over the baseline condition for epibenthic prey availability.

### 5.2.8 Removal and Reinstallation of Piles

Large numbers of timber piles will be removed from Thea Foss and Middle Waterway. Where pile replacement is needed, both concrete and steel piling will be used which will have none of the chemical concerns associated with creosote-treated timber piles. Removed timber piles will be disposed of at an approved upland site. Pile removal and driving could temporarily increase the turbidity of surrounding waters, but much less so than the dredging activities. In addition, pile driving of hollow steel pipe piles will temporarily increase the noise within the Project Area and potentially create overpressure waves adjacent to the pile driving activity. While a vibratory hammer will routinely be used, it may be necessary to test 5 to 10 percent of the steel piles with an impact hammer to determine bearing capacity, referred to "proofing" in the industry. Biological effects to Puget Sound chinook may result from the high sound pressures produced when driving hollow steel piles with an impact hammer. Extensive discussions of the effects of driving hollow steel piles was provided in a recent NOAA Fisheries ESA consultation of the Hood Canal Bridge Retrofit and Replacement (NOAA Fisheries No. 2002-00546; NOAA Fisheries 2003). The EPA and the City of Tacoma has agreed that any pile driving with an impact hammer on hollow steel piles will employ an approved protective air bubble curtain.

Impact pile driving activities may temporarily disrupt foraging behavior of bald eagles in the vicinity of the project area. The nearest recorded bald eagle nests are located on Vashon Island, outside of the Action Area (WDFW Priority Habitats and Species Program). The Washington State Department of Transportation (WSDOT) conducted monitoring studies to determine the potential impacts on wintering eagles associated with pile-driving activities at Orcas and Shaw Islands in San Juan County, Washington, from December 15, 1986, through March 15, 1987 (Bottorff et al. 1987). Each of the monitoring areas was associated with a Washington State ferry terminal, thus background noise sources included ferry whistles, boat motors, chain saws, aircraft, and other construction noises including front end loaders, cranes, generators, diesel trucks, hammers, and other general noise sources associated with construction areas. Noise readings were taken at the construction sites and various intermediate points out to about 6,000 feet from the construction sites.

Driving of wood piling did not visibly disturb the eagles observed during the course of the study. A steel pile, which produces some of the loudest noises during pile-driving activities, may have disturbed a bald eagle at a distance of 4,000 feet. However, this same pair of eagles had been in the same location during the driving of two steel piles earlier in the day and exhibited no visible disturbance reactions. The eagle pair returned to their preferred perch and no further adverse reactions were observed, even after over 100 wood piles were driven (Bottorff et al. 1987).

According to the authors, between 0.25 and 0.5 mile from the construction site and beyond, construction noises were similar in level to background noise. Environmental factors such as wind and wave action, movement of tree branches and forest litter, barking dogs, bird noises, automobiles, airplanes, human voices, woodcutting, light construction activities, boats, and other unidentified noise sources create ambient noise levels that are similar to noise levels produced by pile driving at distances of 0.25 to 0.5 mile away from the point source (Bottorff et al. 1987).

WSDOT also monitored noise levels during pile-driving activities at their Anacortes facility (Visconty, S., Washington State Ferries, personal communication, March 9, 2000). For comparison purposes, background noise levels were monitored at the Friday Harbor terminal. At the Friday Harbor terminal, ambient noise levels around the closest bald eagle nest (located near the terminal) ranged between 45 and 72 dB, 40 to 51 dB for local harbor traffic noise, and 69 to 74 dB from use of a 100-ton crane at the terminal.

Pile-driving noise at the Anacortes facility ranged from 105 to 115 dB at 15 m (50 feet) from the noise source. Noise levels were highest when a pile was first driven and decreased near completion because of a reduction of exposed surface area and increased stiffness as the pile became more embedded (Visconty, S., Washington State Ferries, personal communication, March 9, 2000). Simultaneous readings taken at several distances to determine propagation loss at Anacortes indicated a 6-dB decrease in sound pressure for every doubling of distance. Given this information, at 560 m (1,850 feet) from the noise source at Anacortes, the sound was 70 dB, well within measured background ambient noise levels recorded at the Friday Harbor terminal (Visconty, S., Washington State Ferries, personal communication, March 3, 2000).

Based upon the data and observations made in these studies, pile driving may cause eagles to alter course when flying near or over activities. Nesting activities will not be affected since the closest nests are 4 to 6 miles to the north on Vashon Island.

### 5.2.9 Demolition and Reconstruction of Structures

The proposed activities will have no significant effect on the presence, number, or configuration of remaining overwater structures, nor will they have any effect on the extent of existing armored shorelines. Both concrete and steel piling will be used and will have none of the chemical concerns associated with creosote-treated timber piles (Section 5.2.8). Pile driving could temporarily increase the turbidity of surrounding waters, but much less so than the dredging activities.

The log haul out facility will be relocated to a subtidal area (below –10 feet MLLW) on the eastern side of the Middle Waterway. Log rafts will be positioned offshore at a location with sufficient water depth to assure they will not ground out on low tides, thereby minimizing impacts to nearshore habitats preferred by juvenile salmonids. The log bundles will be lifted intact from the subtidal area to an adjacent upland location and transported inland to the storage location. The "easy lift" nature of the haul out facility will reduce the potential for wood debris loss and accumulation of the sediments adjacent to the operation. The log bundles will be floated onto a track-mounted cradle lift. The intact bundles will be removed from the water to the adjacent upland and delivered to an upland log bunker where they will be broken open.

In addition to the monitoring and adaptive management/contingency plan, the following best management practices will be incorporated to minimize impacts to marine habitat:

- No raft storage or grounding of log rafts will occur in the Middle Waterway. Current log rafts are typically 80 by 300 feet and moorage in the waterway will be limited to the time period required to handle and remove the bundles from the water.

- Floatables will be contained within a containment boom consisting of stringer logs placed around the working/rafting area and routinely removed from the water.

- Bundles of logs will not be broken in the water. Instead, unbroken bundles will be delivered to an upland log bunker.

- An upland storage bunker will be used to keep wood debris from falling or washing back into the waterway. The upland bunker will be periodically cleaned, with the debris reclaimed for upland disposal, hog fuel, or other beneficial use.

- Accumulations of debris on sediment at the log haul out facility will be monitored on a defined survey schedule, per the adaptive management/contingency plan, and removed as necessary.

Accumulations of bark and woody debris on intertidal and shallow subtidal habitat can have a number of adverse environmental effects including smothering of benthos and degradation of sediment conditions (see reviews by Tetra Tech 1996; Floyd & Snider and Pentec 1997). The design of the proposed easy lift system, the absence of long-term storage of log rafts, and the BMPs listed above should preclude significant adverse effects from the operations of the log haul out facility in Middle Waterway.

### *5.3 Indirect Effects*

Indirect effects are caused by or result from the proposed activities, are later in time, and are reasonable to occur (50 CFR 402.02). Indirect effects may occur outside the area directly affected by the activities. Indirect effects from this project include those impacts that would result from the future use of the Thea Foss Waterway.

Small-vessel marina, petroleum handling, and ship repair industries are the principal water-related activities that currently occur on Thea Foss and Wheeler-Osgood Waterways. After the completion of contaminated sediment removal and capping, no change in the level of these activities is expected to occur. The St. Paul Waterway is currently used entirely by the Simpson entities. After filling the waterway for the St. Paul CDF Disposal Option, log transfer activities will move to the Middle Waterway Peninsula. No change in the activities is anticipated.

The proposed action does not substantially change water depths or structure such that increased uses could occur without requiring future federal permitting and ESA consultation. Therefore, no adverse indirect effects to any of the indicators of habitat quality are anticipated.

## 5.4 Cumulative Effects

Cumulative effects are defined as "those effects of future state or private activities, not involving federal activities, that are reasonable certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). The project involves action within a portion of Thea Foss Waterway, which has been previously altered by dredging, filling, and other anthropogenic activities. However, future federal activities that will impact the Action Area, such as navigational dredging and other activities permitted under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, will be reviewed under separate Section 7 consultations, and cannot be considered cumulative effects.

A number of active programs have had or will have cumulative positive effects on the status of salmon in Commencement Bay and the Puyallup River basin. The Recovery Plan for White River Spring Chinook Salmon (Muckleshoot Indian Tribe et al. 1996) identifies a series of objectives and activities designed to enhance the recovery of White River spring chinook, the only remaining spring run of chinook in the Puyallup River system. These activities are targeted at improved freshwater spawning and rearing conditions with the goal of reducing run dependence on artificial production.

In addition to the tribal and agency efforts to improve chinook and other salmon habitat and survival in the freshwater drainage area of the Puyallup River system, a number of regulatory, directed, and voluntary efforts in Commencement Bay have resulted or will result in improved estuarine habitat conditions for juvenile salmonids. Designation of Commencement Bay as a federal Superfund site has already resulted in cleanup of contaminated portions of St. Paul, Blair, and Sitcum Waterways, and studies are well underway to define areas requiring remediation in Middle and Hylebos Waterways, as well as at the old Asarco smelter site along Ruston Way. These efforts are expected to be completed in the near future.

Increasingly strict enforcement of Clean Water Act Section 404 and the State of Washington Hydraulic Project Approval rules (Chapter 220-110 WAC) and guidelines requiring "no net loss" of wetlands and habitat for fish and shellfish resources has reversed the trend of continued losses of marine littoral habitat that had persisted from the time of earliest Euro-American settlement through the 1970s. The first major project for which a substantial mitigation area was provided was the Port of Tacoma's completion in 1986 of the 9.6-acre Gog-Li-Hi-Te tidal wetland approximately 2 km up the Puyallup River. This project was constructed as compensation for filling a similar-sized site containing isolated wetlands. Subsequent monitoring (Shreffler et al. 1992) has shown that this saltmarsh/mudflat complex provides a productive foraging area for juvenile salmonids, including chinook. In 1987, the Port of Tacoma constructed the Slip 5 enhancement as mitigation for filling of Slip 2 and adjacent areas near the entrance to Blair Waterway (Jones & Stokes 1992). A deepwater area was filled to provide 2.7 acres of intertidal habitat. Subsequent monitoring showed that production of epibenthic zooplankton in the mitigation area was good and supported juvenile salmon rearing.

About the same time (1988), a settlement was reached between the Simpson Tacoma Kraft Company and the EPA that resulted in the capping of an area of contaminated sediments at the end of the peninsula between the Puyallup River and St. Paul Waterway to restore approximately 11 acres of nearshore shallow-water habitat, including approximately 7 acres of littoral habitat. This site has been monitored continually (Parametrix 1999) and has been shown to have a rich and diverse infauna and epibenthos, as well as seasonal use by juvenile salmon migrating out from the Puyallup River. The Port of Tacoma has also completed mitigation projects at Rhone-Poulenc and the Fairliner Marina site in Blair Waterway.

As the culmination of a 10-year negotiation, Milwaukee Waterway, on the opposite side of the Puyallup River, was partially filled with contaminated sediments in 1993, eliminating approximately 21 acres of disturbed marine habitat. As compensation, the Port of Tacoma constructed a 19.5-acre, shallow-water mitigation site in the entrance to the waterway. In addition, the Port and the City have independently expanded an existing freshwater wetlands at Clear Creek and Swan Creek up the Puyallup River, and provided access for juvenile salmon. The City also has completed intertidal contaminant cleanup and habitat restoration in Middle Waterway and at the Olympic View site at the tip of the Middle/Thea Foss peninsula. Cleanup and habitat enhancements are also well underway in Thea Foss Waterway, e.g., the Thea Foss South Esplanade Habitat Enhancements. Monitoring to date has indicated that these projects will more than meet their goals for provision of habitat for juvenile salmonids, among other species. Several other smaller-scale enhancement and restoration activities have been completed or are underway as compensatory mitigation for permitted shoreline modifications throughout Commencement Bay.

Other effects in the action area are those from restoration activities taking place as a part of Commencement Bay Natural Resource Damage Assessment pursuant to CERCLA (USFWS and NOAA 1997; Kerwin 1999). Landscape and watershed-scale restoration sites have also been identified to increase connectivity between important salmon habitat transition regions (Simenstad

2000). It is particularly difficult to detect, with confidence, the effects of habitat improvements based on observed run-size trends. It has been estimated that, because of inherent variability, it would take 30 years to detect a 50 percent improvement in average production, if we were to use adult run size as the response variable (Lichatowich and Cramer 1979; Mobrand Biometrics 2001).

### *5.5 Conclusions*

The collective efforts of proposed remedial and mitigative activities may result in short-term adverse impacts to chinook salmon and bull trout due to in-water work and short-term impacts to bald eagle due to impact pile driving. Of the ten indicators of water and habitat quality, seven indicators will be maintained in the long term, and three indicators (water quality, sediment quality, benthic community) will be restored. The indicators of water quality and benthic community are expected to temporarily be degraded before being restored to levels above existing baseline conditions (Table 3). Water quality degradation is expected to be temporary and limited to dredging and capping periods only. Degradation of the benthic community would last only until the recolonization of newly exposed or newly placed clean sediments. Measures to avoid in-water work during the juvenile salmonid and bull trout migration periods, as well as engineering controls, will help minimize adverse short-term effects to salmonids.

Over the long term, removal of highly contaminated sediments is a beneficial aspect of the remedial action and will improve conditions for water and sediment quality over baseline conditions. The level of mitigation/restoration provided for the proposed remedial activities will provide affirmative conservation measures that will contribute to the restoration of salmon in the Puyallup River/Commencement Bay system.

## 6.0 TAKE ANALYSIS

### *6.1 Regulatory Summary*

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct of listed species without a specific permit or exemption (50 CFR 222.102). "Harm" is further defined by the NOAA Fisheries Final Rule to include significant habitat modification or degradation that results in death or injury to a listed species by "significantly impairing essential behavioral patterns such as breeding, spawning, rearing, migrating, feeding, and sheltering" (50 CFR 222.102). "Incidental take" is take of listed animal species that results from, but is not the purpose of, the federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), take that is incidental to, and not intended as part of, the agency action is not considered prohibited take provided that such takes are in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize the effects and sets forth terms and conditions with which the action agency must comply to implement the reasonable and prudent measures.

### *6.2 Extent of Take*

While the in-water dredging, capping, disposal, and habitat construction activities of this action are scheduled to occur during a period of time when few individuals of the listed species are expected to be present, it is anticipated that some low and unquantifiable incidental take of Puget Sound chinook is probable from project activities. While injury or death may unintentionally result during construction activities, substantially more harm is more likely to accrue by the continued long-term exposure of fish to unremediated contamination of the nearshore environment during juvenile rearing and migration.

Incidental take is likely in the form of harm, or habitat modification that kills or injures fish by impairing certain normal behavioral patterns (feeding, rearing, migrating, etc.). Because in-water work is timed to reduce the exposure of listed species to project effects to the fewest individuals possible, and because incidental take is mainly from habitat modification, the precise number of individual fish that might be taken cannot be quantified. In such circumstances, the extent of habitat affected by an action can be a surrogate measure for take.

In this action, the amount of habitat modification proposed can be assigned by the construction activities based on the amount of change or activity in the littoral zone where juvenile chinook salmon can be found, if any are present during the time of the year when the construction occurs. Dredging, capping, shoreline modifications, and habitat enhancements occur over approximately 101 acres of Commencement Bay habitat: 18.6 acres of upland (above +13 feet MLLW), 42.0 acres of subtidal (below –10 feet MLLW) with the remaining 40.8 acres being in the littoral zone between these elevations.

## 7.0 IMPACT MINIMIZATION MEASURES

Federal, state, and local permits contain conditions that are intended to reduce the potential for short-term effects from construction activities. Although the remediation and mitigation of Thea Foss and Wheeler-Osgood Waterways will not result in the need to obtain federal or state permits (CERCLA action are exempt from permitting requirements), the project will comply with the substantive permitting requirements.

### *7.1 Reasonable and Prudent Measures*

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the take of Puget Sound chinook salmon and bull trout. The RPMs are integrated into the BA Addendum for the proposed action. NOAA Fisheries has included them here to provide further detail as to their implementation.

1. Project activities will minimize incidental take during construction by avoiding or minimizing adverse effects of dredging activities on listed salmonids.

2. Project activities will minimize incidental take during construction by avoiding or minimizing adverse effects of capping activities on listed salmonids.

3. Project activities will minimize incidental take during construction by avoiding or minimizing adverse effects of demolition/reconstruction activities on listed salmonids.

4. Project activities will minimize incidental take during construction by avoiding or minimizing adverse effects of habitat development activities on listed salmonids.

### *7.2 Best Management Practices*

Best management practices (BMPs) are employed to reduce the potential for construction-related impacts on listed species and their habitats. The following will be incorporated into the remedial design for the Thea Foss/Wheeler-Osgood Waterways:

### 7.2.1 Dredging Best Management Practices

- The construction contractor will ensure that no fuel, garbage, or debris enters the waterway from the dredge, receiving barge, or other vessels associated with the project.

- Dredging will be conducted to the extent practicable, using an environmental clamshell bucket that is closed, vented, and sealed to minimize the release and redistribution of dredged material to the water column during dredging.

- If mechanical dredging is selected as the alternative for sediment removal, the following procedures will be implemented to minimize impacts to water and sediment quality to the extent practicable. These procedures include the following:

  - "Sweeping" the post-dredge surface to smooth contours will not be allowed; and

  - Stockpiling of material on the bottom will not be allowed (i.e., each time the bucket is closed it will be brought to the surface).

- After each construction season, all construction equipment will be properly decontaminated to prevent potential spreading of contaminated sediment.

- To avoid slope instability and impacts to littoral habitats during dredging, material will be cut downward from the embankment toe at a slope of 2H:1V to the specified dredge depth. This reduces the risk of impacts to the existing slopes and littoral habitats will not occur from dredging activities at the toe of the slope.

### 7.2.2 Sand Cap and Habitat Mix Placement Best Management Practices

- Materials will meet project specifications regarding fines content so as to minimize the potential for elevated turbidity in receiving waters during placement.

- Materials will be uniformly discharged as a stream of material, rather than being abruptly discharged, to provide for uniform bottom coverage and minimize impacts to the receiving surface.

- Short-term impacts to water quality will be minimized during cap placement by placing material in a controlled manner, minimizing the free fall distance of the capping material, and placing material during low tides, whenever possible.

### 7.2.3 Spill Prevention Best Management Practices

- During construction, all prudent and necessary steps will be taken to avoid discharge of oil, fuel, or chemicals into waters or onto land with a potential for entry into waters.

- Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., on construction equipment will be checked regularly for drips or leaks, and will be maintained and stored properly to prevent spills into waters. Proper security will be maintained to prevent vandalism.

- In the event of a discharge of oil, fuel, or chemicals into waters, or onto land with a potential for entry into waters, containment and cleanup efforts will begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup will include proper disposal of any spilled material and used cleanup materials.

- Spills into waters, spills onto land with a potential for entry into waters, or other significant water quality impacts will be reported immediately to the Department of Ecology's Southwest Office.

- The contractor will be responsible for the preparation of a Spill Prevention Control, and Countermeasure Plan to be used for the duration of the project. This ensures that care would be taken to prevent any petroleum products, chemicals, or other toxic or deleterious materials from entering the water.

### 7.2.4 Piling Removal Best Management Practices

- Containment booms will be deployed around in-water piling removal areas to contain any potential debris or petroleum sheens released to the waterway as the result of pile disturbance.

- If debris or spill material accidentally enters the waterway, activities will be taken to remove the material. All debris or spill material will be properly disposed of at an approved disposal facility.

- As the piles are pulled from the subsurface, they will be quickly placed onto a receiving barge to minimize potential releases of creosote, petroleum sheens, and turbidity to the waterway. Pilings will not be rinsed or washed in any way. Piles will be recycled or properly disposed of at an approved upland disposal facility.

- All areas where pilings are broken or cut off, will be subsequently covered with a minimum of 2 feet of cap or riprap with habitat mix.

- Creosote-treated pilings will only be pulled from below the waterline during the August 1 through February 14 work window for the protection of migrating juvenile salmonids.

### 7.2.5 Pile Driving Best Management Practices

- Only steel, ACZA-treated timber, or concrete pilings will be used when piling replacement is necessary.

- A vibratory hammer will be used to set and drive pilings rather than an impact hammer, wherever practicable.

- If an inpact hammer is used, an air bubble curtain will be deployed around the pile during pile driving.

- Pile driving activities will occur from August 1 through February 14. However, based on review of project specific activities, project location, and existing data of juvenile salmonid use in Commencement Bay, work may be permitted from July 16 through July 31 under the conditions that construction activities shall occur no more than 12 hours in any 24-hour period and no more than 5 days in any 7-day period.

## *7.3 Conservation Measures*

The following list summarizes conservation measures that are applied to projects in marine and estuarine waters and have been incorporated into the remedial design for the Thea Foss and Wheeler-Osgood Waterways to avoid and/or minimize short-term effects to listed threatened species during construction activities.

- Dredging activities will be designed to avoid conversion of littoral habitat to subtidal habitat. Proposed remediation and mitigation activities will result in a net gain of littoral habitat compared with existing conditions.

- Dredging, capping, habitat construction, and slope rehabilitation will be performed outside of the peak juvenile salmonid outmigratory periods for the protection of juvenile salmonids and bull trout.

- Compliance with the project's EPA/Ecology Water Certification requirements for chemical constituents, turbidity, DO, and other parameters will limit any adverse impact to water quality to a defined mixing zone.

- Dredging controls will be used to minimize potential water quality impacts.

- Acute marine water quality criteria will be met during dredging at the compliance boundary established by EPA. Nevertheless, even with engineering and compliance monitoring controls, the potential exists for degraded water quality conditions during construction to adversely impact listed salmonid species on a localized, periodic, and temporary basis.

- Compliance Monitoring and Contingency Actions will be performed during dredging activities in accordance with the forthcoming EPA/Ecology Water Certification.

- Design production rates will be reduced to the extent practicable to limit exceedances of acute marine water quality criteria to within the established mixing zone.

- Dredge timing will be modified to the extent practicable to limit exceedances of acute marine water quality to within the established mixing zone.

- During mechanical placement of fill material within the CDF, the containment berm will be at an elevation of –4 feet MLLW or shallower to provide a sill to aid in the retention of material deposited within the CDF. For hydraulic placement of fill material, the containment berm will completely enclose the CDF; effluent waters will be release through a weir system.

- Relevant marine water quality criteria will be met during disposal/placement operations at the boundary of the established mixing zones.

- The level of mitigation/restoration provided under the sediment disposal option will provide affirmative conservation measures that will result in a net improvement of salmon habitat conditions and contribute to the restoration of salmon populations in the Puyallup River/Commencement Bay system.

- The addition of select substrates (e.g., habitat mix) as part of littoral capping will assist in providing suitable habitat for prey items of juvenile salmonids within the interstices of riprap armoring.

- The Contractor will be required to submit an environmental protection plan which will contain sections for contamination prevention, closure, and cleanup, and erosion and turbidity control as they pertain to the different project elements. This plan will be subject to approval by the EPA.

- The Contractor will prepare a Construction Quality Control Plan, which will present the system through which the Contractor assures that the requirements of the contract are being complied with. This plan will be subject to approval by the EPA.

- A work plan will be prepared by the Contractor and submitted to the City and the EPA for review and approval prior to the start of construction.

- If dredging and or other construction operations are not in compliance with the above-mentioned provisions of the work plan, or they result in conditions causing distressed or dying fish, the operator will immediately take the following activities:

  - Cease operations at the location of the incident.

  - Assess the cause of the water quality problem and take appropriate measures to correct the problem and/or prevent further environmental damage.

  - In the event of finding distressed or dying fish, the operator will collect fish specimens and water samples in the affected area and, within the first hour of such conditions, make every effort to have the water samples analyzed for DO and total sulfides.

  - Notify EPA, and other agencies as appropriate, of the nature of the problem, any activities taken to correct the problem, and any proposed changes in operations to prevent further problems.

## 8.0 EFFECTS DETERMINATION

NOAA Fisheries/USFWS guidelines for the preparation of biological assessments state that a conclusion of "may affect, but is not likely to adversely affect" is the

"...appropriate conclusion when the effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects have contemporaneous positive effects without any adverse effects...." Insignificant effects, in the NOAA Fisheries/USFWS definition, "...relate to the size of the impacts and should never reach the size where take occurs...[One would not expect to]...be able to meaningfully measure, detect, or evaluate insignificant effects." This BA addendum leads to the following conclusions regarding the potential effects of proposed remediation and mitigation activities on chinook salmon, bull trout, and bald eagle.

The proposed action **may affect, and is likely to adversely affect**, juvenile chinook salmon. The proposed action will result in no permanent adverse modification or destruction of designated chinook salmon critical habitat.

The proposed action **may affect, but is not likely to adversely affect**, juvenile and adult bull trout. The proposed action will result in no permanent adverse modification or destruction of designated bull trout critical habitat.

The proposed action **may affect, but is not likely to adversely affect**, bald eagle. The proposed action will result in no permanent adverse modification or destruction of designated bald eagle critical habitat.

## 9.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

### *9.1 Background*

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));

- NOAA Fisheries must provide conservation recommendations for any federal or state action that would adversely affect EFH (§305(b)(4)(A));

- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations.

> The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). "Adverse effect" means any impact that reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific or habitat-wide effects, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by federal agencies regarding any activity that may adversely affect EFH, regardless of its location.

The objective of this EFH consultation is to determine whether the proposed action may adversely affect designated EFH, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

## *9.2 Identification of Essential Fish Habitat*

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for federally managed fisheries within the waters of Washington, Oregon, and California. The designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, seaward to the boundary of the United States exclusive economic zone (370.4 km) (PFMC 1998a and 1998b). Freshwater EFH for Pacific salmon includes those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years) (PFMC 1999). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (Casillas et al. 1998; PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific salmon (PFMC 1999). Assessment of the effects to these species' EFH from the proposed activities is based on these descriptions and information provided by EPA.

### *9.3 Proposed Activities*

The proposed activities and action area are detailed above in Section 2 of this document. The action area includes habitats that have been designated as EFH for various life history stages of 46 species of groundfish, four coastal pelagic species, and three species of Pacific salmon (Table 4).

### *9.4 Effects of Proposed Activities*

As described in detail in Section 5.0 of this document, the proposed action may result in detrimental short-term effects to a variety of habitat parameters. These adverse effects are:

- Short-term degradation of benthic foraging habitat during dredging and capping activities.

- Short-term degradation of water quality (e.g., elevated turbidity or the accidental release of contaminants including petroleum products, chemicals, or deleterious materials) because of in-water construction activities (sediment dredging, capping, disposal, shore rehabilitation, and mitigation construction).

- Temporal delays during replacement of functioning subtidal habitat by enhanced intertidal habitats as part of habitat development

- Short-term production of high sound pressure levels during the impact driving of hollow steel piles that may injure or kill fish.

### 9.5 Conclusion

The proposed action may have a short-term adverse impact on EFH for the groundfish, coastal pelagic, and Pacific salmon species listed in Table 4. These short-term impacts will be minimized with the implementation of RPMs, conservation measures, and BMPs presented in Section 7.0. Long-term effects on EFH are expected to be positive because of the removal or isolation of contaminated sediment and the affirmative conservation measures included in the project mitigation/restoration activities.

## 10.0 REFERENCES

Bisson, P.A., and R.E. Bilby 1982. Avoidance of Suspended Sediment by Juvenile Coho Salmon. North American Journal of Fisheries Management, 4:371-374.

Bottorff, J., J. Schafer, D. Swanson, A. Elston, and D. Anderson 1987. Noise Disturbance Study on Bald Eagles at Orcas and Shaw Island Ferry Terminals, San Juan County, Washington. Washington State Department of Transportation, Olympia.

Brown, L. 1992. The Zoogeography and Life History of Washington Native Char. Washington Department of Fish and Wildlife, Report 94-04, Olympia.

Casillas, E., L. Crockett, Y. deReynier, J. Glock, M. Helvey, B. Meyer, C. Schmitt, M. Yoklavich, A. Bailey, B. Chao, B. Johnson, and T. Pepperell 1998. Essential Fish Habitat West Coast Groundfish Appendix. National Marine Fisheries Service. Seattle, Washington.

City of Tacoma 1999. Final Round 3 Data Evaluation and Pre-Design Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington, September 30, 1999.

Corps (U.S. Army Corps of Engineers), U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration 1993. Commencement Bay Cumulative Impact Study, Vol. 1, Assessment of Impacts. Corps Seattle District, Washington.

Cyrus, D.P., and S.J.M. Blaber 1987a. The Influence of Turbidity on Juvenile Marine Fishes in Estuaries. Part 1: Field Studies at Lake St. Lucia on the Southeastern Coast of Africa. Journal of Experimental Marine Biology and Ecology, 109:53-70.

Cyrus, D.P., and S.J.M. Blaber 1987b. The Influence of Turbidity on Juvenile Marine Fishes in Estuaries. Part 2: Laboratory Studies, Comparisons with Field Data and Conclusions. Journal of Experimental Marine Biology and Ecology, 109:71-91.

Dames & Moore 1981. Commencement Bay Study. Volume I, Summary and Synthesis; Volume II, Land and Water Use; Volume III, Fish Wetlands; Volume IV, Invertebrates; Volume V, Water Quality; Volume VI, Physical Oceanography; Volume VII, Sediments, Noise, Climate, and Air Quality, Aesthetics, Birds. Prepared for U.S. Army Corps of Engineers, Seattle District, Washington.

Duker, G., C. Whitmus, E.O. Salo, G.B. Grette, and W.M. Schuh 1989. Distribution of Juvenile Salmonids in Commencement Bay, 1983. Final Report to Port of Tacoma, Washington. Fisheries Research Institute, FRI-UW-8908, School of Fisheries, University of Washington, Seattle.

EPA 2000a. Biological Assessment, Commencement Bay Nearshore/Tideflats Superfund Site. Prepared by URS Greiner, Seattle, Washington, for the EPA, Region 10, Seattle, Washington.

EPA 2000b. Explanation of Significant Differences, Commencement Bay Nearshore/Tideflats Superfund Site. U.S. EPA Region 10. August 3, 2000.

Floyd & Snider and Pentec (Floyd & Snider Inc. and Pentec Environmental, Inc.) 1997. Review of the Significance of Log Handling and Wood Debris in the Marine Environment. Prepared for the Hylebos Waterway Wood Debris Group: Louisiana-Pacific Corporation, Portland, Oregon; Manke Lumber Company, Tacoma, Washington; and Weyerhaeuser Company, Tacoma, Washington.

Graeber, W.H. 1999. Draft Puyallup River Delta Estuary Landscape Restoration Plan, an Estuary Wide Ecological Assessment and Decision Making Framework for Long-Term Ecosystem Restoration and Protection within the Context of an Emerging Salmon Recovery Regime. Washington Department of Natural Resources, Olympia.

Healey, M.C. 1991. Life History of Chinook Salmon *(Onchorhychus tshawytscha)*. Pages 311-393 in C. Grant and L. Margolis, editors. Pacific Salmon Life Histories. University of British Columbia Press, Vancouver, BC.

Jones & Stokes Associates, Inc. 1988. Final Report: Results of Preliminary Studies Used to Examine Two Candidate Mitigation Sites at the Port of Tacoma. Submitted to Port of Tacoma, Washington, by Jones & Stokes Associates, Inc, Bellevue, Washington.

Jones & Stokes Associates, Inc. 1991a. Post-project Monitoring at Slip 5 Mitigation Area, 1988 and 1989. Submitted to Port of Tacoma, Washington, by Jones & Stokes Associates, Inc., Bellevue, Washington.

Jones & Stokes Associates, Inc. 1991b. Post-project Monitoring at Slip 5 Mitigation Area, 1990. Prepared for the Port of Tacoma, Washington. Jones & Stokes Associates, Inc., Bellevue, Washington.

Jones & Stokes Associates, Inc. 1992. Post-project Monitoring at Slip 5 Mitigation Area, 1991. Draft Report. Prepared for Port of Tacoma, Washington.

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

Kraemer, C. 1999. Bull Trout in the Snohomish River System. Washington Department of Fish and Wildlife, Mill Creek, Washington.

Kyte, M.A., and J.P. Houghton 1994. Results of La Conner Marina Maintenance Dredging Fish Monitoring, 1993-1994 Final Report. Prepared for the Port of Skagit County by Pentec, Edmonds, Washington.

Leary, R.F., and F.W. Allendorf 1997. Genetic Confirmation of Sympatric Bull Trout and Dolly Varden in Western Washington. Transactions of the American Fisheries Society 126:715-720.

Levings, C.D. 1982. Short-Term Use of a Low Tide Refuge in a Sandflat by Juvenile Chinook, (*Onchorhynchus tshawytscha*), Fraser River Estuary. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1111, Department of Fisheries and Oceans, Fisheries Research Branch, West Vancouver, British Columbia.

Levy, D.A., and T.G. Northcote 1982. Juvenile Salmon Residency in a Marsh Area of the Fraser River Estuary. Canadian Journal of Fisheries and Aquatic Science, 39:270-276.

Lichatowich, J., and S. Cramer 1979. Parameter Selection and Sample Sizes in Studies of Anadromous Salmonids. Oregon Fish and Wildlife, Information Report. Series 80-1, Portland.

McCauley, J.F., R.A. Parr, and D.R. Hancock 1977. Benthic Infauna and Maintenance Dredging—A Case Study. Pergamon Press, Water Research II:233-242.

MEC Analytical 1997. An Investigation into the Turbidity Plume Associated with Dredge Activities in the Port of Oakland Estuary. Prepared for the Port of Oakland.

Miyamoto, J. Sr., T. Deming, and D. Thayer 1980. Estuarine Residency and Habitat Utilization by Juvenile Anadromous Salmonids within Commencement Bay, Tacoma, Washington. Technical Report 80-1, Puyallup Tribal Fisheries Division, Fisheries Management Division, Puyallup, Washington.

Mobrand Biometrics 2001. Pierce County Watershed Analysis. Tacoma, Washington.

Muckleshoot Indian Tribe, Puyallup Tribe of Indians, and Washington Department of Fish and Wildlife 1996. Recovery Plan for White River Spring Chinook Salmon. Washington Department of Fish and Wildlife, Olympia.

Nightingale, B., and C. Simenstad 2001. Dredging Activities: Marine Issues. White Paper. Submitted to the Washington Department of Fish and Wildlife, Washington State Department of Ecology, and the Washington State Department of Transportation.

NOAA Fisheries 1998a. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. NOAA Tech. Memo NOAA Fisheries-NWFSC-35.

NOAA Fisheries 1998b. Updated Factors for Decline: A Supplement to the Notice of Determination for West Coast Chinook under the Endangered Species Act. NOAA Fisheries Protected Resources Division. Portland, Oregon.

NOAA Fisheries 2001. Biological Opinion for the Port of Tacoma Maersk Sealand Project (WSB-00-481).

NOAA Fisheries 2003. Biological Opinion for the Hood Canal Bridge Retrofilt and Replacement Project; Kitsap, Jefferson, Clallam Counties. Northwest Region. Lacey WA. NOAA Fisheries Tracking No. 2002/00546.

Palermo, M., S. Maynord, J. Miller, and D. Reible 1998. Guidance for in-situ Subaqueous Capping of Contaminated Sediments. U.S. Environmental Protection Agency, Great Lakes National Program Office, EPA 905-B96-004, Chicago, Illinois.

Parametrix, Inc. 1996. Sitcum Waterway Remediation Project: Milwaukee Habitat Area Monitoring Report, 1995. Prepared for the Port of Tacoma, Washington, by Parametrix, Inc., Seattle, Washington.

Parametrix, Inc. 1999. Tenth Annual Monitoring Report for the St. Paul Waterway Area Sediment Remedial Action and Habitat Restoration Project. October 1999.

Parametrix, Inc. 2000. Habitat Plan and Design Report St. Paul Waterway Nearshore Facility. Final Appendix Z of Final Thea Foss Round 3 Data Evaluation and Pre-Remedial Design Evaluation. Prepared for the City of Tacoma, Simpson Tacoma Land Company, and the USEPA.

Pentec 2002. Bull Trout Monitoring in the Snohomish River During Periods of Hydraulic Dredging. Prepared for the U.S. Corps of Engineers, Seattle, Washington, by Pentec, Edmonds, Washington.

Pentec 2003a. In Preparation. Juvenile Salmon Monitoring in Commencement Bay 2002 Data Report. Prepared for the City of Tacoma.

PFMC (Pacific Fishery Management Council) 1998a. Final Environmental Assessment/Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan.

PFMC 1998b. The Coastal Pelagic Species Fishery Management Plan: Amendment 8, Portland, Oregon.

PFMC 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

PIE 1999. Puyallup Tribe of Indians Beach Seine Data Summary, 1980-1995. Prepared for the Port of Tacoma and Puyallup Tribe of Indians by Pacific International Engineering, Wenatchee, Washington.

PIE 2000. Sitcum Waterway Remediation Project Milwaukee Habitat Area Juvenile Salmon Habitat Utilization Study, 1999. Prepared for Port of Tacoma, Tacoma, Washington.

PIE 2001. Pierce County Terminal Expansion Project Biological Assessment. Prepared for the Port of Tacoma. Tacoma, Washington.

PIE and Parametrix 1998. Sitcum Waterway Remediation Project: Milwaukee Habitat Area Monitoring Report, 1996. Prepared for the Port of Tacoma, Washington

Port of Tacoma and Puyallup Tribe of Indians 1999. Commencement Bay Juvenile Salmonid Sampling, 1980-1995. Data compilation by Pacific International Engineering for the Port of Tacoma, Tacoma, Washington.

Puyallup Tribe of Indians 2002. Letter to William Rucklshaus, Puget Sound Salmon Forum Development Committee on Chinook Recovery Target Numbers for Use in Step 3 of the Shared Strategy. March 14, 2002.

Ratte, L.D., and E.O. Salo 1985. Under-Pier Ecology of Juvenile Pacific Salmonids (*Onchorynchus* spp.) in Commencement Bay, Washington. Final Report to the Port of Tacoma. Fisheries Research Institute, University of Washington, Seattle.

Richardson, M.D., A.G. Carey, Jr., and W.A. Colgate 1977. Aquatic Disposal Field Investigations Columbia River Site, Oregon. Appendix C: The Effects of Dredged Material Disposal on Benthic Assemblages. U.S. Army Corp of Engineers Waterways Experiment Station, Dredged Material Research Program Technical Report D-77-30, Vicksburg, Mississippi.

Rodrick, E. and R. Milner, technical editors 1991. Management Recommendations for Washington's Priority Habitats and Species. Washington State Department of Wildlife, Olympia, Washington.

Romberg, P., C. Homan, and D. Wilson 1995. Monitoring at Two Sediment Caps in Elliott Bay. Pages 289-299 *in* Puget Sound Research '95: proceedings. Puget Sound Water Quality Authority, Olympia, Washington.

Servizi, J.A. 1988. Sublethal Effects of Dredged Sediments on Juvenile Salmon. Pages 57-63 *in* C.A. Simenstad, editor. Effects of Dredging on Anadromous Pacific Coast Fishes. University of Washington Press, Seattle.

Sherwood, C.R., D.A. Jay, R.B. Harvey, P. Hamilton, and C.A. Simenstad 1990. Historical Changes in the Columbia River Estuary. Prog. Oceanog. 25: 299-357.

Shreffler, D.K., C.A. Simenstad, and R.M. Thom 1992. Foraging by Juvenile Salmon in a Restored Estuarine Wetland. Estuaries, 15(2):204-213.

Simenstad, C.A., K.L. Fresh, and E.O. Salo 1982. The Role of Puget Sound and Washington Coastal Estuaries in the Life History of Pacific Salmon: An Unappreciated Function. Pages 343-364 *in* V.S. Kennedy, editor. Estuarine Comparisons. Academic Press, New York.

Simenstad, C.A. 2000. Commencement Bay Aquatic Ecosystem Assessment: Ecosystem-Scale Restoration for Juvenile Salmon Recovery. Published for: City of Tacoma, Washington Department of Natural Resources, and U.S. Environmental Protection Agency.

Simenstad, C.A., H.B. Anderson, J.R. Cordell, and L. Hallum 1993. Analysis of Changes in Benthic and Epibenthic Invertebrate Communities in Commencement Bay, Washington. Report to U.S. Army Corps of Engineers, Seattle, Washington.

Simenstad, C.A., J.R. Cordell, D.M. Milward, and E.O. Salo 1985. Diet Composition of Juvenile Salmon *(Oncorhynchus* spp.) *In* An Urbanized Estuary: Results of Three Years' Studies in Commencement Bay, Puget Sound, Washington, 1983-1985.

Slotta, L.S., D.A. Bella, D.R. Hancock, J.E. McCauley, C.K. Sollitt, J.M. Stander, and K.J. Williamson. 1974. An Examination of Some Physical and Biological Impacts of Dredging in Estuaries. Oregon State University, Corvallis OR.

Smith, J.M., J.D. Phipps, E.D. Schermer, and D.F. Samuelson 1976. Impact of Dredging on Water Quality in Grays Harbor, Washington. Pp. 512-528. *In* P.A. Krenkel, J. Harrison, and J.C. Burdick III (eds.). Proceedings Special Conference on Dredging and Environmental Effects, American Society of Civil Engineers.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, R.P. Novitzki 1996. An Ecosystem Approach to Salmonid Conservation. Prepared for National Marine Fisheries Service.

Suckley, G. and J.G. Cooper 1860. The Natural History of Washington Territory and Oregon. Bailliere Brothers, New York.

Tetra Tech, Inc. 1996. Ocean Discharge Criteria Evaluation (ODCE) of the NPDES General Permit for Log Transfer Facilities. TC B216-06, final Draft Report. Prepared by Tetra Tech, Inc., Redmond, Washington, for U.S. Environmental Protection Agency, Seattle, Washington.

USFWS and NOAA (National Oceanic and Atmospheric Administration) 1996. Commencement Bay Draft Restoration Plan and Programmatic Environmental Impact Study. Olympia, Washington.

USFWS and NOAA 1997. Commencement Bay Natural Resource Damage Assessment: Restoration Plan and Final Programmatic Environmental Impact Statement.

USFWS (U.S. Fish and Wildlife Service) 1986. Pacific Bald Eagle Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS 1998. Bull Trout Facts *(Salvelinus confluentus)*. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS 2001. Biological Opinion for the Port of Tacoma Maersk Sealand Project.

WDFW (Washington Department of Fish and Wildlife) and WWTIT (Western Washington Treaty Indian Tribes) 1994. Washington State Salmon and Steelhead Stock Inventory, Appendix One. 1992. Puget Sound Stocks, South Puget Sound Volume. WDFW and WWTIT, Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife) 1998. Washington State Salmonid Stock Inventory. Bull Trout/Dolly Varden. WDFW, Olympia.

WDFW 2000. Bull Trout and Dolly Varden Management Plan. WDFW, Olympia.

Weiner, K.S. 1991. Commencement Bay Nearshore Tideflats Superfund Completion Report for St. Paul Waterway Sediment Remedial Action. Prepared for the U.S. EPA, Simpson Tacoma Kraft, and Champion International Corporation.

Whitman, R.P., T.P. Quinn, and E.L. Brannon 1982. Influence of Suspended Volcanic Ash on Homing Behavior of Adult Chinook Salmon. Transactions of the American Fisheries Society, 111:63-69.

Wilson, D., and P. Romberg 1995. Elliott Bay/Duwamish Restoration Program: Pier 52-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project, 1993 Data. Prepared for the Elliott Bay/Duwamish Restoration Program Panel by the King County Department of Metropolitan Services, Seattle, Washington.

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# TABLES

## Table 1 - Remedial Actions Within Thea Foss/Wheeler-Osgood Waterways

| Remediation Area (RA) | Superfund Sediment Management Area (SSMA) | Surface Area in Square Feet below 11.8 Feet (MLLW) | Remedial Action |
|---|---|---|---|
| 1A/1B* | 1e1, 1e2 | 74,240 | 3-ft cap |
| 2 | 2b5 | 44,782 | Dredge 4 ft, backfill |
| 3* | 2a2 | 30,625 | 3-ft cap |
| 4 | 2b4 | 20,700 | Dredge 4 ft, backfill |
| 5 | 3b1,3b2,3b4,5b1 | 165,977 | Dredge to –28 ft MLLW |
| 6 | 3b3,3b5a,3b5b,5b2a,5b2b,5b3a,5b3b,5b4 | 587,395 | Dredge to –31 ft MLLW |
| 7/7A | 3c1 | 139,314 | 0.5-ft cap (partial dredge to support SSMA 3b3) |
| 8 | 3c2,3d,5c | 71,763 | 3-ft cap (partial dredge to support RA6) |
| 9 | 4c | 50,000 | Dredge to –8 ft MLLW, backfill |
| 10/11 | 4d2 | 62,484 | Partial dredge to support RA5 |
| 12 | 4a | 34,693 | Dredge 2 ft |
| 13 | 4d1 | 17,801 | Natural recovery |
| 14 | 5a1,5a2 | 42,638 | 3-ft cap (partial dredge to support RA5) |
| 15 | 6a1 | 32,107 | Natural recovery |
| 16 | 6a2,6b3 | 140,472 | Dredge to –17 ft MLLW |
| 17 | 6b1 | 136,447 | Dredge to –23 ft MLLW |
| 18 | 6b2 | 59,646 | Dredge to –24 ft MLLW; 3-ft cap |
| 19A | 6b4,6b5,7c,7d1 | 225,744 | Dredge to –13 ft MLLW; cap to –10 ft MLLW |
| 19B | 7c,7d1,7d2 | 26,460 | Dredge to –13 ft MLLW; cap to –10 ft MLLW |
| 20 | 7a,7b1 | 123,390 | Dredge to –13 ft MLLW; cap to –10 ft MLLW |
| 21 | 7b2 | 73,063 | Dredge to –24 ft MLLW; cap to –21ft MLLW |
| 22 | 7b3a | 22,500 | Dredge to –24 ft MLLW; cap to –21 ft MLLW |
| Total Dredge-Only Area: 1,127,498 (25.9 acres)<br>Total Cap-Only Area: 104,865 (2.4 acres)<br>Total Cap and Dredge Area: 900,000 (20.7 acres) | | | |

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*Remediation Area construction completed by the City of Tacoma as part of the 2002 Construction Project.

**Table 2 – Acreage Calculations for the Thea Foss and Wheeler-Osgood Waterways Remediation Project (11-4-03)**

| | Elevation Increment in feet (MLLW) | | | | | | | | | | | | | | | | | | | | | | | | Riparian Acreage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Above OHW (+13)** | | | **OHW to +10** | | | **+10 to +4** | | | **+4 to –4** | | | **–4 to –10** | | | **Littoral (OHW to –10)** | | | **Subtidal (Below –10)** | | | **Total Aquatic Habitat** | | | |
| | Before | After | Change | Before | After | Change | Before | After | Change | Before | After | Change | Before | After | Change | Before | After | Change | Before | After | Change | Before | After | Change | |
| Thea Foss Wwy | 1.19 | 1.40 | 0.21 | 1.40 | 1.56 | 0.16 | 3.26 | 3.54 | 0.29 | 10.20 | 10.65 | 0.45 | 5.72 | 7.16 | 1.43 | 20.58 | 22.91 | 2.33 | 40.23 | 37.68 | (2.55) | 60.81 | 60.59 | (0.22) | |
| St. Paul Wwy | 2.35 | 14.13 | 11.78 | 1.10 | - | (1.10) | 2.25 | - | (2.25) | 5.09 | - | (5.09) | 3.23 | - | (3.23) | 11.68 | - | (11.68) | 0.10 | - | (0.10) | 11.78 | - | (11.78) | |
| Puyallup River SC | 8.14 | 2.83 | (5.31) | 0.03 | 1.24 | 1.21 | 0.05 | 2.34 | 2.29 | - | 1.81 | 1.81 | - | - | - | 0.08 | 5.39 | 5.31 | - | - | - | 0.08 | 5.39 | 5.31 | 0.44 |
| North Beach | 0.23 | 0.12 | (0.10) | 0.10 | 0.96 | 0.86 | 0.55 | 2.15 | 1.61 | 3.67 | 3.40 | (0.27) | 0.62 | 0.07 | (0.54) | 4.94 | 6.59 | 1.66 | 1.65 | 0.10 | (1.55) | 6.58 | 6.69 | 0.10 | 0.30 |
| Middle Corridor | - | - | - | 0.04 | - | (0.04) | 0.15 | 0.08 | (0.07) | 0.35 | 0.46 | 0.11 | 0.13 | 0.13 | - | 0.67 | 0.67 | - | - | - | - | 0.67 | 0.67 | - | |
| Middle Wwy Tideflat | 6.68 | 0.68 | (6.00) | 0.53 | 2.19 | 1.66 | 1.97 | 2.95 | 0.98 | 0.34 | 3.70 | 3.36 | - | - | - | 2.84 | 8.84 | 6.00 | - | - | - | 2.84 | 8.84 | 6.00 | 0.55 |
| **All Habitats** | **18.59** | **19.16** | **0.57** | **3.20** | **5.95** | **2.75** | **8.23** | **11.07** | **2.85** | **19.65** | **20.01** | **0.36** | **9.70** | **7.36** | **(2.34)** | **40.78** | **44.41** | **3.62** | **41.98** | **37.78** | **(4.20)** | **82.76** | **82.18** | **(0.58)** | **1.29** |

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1. For the Puyallup River Side Channel, the existing wetland acreage below elevation +13 feet (OHW), is not considered to be "habitat" in the pre-construction condition since it is not fish-accessible. Only the area adjacent to the levee breach is considered aquatic habitat for the pre-construction condition.
2. For the St. Paul CDF, the swale between the off-set berm and the clarifiers will be below +13 feet following construction, however, since this area is not fish-accessible, it is not included in the acreage calculations.
3. Acreage calculations for the riparian planting areas along the Thea Foss Waterway are not included in this table.
4. Acreage calculations in this table are not related to habitat function.

## Table 3 - Summary of Effects to Salmonids Based on Indicators of Habitat Quality

| Indicator | Effects | | | |
|---|---|---|---|---|
| | Restore | Maintain | Degrade Short-Term | Degrade Long-Term |
| Water Quality | | | | |
| Turbidity | | X | | |
| DO | | X | | |
| Water Quality | X | | X | |
| Sediment Quality | X | | | |
| Estuarine Habitat Quality | | | | |
| Area, Diversity, Accessibility | | X | | |
| Salt/Freshwater Mixing | | X | | |
| Current Patterns | | X | | |
| Shoreline Armoring | | X | | |
| Biological Habitat Quality | | | | |
| Benthic Prey | X | | X | |
| Forage Fish | | X | | |

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## Table 4 – Species of Fish with Designated EFH in Puget Sound

| | | |
|---|---|---|
| **Groundfish Species** | redstripe rockfish *S. proriger* | Dover sole *Microstomus pacificus* |
| spiny dogfish *Squalus acanthias* | rosethorn rockfish *S. helvomaculatus* | English sole *Parophrys vetulus* |
| big skate *Raja binoculata* | rosy rockfish *S. rosaceus* | flathead sole *Hippoglossoides elassodon* |
| California skate *Raja inornata* | rougheye rockfish *S. aleutianus* | petrale sole *Eopsetta jordani* |
| longnose skate *Raja rhina* | sharpchin rockfish *S. zacentrus* | rex sole *Glyptocephalus zachirus* |
| ratfish *Hydrolagus colliei* | splitnose rockfish *S. diploproa* | rock sole *Lepidopsetta bilineata* |
| Pacific cod *Gadus macrocephalus* | striptail rockfish *S. saxicola* | sand sole *Psettichthys melanostictus* |
| Pacific whiting (hake) *Merluccius productus* | tiger rockfish *S. nigrocinctus* | starry flounder *Platichthys stellatus* |
| black rockfish *Sebastes melanops* | vermilion rockfish *S. miniatus* | arrowtooth flounder *Atheresthes stomias* |
| bocaccio *S. paucispinis* | yelloweye rockfish *S. ruberrimus* | |
| brown rockfish *S. auriculatus* | yellowtail rockfish *S. flavidus* | **Coastal Pelagic Species** |
| canary rockfish *S. pinniger* | shortspine thornyhead *Sebastolobus alascanus* | anchovy *Engraulis mordax* |
| China rockfish *S. nebulosus* | cabezon *Scorpaenichthys marmoratus* | Pacific sardine *Sardinops sagax* |
| copper rockfish *S. caurinus* | lingcod *Ophiodon elongatus* | Pacific mackerel *Scomber japonicus* |
| darkblotch rockfish *S. crameri* | kelp greenling *Hexagrammos decagrammus* | market squid Loligo opalescens |
| greenstriped rockfish *S. elongatus* | sablefish *Anoplopoma fimbria* | **Pacific Salmon Species** |
| Pacific ocean perch *S. alutus* | Pacific sanddab *Citharichthys sordidus* | chinook salmon *Oncorhychus tshawytscha* |
| quillback rockfish *S. maliger* | butter sole *Isopsetta isolepis* | coho salmon *O. kisutch* |
| redbanded rockfish *S. babcocki* | curlfin sole *Pleuronichthys decurrens* | Puget Sound pink salmon *O. gorbuscha* |

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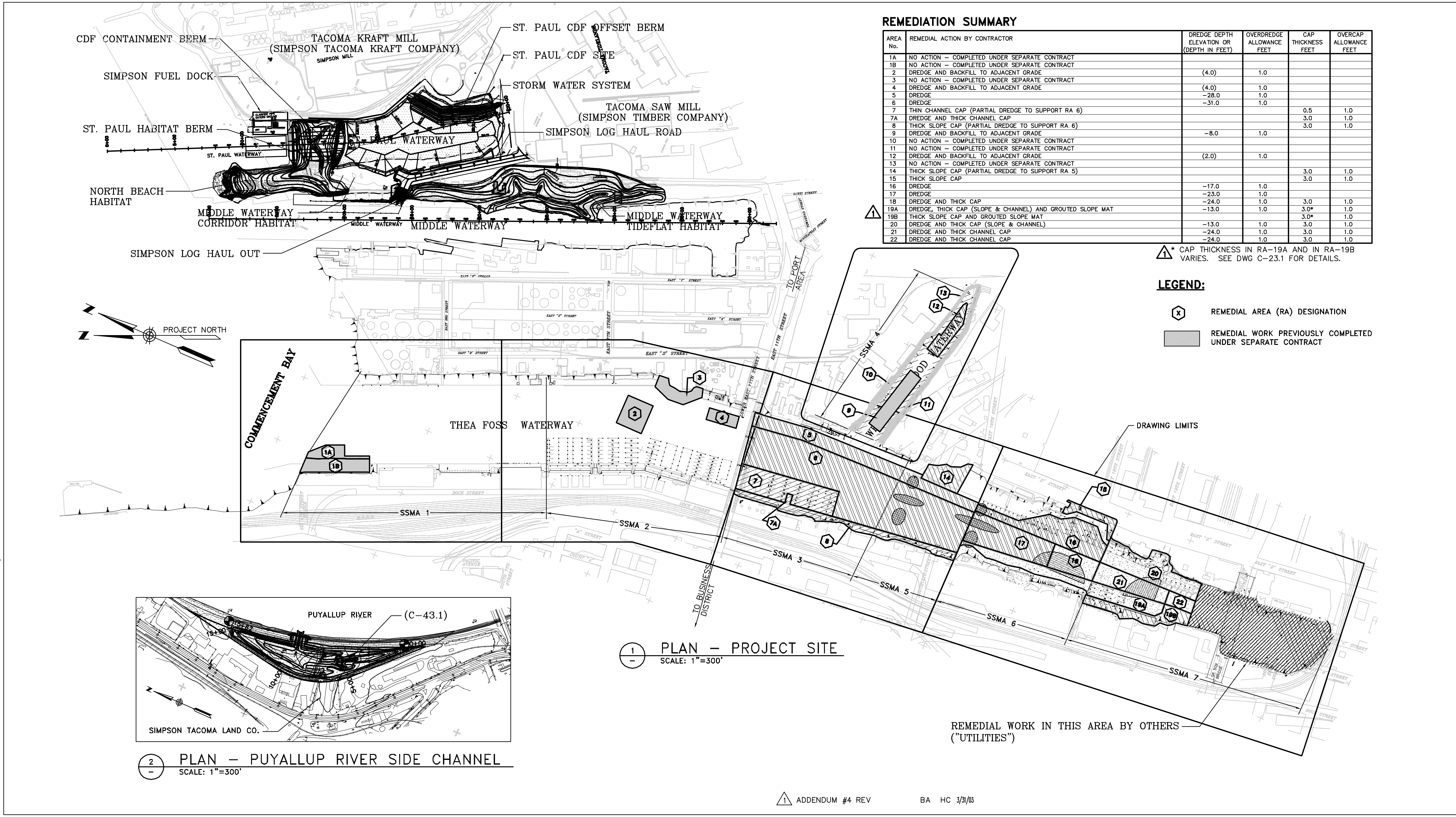
# FIGURES

## *Project Site Plan*




**REMEDIATION SUMMARY**

| AREA No. | REMEDIAL ACTION BY CONTRACTOR | DREDGE DEPTH ELEVATION OR (DEPTH IN FEET) | OVERDREDGE ALLOWANCE FEET | CAP THICKNESS FEET | OVERCAP ALLOWANCE FEET |
|---|---|---|---|---|---|
| 1A | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 1B | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 2 | DREDGE AND BACKFILL TO ADJACENT GRADE | (4.0) | 1.0 | | |
| 3 | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 4 | DREDGE AND BACKFILL TO ADJACENT GRADE | (4.0) | 1.0 | | |
| 5 | DREDGE | −28.0 | 1.0 | | |
| 6 | DREDGE | −31.0 | 1.0 | | |
| 7 | THIN CHANNEL CAP (PARTIAL DREDGE TO SUPPORT RA 6) | | | 0.5 | 1.0 |
| 7A | DREDGE AND THICK CHANNEL CAP | | | 3.0 | 1.0 |
| 8 | THICK SLOPE CAP (PARTIAL DREDGE TO SUPPORT RA 6) | | | 3.0 | 1.0 |
| 9 | DREDGE AND BACKFILL TO ADJACENT GRADE | −8.0 | 1.0 | | |
| 10 | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 11 | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 12 | DREDGE AND BACKFILL TO ADJACENT GRADE | (2.0) | 1.0 | | |
| 13 | NO ACTION – COMPLETED UNDER SEPARATE CONTRACT | | | | |
| 14 | THICK SLOPE CAP (PARTIAL DREDGE TO SUPPORT RA 5) | | | 3.0 | 1.0 |
| 15 | THICK SLOPE CAP | | | 3.0 | 1.0 |
| 16 | DREDGE | −17.0 | 1.0 | | |
| 17 | DREDGE | −23.0 | 1.0 | | |
| 18 | DREDGE AND THICK CAP | −24.0 | 1.0 | 3.0 | 1.0 |
| 19A | DREDGE, THICK CAP (SLOPE & CHANNEL) AND GROUTED SLOPE MAT | −13.0 | 1.0 | 3.0* | 1.0 |
| 19B | THICK SLOPE CAP AND GROUTED SLOPE MAT | | | 3.0* | 1.0 |
| 20 | DREDGE AND THICK CAP (SLOPE & CHANNEL) | −13.0 | 1.0 | 3.0 | 1.0 |
| 21 | DREDGE AND THICK CHANNEL CAP | −24.0 | 1.0 | 3.0 | 1.0 |
| 22 | DREDGE AND THICK CHANNEL CAP | −24.0 | 1.0 | 3.0 | 1.0 |

(1) * CAP THICKNESS IN RA-19A AND IN RA-19B VARIES. SEE DWG C-23.1 FOR DETAILS.

xrefs/see drawing

CAS 12/07/03 785300073.DWG

0 700 1400
Scale in Feet

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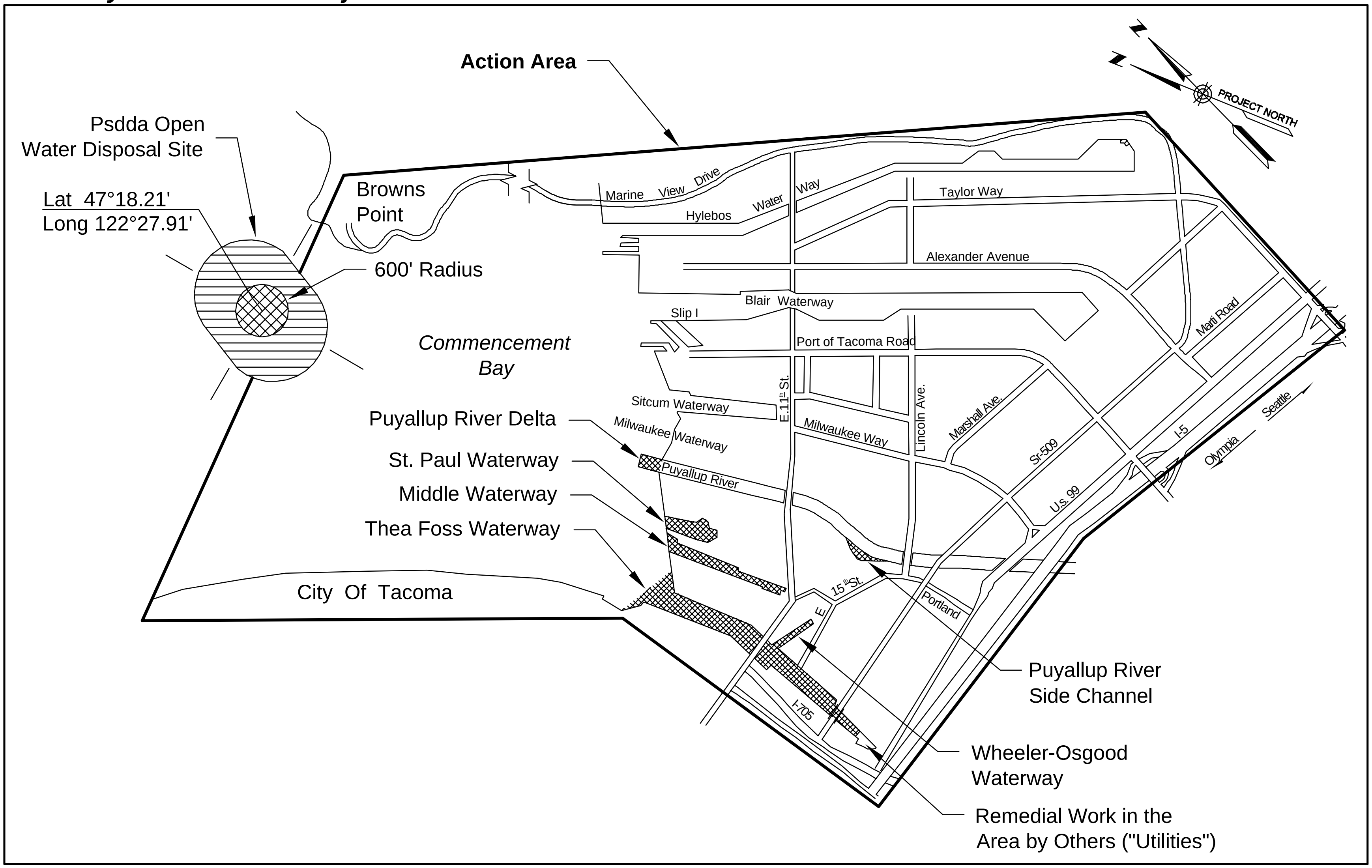
*7853-00* *12/03*

*Figure 1*

## *Vicinity Map*
## *Thea Foss and Wheeler-Osgood Waterways Remediation Project*




Not to Scale

Project Sites

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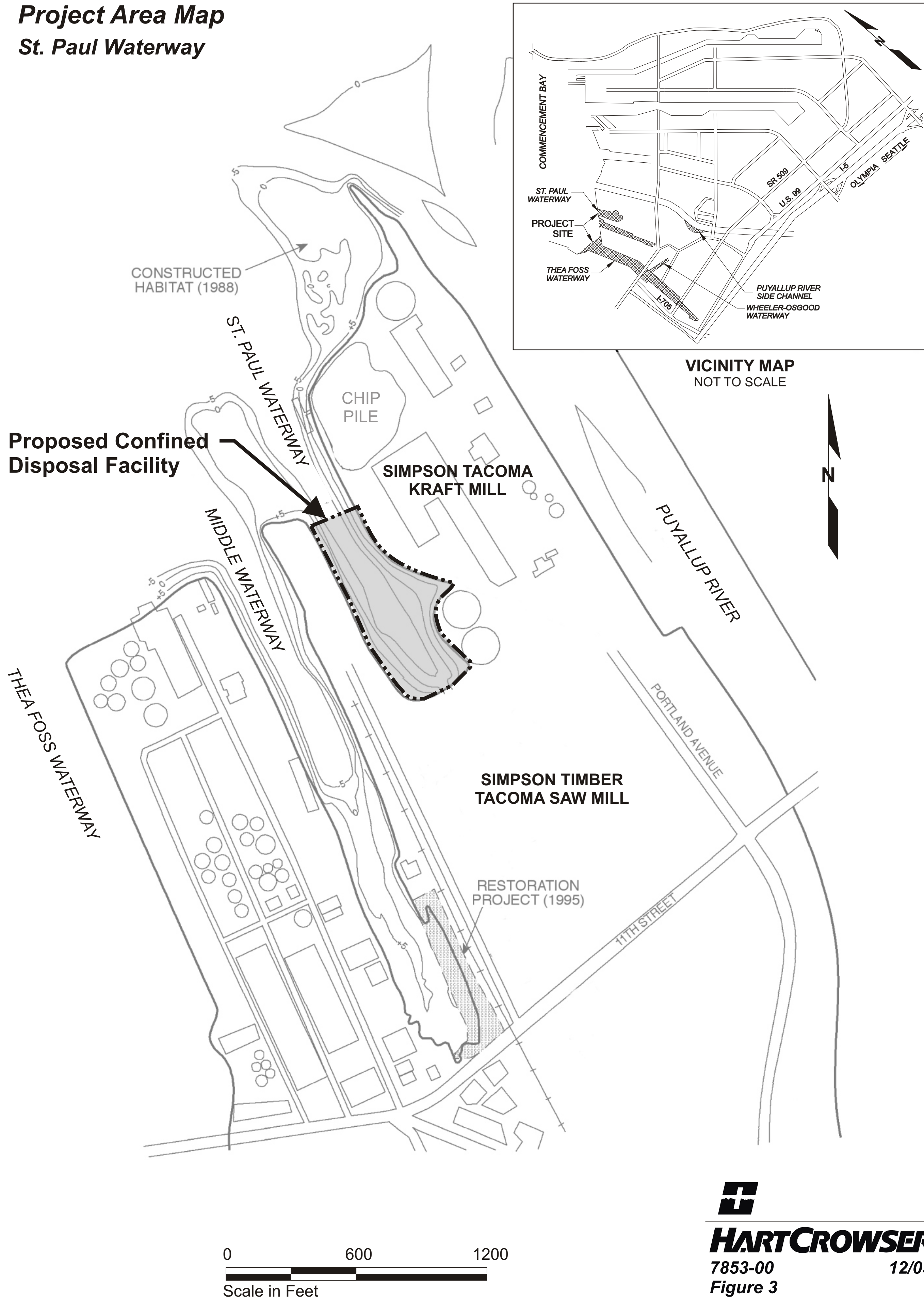
7853-00 12/03
*Figure 2*

## *Project Area Map*
### *St. Paul Waterway*




78530OAA.CDR CAS 12/07/03

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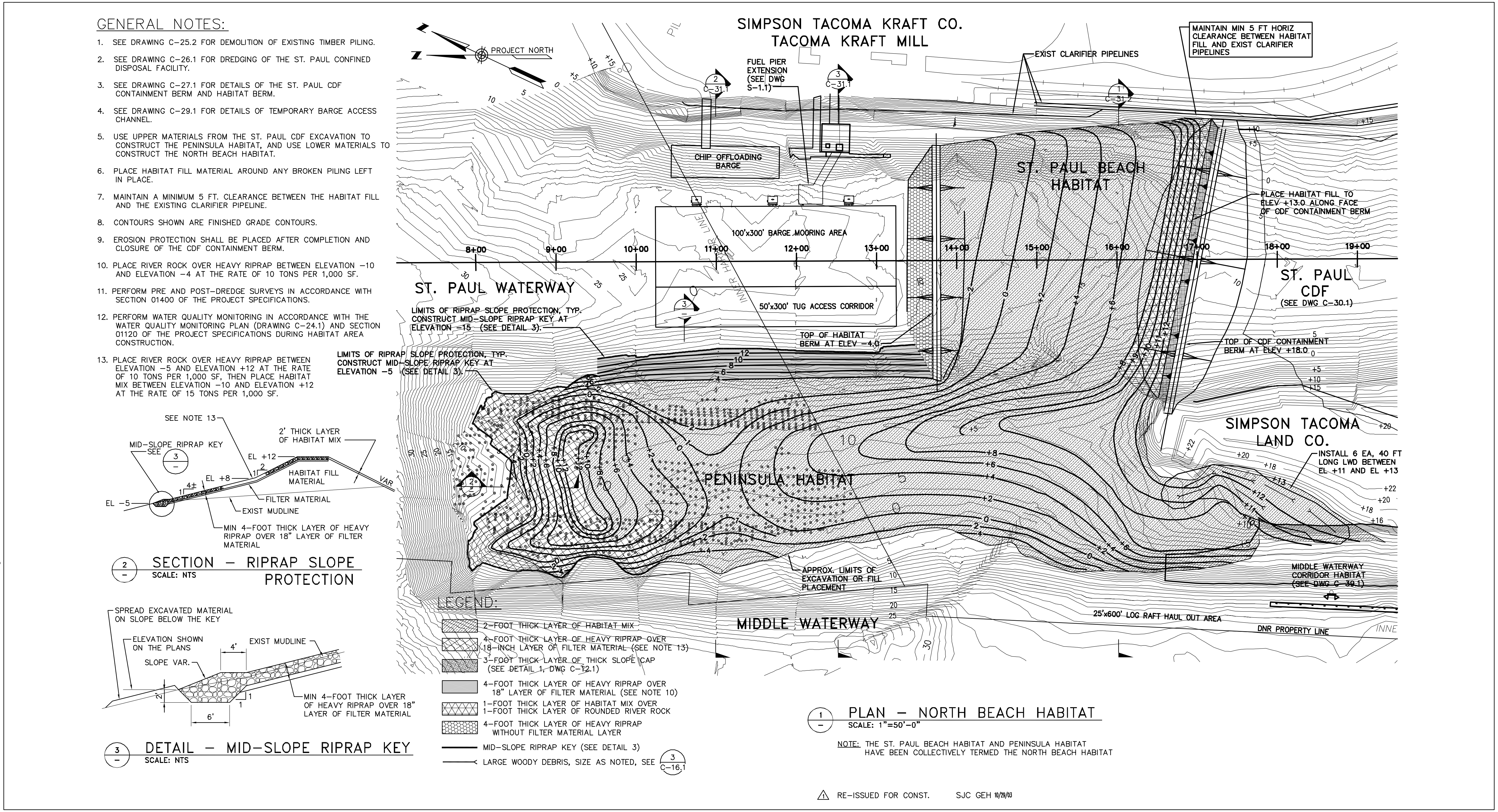
*7853-00* *12/03*

*Figure 3*

# North Beach Habitat Site Plan




CAS 12/08/03 785300074.DWG xREFs/see drawing

0 120 240
Scale in Feet

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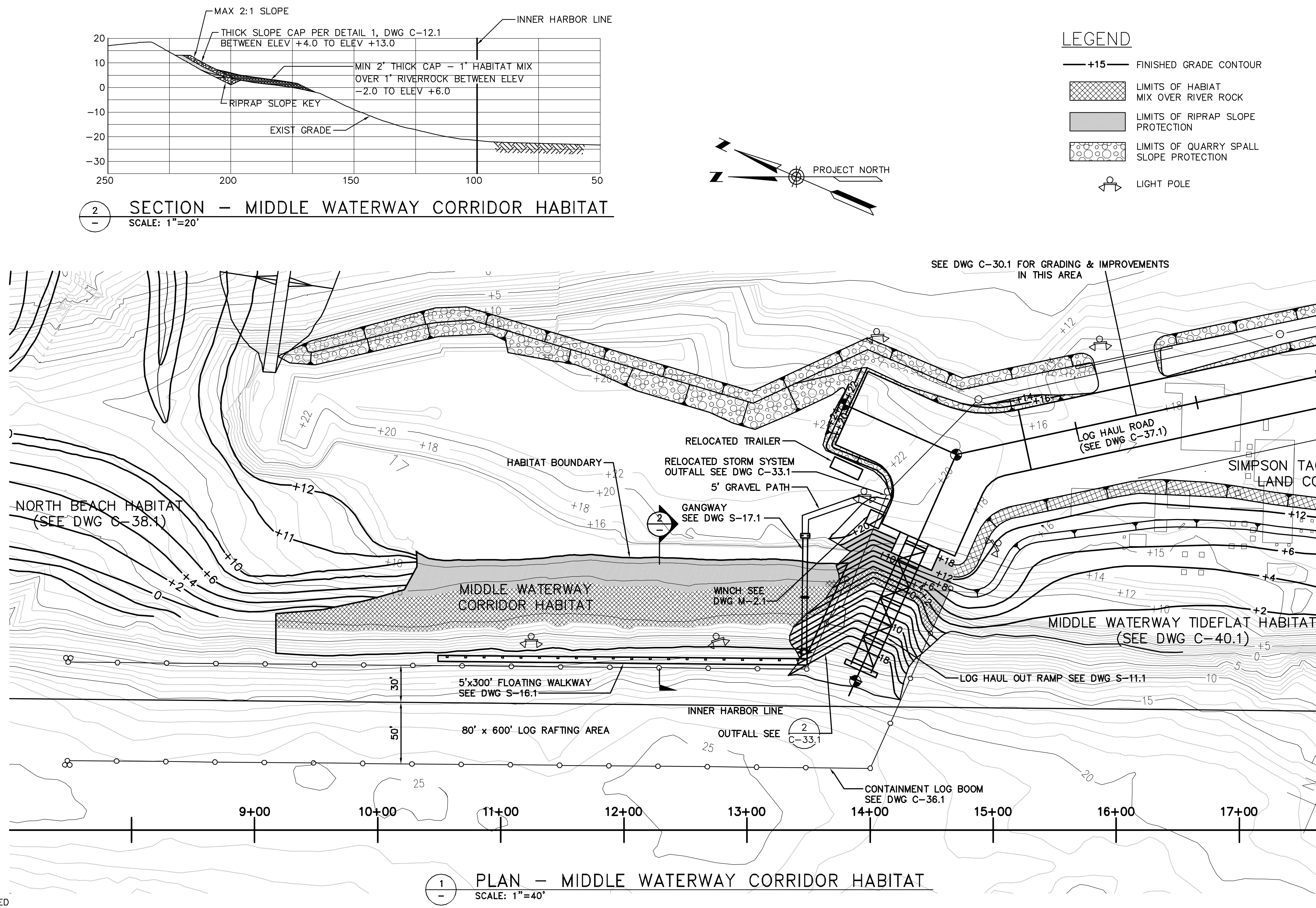
7853-00 12/03
Figure 4

## *Middle Waterway Corridor Habitat Site Plan*




NOTES:

1. BASE MAPPING DEVELOPED FROM ANCHOR ENVIRONMENTAL, L.L.C. DRAWING MWW 029-01, FIGURE 1, DATED 6/22/00.
2. REMOVE EXISTING BROKEN CONCRETE AND DEBRIS WITHIN THE MIDDLE WATERWAY CORRIDOR HABITAT AREA AS DIRECTED BY THE ENGINEER AND DISPOSE OF IN THE ST. PAUL CDF.
3. PLACE HABITAT MIX OVER RIPRAP SLOPE PROTECTION BETWEEN THE ELEVATIONS OF –5.0 AND +13.0, UNIFORMLY APPLIED AT THE RATE OF 10 TONS PER 1,000 S.F. FILLING THE UPPER VOIDS OF THE RIPRAP.
4. THE CONTRACTOR SHALL PERFORM PRE AND POST-DREDGE SURVEYS IN ACCORDANCE WITH SECTION 01400 OF THE PROJECT SPECIFICATIONS.
5. THE CONTRACTOR SHALL PERFORM WATER QUALITY MONITORING IN ACCORDANCE WITH THE WATER QUALITY MONITORING PLAN (DRAWING C-24.1) AND SECTION 01120 OF THE PROJECT SPECIFICATIONS DURING HABITAT AREA CONSTRUCTION.
6. MATERIALS EXCAVATED DURING CONSTRUCTION OF THE LOG HAUL OUT RAMP SHALL BE DISPOSED OF AT A CITY-APPROVED UPLAND DISPOSAL FACILITY OR STOCKPILED ON-SITE AND PLACED IN THE ST. PAUL CDF AS DIRECTED BY THE ENGINEER AFTER DREDGING OF THE CDF IS COMPLETE.

CAS 12/08/03 785300075.DWG xREFs/see drawing

0 90 180
Scale in Feet

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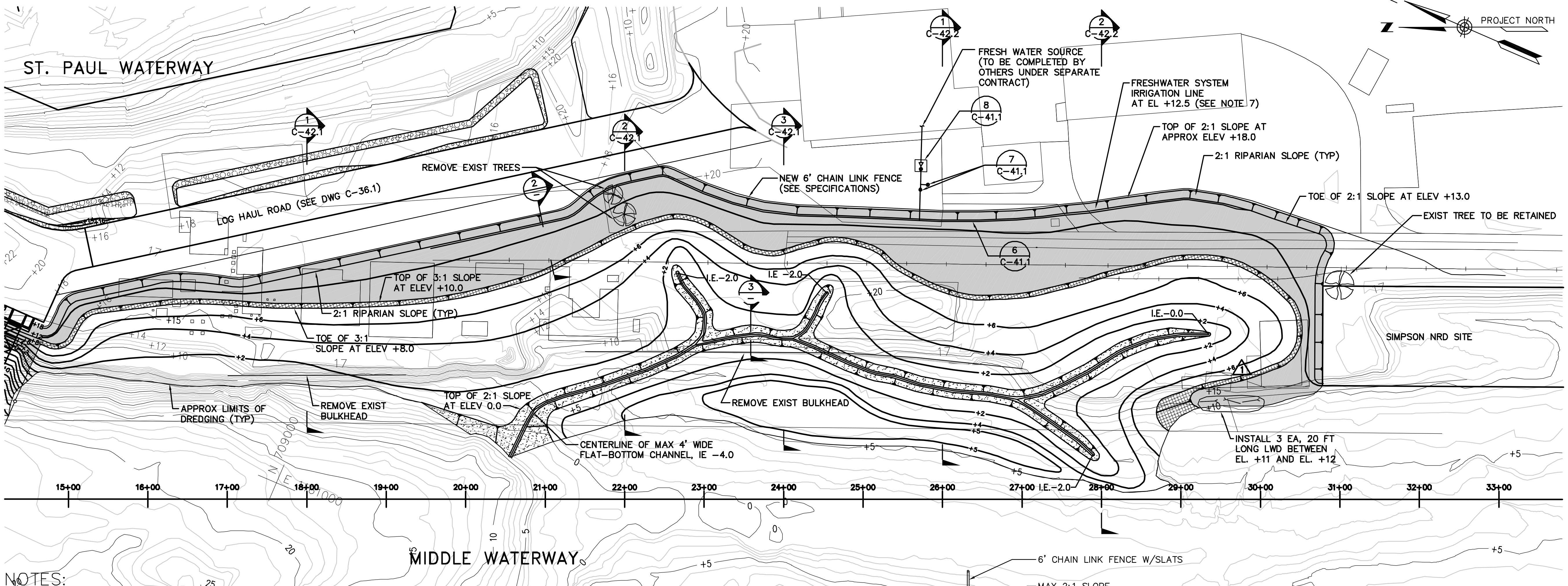
7853-00 12/03
*Figure 5*

## Middle Waterway Tideflat Habitat Site Plan



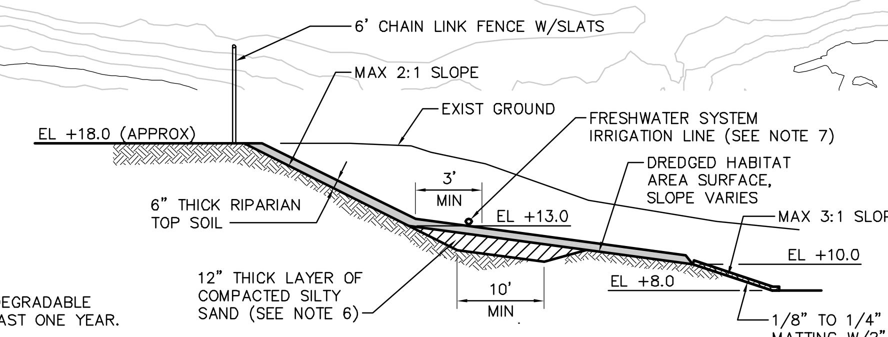

1 SITE PLAN
SCALE: 1"=60'-0"

## NOTES:

1. BASE MAPPING DEVELOPED FROM ANCHOR ENVIRONMENTAL, L.L.C. DRAWING MWW 029-01, FIGURE 1, DATED 6/22/00.
2. THE MIDDLE WATERWAY HABITAT AREA SHALL BE CONSTRUCTED AS SHOWN ON THE PLAN. DREDGED MATERIALS FROM CONSTRUCTION SHALL BE USED TO CONSTRUCT THE PENINSULA HABITAT AREA FILL OR AS CAPPING MATERIAL FOR THE ST. PAUL CDF, OR DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATIONS, AS APPROVED BY THE ENGINEER.
3. THE CONTRACTOR SHALL PERFORM PRE AND POST-DREDGE SURVEYS IN ACCORDANCE WITH SECTION 01400 OF THE PROJECT SPECIFICATIONS. THE CONTRACTOR SHALL RECEIVE APPROVAL FROM THE ENGINEER PRIOR TO DREDGING OR EXCAVATION IN THE MIDDLE WATERWAY OR ON SIMPSON PROPERTY.
4. THE CONTRACTOR SHALL PERFORM WATER QUALITY MONITORING IN ACCORDANCE WITH THE WATER QUALITY MONITORING PLAN (DRAWING C-24.1) AND SECTION 01120 OF THE PROJECT SPECIFICATIONS DURING HABITAT AREA CONSTRUCTION.
5. DEMOLITION OF FOUNDATION AND STRUCTURES IS SHOWN ON DRAWING C-25.2.
6. THE CONTRACTOR SHALL CONSTRUCT THE AQUITARD LAYER USING SUITABLE CLEAN SITE SOIL OR SILTY SAND, AS APPROVED BY THE ENGINEER. PLACE FILL ONLY WHEN WATER IS 2 FEET OR MORE BELOW SUBGRADE ELEVATION, AS APPROVED BY THE CITY INSPECTOR. ENTIRE SURFACE OF THE LIFT SHALL BE COMPLETELY ROLLED TWO TIMES OR MORE WITH A HEAVY STEEL-WHEELED DRIVEN ROLLER (WITHOUT VIBRATING) OR OTHER ENGINEER APPROVED EQUIPMENT.
7. FRESHWATER DESIGN CRITERIA: FRESHWATER APPLICATION RATES SHALL BE SUFFICIENT TO DECREASE SEDIMENT PORE WATER SALINITY TO LESS THAN 10 PPT OVER 50 PERCENT OF THE AREA BETWEEN +12.5 AND +11 FEET; SALINITY TO BE ACHIEVED WITHIN 2 HOURS AFTER TIDE HAS FALLEN BELOW ELEVATION BEING MEASURED.

## JUTE MATTING NOTES:

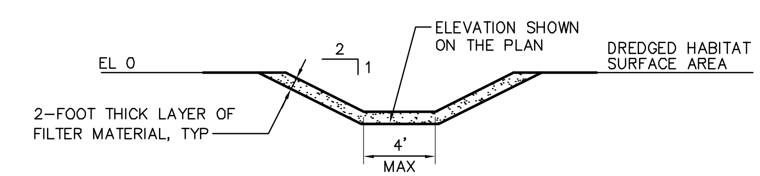
1. TEMPORARY BANK STABILIZATION SHALL BE ACCOMPLISHED WITH BIODEGRADABLE EROSION CONTROL MATERIAL (JUTE MATS) DESIGNED TO LAST AT LEAST ONE YEAR.
2. JUTE MATS WILL BE PLACED ON THE +8 TO +10 FEET MLLW 2H:1V TRANSITION SLOPE AS SHOWN ON THE PLAN.
3. JUTE MATTING SHALL CONFORM TO REQUIREMENTS SET FORTH IN SECTION 9-14.5(1) OF THE WSDOT STANDARD SPECIFICATIONS. THE CONTRACTOR WILL PROVIDE CERTIFICATION FROM THE MANUFACTURER THAT THE MAT WILL SURVIVE AT LEAST ONE YEAR.
4. EROSION CONTROL MATERIAL SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTION. PLACEMENT OF THE EROSION CONTROL MATERIAL INCLUDING OVERLAP SHALL BE ACCOMPLISHED WITHOUT DAMAGE TO INSTALLED MATERIAL AND WITHOUT DEVIATION TO FINISHED GRADE.
5. ANCHORS FOR JUTE MATTING SHALL BE BIODEGRADABLE AND SHALL MEET MANUFACTURERS RECOMMENDATION, OR SHALL BE AN ALTERNATIVE FORM AS RECOMMENDED BY THE MANUFACTURER, IF APPROVED IN WRITING BY THE CITY.




2 SECTION - RIPARIAN SLOPE
SCALE: NTS

## LEGEND:

- JUTE MAT SLOPE (SEE NOTES)
- RIPARIAN TOPSOIL
- FILTER MATERIAL
- FRESHWATER SYSTEM IRRIGATION LINE (SEE NOTE 7)
- LARGE WOODY DEBRIS, SIZE AS NOTED, SEE 3/C-16.1




3 SECTION - FLAT-BOTTOM CHANNEL
SCALE: NTS

| | | | |
|---|---|---|---|
| 1 | ADDENDUM #2 REV | BA HC | 3/14/03 |
| 2 | RE-ISSUED FOR CONSTRUCTION | SJC GEH | 10/30/03 |

CAS 12/08/03 7853000076.DWG xREFs/see drawing

0 140 280
Scale in Feet

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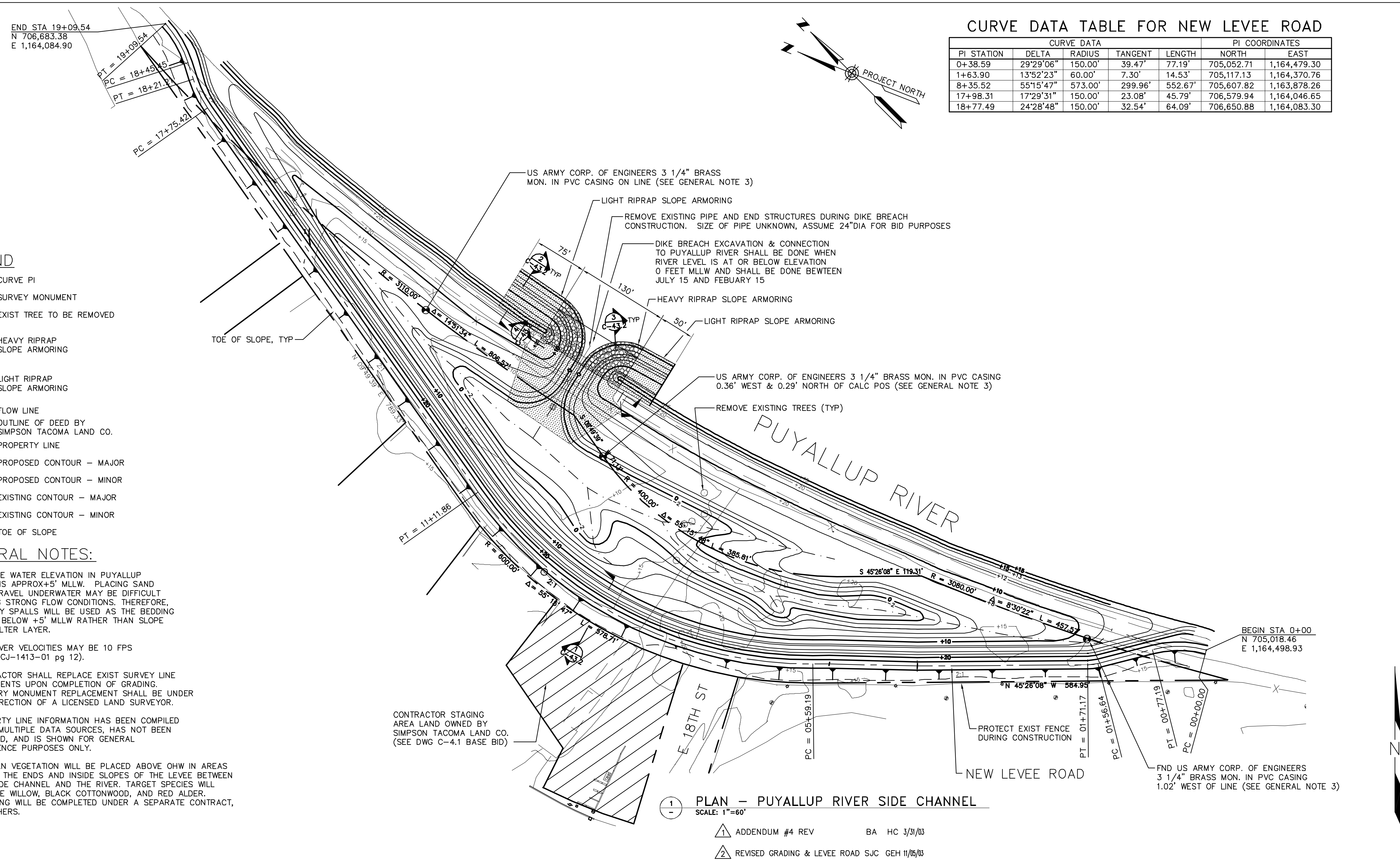
7853-00 12/03
Figure 6

# Puyallup River Side Channel Site Plan




CURVE DATA TABLE FOR NEW LEVEE ROAD

| | CURVE DATA | | | | PI COORDINATES | |
|---|---|---|---|---|---|---|
| PI STATION | DELTA | RADIUS | TANGENT | LENGTH | NORTH | EAST |
| 0+38.59 | 29°29'06" | 150.00' | 39.47' | 77.19' | 705,052.71 | 1,164,479.30 |
| 1+63.90 | 13°52'23" | 60.00' | 7.30' | 14.53' | 705,117.13 | 1,164,370.76 |
| 8+35.52 | 55°15'47" | 573.00' | 299.96' | 552.67' | 705,607.82 | 1,163,878.26 |
| 17+98.31 | 17°29'31" | 150.00' | 23.08' | 45.79' | 706,579.94 | 1,164,046.65 |
| 18+77.49 | 24°28'48" | 150.00' | 32.54' | 64.09' | 706,650.88 | 1,164,083.30 |

LEGEND

- CURVE PI
- SURVEY MONUMENT
- EXIST TREE TO BE REMOVED
- HEAVY RIPRAP SLOPE ARMORING
- LIGHT RIPRAP SLOPE ARMORING
- FLOW LINE
- OUTLINE OF DEED BY SIMPSON TACOMA LAND CO.
- PROPERTY LINE
- PROPOSED CONTOUR - MAJOR
- PROPOSED CONTOUR - MINOR
- EXISTING CONTOUR - MAJOR
- EXISTING CONTOUR - MINOR
- TOE OF SLOPE

GENERAL NOTES:

1. AVERAGE WATER ELEVATION IN PUYALLUP RIVER IS APPROX+5' MLLW. PLACING SAND AND GRAVEL UNDERWATER MAY BE DIFFICULT DURING STRONG FLOW CONDITIONS. THEREFORE, QUARRY SPALLS WILL BE USED AS THE BEDDING LAYER BELOW +5' MLLW RATHER THAN SLOPE CAP FILTER LAYER.
2. MAX RIVER VELOCITIES MAY BE 10 FPS (SEE HCJ-1413-01 pg 12).
3. CONTRACTOR SHALL REPLACE EXIST SURVEY LINE MONUMENTS UPON COMPLETION OF GRADING. SURVERY MONUMENT REPLACEMENT SHALL BE UNDER THE DIRECTION OF A LICENSED LAND SURVEYOR.
4. PROPERTY LINE INFORMATION HAS BEEN COMPILED FROM MULTIPLE DATA SOURCES, HAS NOT BEEN VERIFIED, AND IS SHOWN FOR GENERAL REFERENCE PURPOSES ONLY.
5. RIPARIAN VEGETATION WILL BE PLACED ABOVE OHW IN AREAS ALONG THE ENDS AND INSIDE SLOPES OF THE LEVEE BETWEEN THE SIDE CHANNEL AND THE RIVER. TARGET SPECIES WILL INCLUDE WILLOW, BLACK COTTONWOOD, AND RED ALDER. PLANTING WILL BE COMPLETED UNDER A SEPARATE CONTRACT, BY OTHERS.

CAS 12/08/03 785300077.DWG xREFs/SEE DRAWING

0 10 20
Scale in Feet

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7853-00 12/03

Figure 7