UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

NMFS Tracking No.
2003/00521

August 11, 2003

Lydna Priddy
Superfund Project Manager
U.S. Environmental Protection Agency
Region 10, ECL-115
1200 Sixth Avenue
Seattle Washington 98101-1128

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Contaminated Sediments Remedial Action at the Todd Shipyards Sediment Operable Unit, Harbor Island Superfund Site, Seattle, WA

Dear Ms. Priddy:

In accordance with section 7 of the Endangered Species Act (ESA) (16 U.S.C. 1536) and the Magnuson Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855), the attached document transmits the NOAA's National Marine Fisheries Service's (NOAA Fisheries) Biological Opinion (Opinion) and MSA consultation on the Superfund removal action of the Todd Shipyards Sediment Operable Unit within Elliott Bay in King County, Washington. The U.S. Environmental Protection Agency (EPA) had determined that the proposed action may affect, and is likely to adversely affect, the Puget Sound (PS) chinook (*Oncorhynchus tshawytscha*) Evolutionarily Significant Units.

This Opinion reflects the results of a formal ESA consultation and contains an analysis of effects covering PS chinook in Elliott Bay, Washington. The Opinion is based on information provided in the Biological Assessment sent to NOAA Fisheries by the EPA, and additional information transmitted via meetings, telephone conversations, fax and electronic mail (e-mail). A complete administrative record of this consultation is on file at the Washington Habitat Branch Office. NOAA Fisheries concludes that implementation of the proposed project is not likely to jeopardize the continued existence of PS chinook. In your review, please note that the incidental take statement includes Reasonable and Prudent Measures and Terms and Conditions to minimize incidental take.

The MSA consultation concluded that the proposed project may adversely affect designated Essential Fish Habitat (EFH) for chinook and other estuarine species. The proposed action includes measures developed during the ESA consultation that would address the adverse effects of the proposed EPA actions on EFH. Therefore, no additional EFH conservation measures are necessary.

If you have any questions, please contact Robert Clark at (206) 526-4338 or via email at robert.clark@noaa.gov.

Sincerely,

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation
Biological Opinion

And

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Todd Shipyards Sediment Operable Unit
Remedial Action
Harbor Island Superfund Site, Seattle, Washington
NMFS Tracking No.: 2003/00521

Agency: Environmental Protection Agency

Consultation Conducted By: NOAA's National Marine Fisheries Service
Northwest Region

Issued by: ______________________ Date: August 11, 2003
D. Robert Lohn
Regional Administrator

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background and Consultation History

On May 5, 2003, NOAA's National Marine Fisheries Service (NOAA Fisheries) received a Biological Assessment (BA; May 5, 2003), Draft Final Design Report (April 20, 2003), and a request for Endangered Species Act (ESA) section 7 and Essential Fish Habitat consultations from the United States Environmental Protection Agency (EPA). Formal ESA consultation was initiated on May 5, 2003, because the EPA concluded that, while it may be difficult to quantify demonstrable effects on ESA-listed resources by this Action, the conservative position must be taken that the proposed dredging, disposal, capping, and habitat development activities are likely to adversely affect Puget Sound (PS) chinook in the short term.

Todd Pacific Shipyards Corporation ("Todd") has agreed to remove and/or cap contaminated sediments (defined as the Todd Shipyards Sediment Operable Unit [TSSOU]) from approximately 39 acres of intertidal and subtidal lands adjacent to Todd's upland shipyard site located on the northwest corner of Harbor Island fronting on West Waterway and Elliott Bay and located within EPA's Harbor Island Superfund Site (Figure 1). Some no longer needed shipyard structures will be removed, obsolete facilities will be rebuilt using state-of-the-art materials, and maintenance dredging for future drydock replacements will occur now to eliminate further disturbance of the sediment habitats in the near future. The proposed Action will replace highly contaminated intertidal and subtidal sediments with chemically-clean relic deltatic substrates or confining caps.

The purpose of this Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund") Remedial Action is to address unacceptable risks to the environment and public health from the contaminated sediments. The EPA's removal order to Todd is considered a Federal action under ESA. The proposed project occurs within the PS chinook (*Oncorhynchus tshawytscha*) Evolutionary Significant Unit (ESU) and the marine/estuarine waters of Water Resource Inventory Area (WRIA) 9.

The objective of this Biological Opinion (Opinion) is to determine whether the proposed action is likely to jeopardize the continued existence of PS chinook. The standards for determining jeopardy are described in section 7(a)(2) of the ESA and further defined in 50 CFR 402.14.

This document also presents the results of NOAA Fisheries' consultation covering EFH, pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and implementing regulations for EFH found at 50 CFR 600. In their EFH assessment included in the BA, the EPA concluded their actions will benefit EFH by the long-term removal or capping of contaminated sediments with only minor short-term construction effects, when their proposed Conservation Measures are applied.

Both the Opinion and the EFH consultation are based on information provided in the BA, Draft Final Design Report, meetings, mail correspondence, electronic mail (e-mail) correspondence, and phone conversations, which are contained in the Administrative Record.

Offsetting conservation measures for this Action involve the reshaping of the intertidal areas to maximize depths in the minus 2-foot to plus 2-foot, mean lower low water (MLLW), zone and the placement of salmonid-friendly clean gravels ("habitat mix") between minus 10 feet and the ordinary high water level, including existing riprapped shorelines (Figure 2).

The various remedial elements to occur as part of the proposed action and covered by this Opinion include:

- Reconstruction of Pier 4S
- Dredging contaminated sediments in open water areas with upland disposal
- Placement of sand cap in under-pier area
- Collection of sediment samples
- Construction of a new nearshore habitat bench in the Pier 4S area
- Placement of habitat mix over open water riprap
- Replacement of timber Dry Dock 2 with a metal surfaced dry dock; relocated to the east side of Pier 6, with associated dredging and anchoring
- Demolition of side-launch shipways on the Northeast Shoreline and reconstruction of a ship launching facility along the Northeast Shoreline
- Dredging to increase berth depth along the west side of Pier 6 to accommodate potential future dry dock replacement or relocation.

Construction activities will be phased over 2.5 years with in-water construction tasks conducted between August 15 and February 15, beginning in 2003, with limited piling removal and installation scheduled to occur between July 1 - August 15, 2003 and between July 15 - August 15, 2004.

1.2 Description of the Proposed Action

The EPA proposes to issue an approval to Todd to proceed, under Superfund authority, with the removal with upland disposal and/or capping of sediments to satisfy its regulatory remedial objective, which is to reduce concentration of hazardous substances to levels that will have no adverse affect on marine organisms. To meet the EPA's objective, the following activities will be conducted:

All contaminated sediments and shipyard waste in the open water areas of the TSSOU will be dredged to depths where contaminant concentrations are less than chemical and/or biological sediment quality standards (SQS) as defined by the Washington State Sediment Management Standards (SMS) in Chapter 173-204 of the Washington Administrative Code (WAC; WDOE 1995).

- Dredged sediments will be disposed of at an appropriate upland disposal facility.

- Sediment samples will be collected from the post-dredge surface and compared to SQS to verify that performance standards have been achieved. Sediment samples will also be collected from berth deepening areas for characterization of sediment for Puget Sound Dredge Disposal Analysis (PSDDA) disposal.

- Piers 2 and 4S will be demolished and underlying sediments will be dredged to depths where contaminant concentrations are less than the SQS, following which Pier 4S will be reconstructed.

- Side-launch shipways on the Northeast Shoreline will be demolished to facilitate dredging of contaminated sediments. A ship launching facility will be reconstructed in this area following dredging to replace the side-launch shipways.

- The existing timber Dry Dock 2 will be replaced with a metal surfaced dry dock as an element of site source control, allowing better future removal of spent sandblast grit. The metal surfaced dry dock will be relocated to the east side of Pier 6. Dredging to increase berth depth will be conducted along the east side of Pier 6 to accommodate the new dry dock, and a new anchoring system and access ramp will be constructed.

- A sand cap will be placed under Piers 1, 1A, 2P, 3, 6, 6P, and the Building Berth to an average thickness of 1 foot in areas requiring remediation. The sand cap will extend beyond the pier footprints to include the "no dredge zone" immediately adjacent to the piers. Contaminated sediments underneath Piers 1, 1A, 2P, 3, 6, 6P and the Building Berth will be fully remediated, after demolition, when the existing structures reach the end of their serviceable life.

- A sand cap will be placed under Piers 4N and 5 to an average thickness of 3 feet in areas requiring remediation. The sand cap will extend beyond the pier footprints to include the "no dredge zone" immediately adjacent to the piers. Contaminated sediments underneath Piers 4N and 5 will be fully remediated after demolition, when the existing structures reach the end of their serviceable life.

- During in-water activities, water quality monitoring will be performed and compared to Washington State acute marine water quality criteria or background concentrations and, if necessary, corrective actions will be taken to mitigate effects on water quality during construction.

- Dredging, capping, and disposal methods will be utilized to minimize adverse effects on habitat and minimize the release and resuspension of contaminated sediments to the environment.

- Remedial activities will be conducted following Best Management Practices (BMPs) to avoid and minimize adverse effects on the aquatic environment. The BMPs include avoiding fish-critical activity periods for in-water work involving contaminated sediment and implementing conservation measures that protect ESA-listed species.

- Long-term maintenance and monitoring of the under-pier sand cap will be conducted at the TSSOU to verify the continued effectiveness of the remedy.

The EPA's Superfund remedial action consists of several discrete but integrated projects or elements which are the subject of this Opinion and are discussed in the following sections.

1.2.1 Demolition of Over-Water Structures

1.2.1.1 Demolition of Pier Superstructures

As part of remedial activities, Pier 2 will be removed entirely and Pier 4S will be removed and replaced with a concrete pier in an improved configuration that limits over-water coverage, as shown in Figure 2. As planned and implemented, a substantial portion of this work will be conducted as "over-water" work allowed during closures of in-water work windows.

Pier demolition will generally consist of removing the existing timber pier superstructure and removing the creosote-treated timber support piling, either by breaking off the piles at or below the post-dredge bottom or by fully extracting the piles, depending on pile location. Removal of the overlying buildings (where present) and pier superstructure will be accomplished in stages through disassembly of the buildings and pier superstructure using track-mounted excavators equipped with various tongs, grabs, and buckets. Asphalt and concrete deck surfaces will be removed and transported off-site by truck to a recycling facility. A containment boom will be deployed around the work area, in a manner as not to impede juvenile fish passage, to contain debris during demolition of the timber superstructure. Demolition debris from the pier superstructure will be loaded on to a barge and transported to the transload facility for upland transfer and off-site shipment to a recycling or disposal facility.

1.2.1.2 Pier 2 Demolition

Pier 2 will be demolished in order to accomplish identified sediment cleanup goals beneath this pier. As part of pier demolition, approximately 800 creosote-treated timber piles will be removed from the aquatic environment. Following pier demolition, sediments below Pier 2 will be dredged, consistent with dredging for cleanup of the remaining portions of Sediment Management Area (SMA) 8 (Figure 3). Pier 2 will not be reconstructed.

1.2.1.3 Pier 4S Demolition

Pier 4S also will be demolished in order to accomplish identified sediment cleanup goals beneath the pier. Pier 4S is the largest over-water structure at the Todd facility, with a current footprint of 76,000 square feet. The demolition of Pier 4S will involve removal of approximately 1,735 creosote-treated timber piles. Depending on location and condition, the existing timber piles will either be broken off at or below the proposed dredge elevation or will be fully extracted and removed.

Following demolition of Pier 4S, the area previously covered by the pier will be dredged to remove sediment exceeding SQS criteria. Once cleanup dredging is complete, intertidal areas (beneath the open areas of the future new pier structure) will be backfilled to construct a habitat bench with elevations varying between approximately minus 2 and plus 2 feet MLLW.

1.2.1.4 Side-Launch Shipways Demolition

The side-launch shipways on the Northeast Shoreline will be demolished to achieve more complete cleanup in this area and to remove approximately 235 creosote-treated timber piles. The concrete beam portions of the shipways will be cut using a concrete wire-saw at the intersection of the shipways and the concrete block bulkhead at a point accessible to the cutting equipment. The concrete beams will then be demolished, likely using a track-mounted excavator operating from the beach during periods of low tide.

Support piling within 30 feet of the bulkhead will be broken off at or below the bottom, with piling outboard of this point being fully extracted. Following demolition, the area previously covered by the shipways will be dredged to a depth below SQS criteria. The pile stubs encountered within the dredge area will be cut off at or below the post-dredge surface. Following dredging, the entire Northeast Shoreline area will be backfilled with clean fill material. A ship launching facility will be constructed along the Northeast Shoreline to replace the side-launch shipways.

1.2.1.5 Piling Removal

During pier and shipway demolition, piling will either be fully extracted or broken off at or below the post-dredge bottom, depending on pile location. Piles to be extracted will be removed using a vibratory pile extractor operated from a floating crane. The power pack for the extractor will employ vegetable oil (or other environmentally friendly oil) instead of petroleum-based hydraulic oil. Piles that cannot be fully extracted, will be sheared off using a newly designed, below-the-bottom pile cut-off tool that is designed to shear off the pile at depths of up to six feet below the mud line.

The cut-off tool will consist of a reinforced section of a 24-inch diameter steel pipe that will be driven down over the top of the pile to the cutoff elevation. A cam, operated from the crane, will be used to wedge the pile within the pipe. The pipe will then be pulled to the side until the pile is sheared at depth. The pipe and contained pile stub will then be lifted out of the hole and pile stub released onto the receiving barge. The advantage of using this piece of equipment is that it should be able to break piling off at depth, below the proposed dredge depth. Most current procedures are only able to break piling off at one to two feet below the bottom, following which additional pile stub length must be removed with the dredge bucket during the dredging process. The alternate process would involve removing the piling as the dredging progresses. Once an adjacent area is dredged to grade, the exposed piling will be broken off towards the cut and the process repeated.

Because the cut-off tool is a new piece of equipment, the effectiveness of its use, particularly when used on deteriorated piling or piling in stiff sediment below the bottom, is unknown. However, the Floyd Snider McCarthy (FSM) Team is relatively confident that this tool will be able to successfully cut off piling below grade while minimizing turbidity and related effects. In cases where the cut-off tool is not effective, the traditional method of using the clamshell bucket to "bite" off piling as the dredge depth is advanced will be implemented, as described above.

1.2.2 Dredging

1.2.2.1 Dredge Areas

Cleanup in all open water areas of the TSSOU will be achieved by dredging sediments to depths where contaminant concentrations are less than SQS criteria. Dredging will also be conducted in the areas beneath Pier 2, Pier 4S, and the side-launch shipways following demolition of these structures.

In general, dredging to remove all SQS exceedances in the Project Area will require two to five-foot deep dredge cuts, with localized areas of deeper dredging. Approximately 195,200 cubic yards (cy) of sediments will be dredged. All dredged sediments will be disposed off-site, at an upland Subtitle D landfill. Post-dredge surfaces will generally be flat, and where practical, will slope towards deeper elevations of Elliott Bay or the West Waterway.

Most of the areas within each SMA have been gridded to establish individual dredge areas that are typically approximately 50 feet by 50 feet in plan dimension. The 50-foot dimension was selected based on a horizontal distance that can be comfortably dredged from one setup location of a derrick barge using standard mechanical dredging equipment. Where the existing topography is steeply sloped (*e.g.,* the steep slopes adjacent to shoreline bulkheads, the slopes along the waterward perimeter of the TSSOU, or the slopes transitioning between previously established berth elevations) notes on the dredge plan drawings identify the required amount of dredging on the slope.

1.2.2.2 Berth Deepening to Accommodate Dry Dock Upgrades

Both Superfund source control and long-term planning for the shipyard have identified the east and west sides of Pier 6 as areas where additional dredging is planned to occur during the next 10 years to accommodate dry dock upgrades. Completion of this work at the same time as the planned CERCLA dredging will minimize future aquatic disturbance for berth deepening, dry dock upgrades, and maintenance dredging.

Dredging will be performed along the east side of Pier 6 below the cleanup depths to provide a berth elevation of minus 45 feet MLLW to accommodate a newly purchased metal surfaced dry dock to replace the existing wooden Dry Dock 2. Dry Dock 2 is being replaced to allow sandblasting operations to continue without risk of sediment recontamination. The new dry dock will be relocated to the east side of Pier 6 to allow for the continued ability to berth post-Panamax ships at the east side of Pier 5. Completion of this work will provide a critical source control component. The new dry dock is anticipated to be approximately 84,000 square feet in plan area. The replacement for Dry Dock 2, along with planned upgrades to Pier 6 to accommodate the new dry dock.

Todd will also perform additional dredging at the west side of Pier 6, to allow future relocation of Dry Dock 1 to this location, at such time that Dry Dock 3 may be replaced. This work includes additional dredging below the cleanup depths to provide a berth elevation of minus 45 feet MLLW to accommodate Dry Dock 1.

Following cleanup dredging, additional sediment depth to be dredged for berth deepening will be characterized using PSDDA protocols. This clean underlying sediment will be suitable for disposal at an approved open-water disposal site (*i.e.*, the nearby Elliott Bay PSSDA site).

1.2.2.3 Dredge Equipment and Techniques

Dredging will be conducted using mechanical equipment, consisting of a barge-mounted crane fitted with a clamshell bucket. In almost all cases, this project will employ an environmental bucket, consisting of a traditional clamshell bucket that has been modified to close, vent, and seal the bucket.

Environmental buckets will be used in order to minimize the release of dredged material to the water column during dredging. Presence of substantial quantities of debris within the TSSOU will require that the dredge bucket be robust and fully capable of handling and removing shipyard debris. Therefore, the contractor will have a selection of dredge buckets available for use depending on conditions and specific material to be dredged (*e.g.,* horizontal cut areas, slope dredging, debris removal, etc.).

The dredge will be equipped with a WINOPS positioning system developed by Lyman Burk and Associates (LBA) that will provide real time display and tracking of the horizontal and vertical position of the dredge bucket (LBA 2003). Differential global positioning system receivers and a gyrocompass will be used to determine real time horizontal (X and Y) positioning of the derrick barge and the dredge bucket. An electronic tide gauge will be used to allow the operator to accurately determine the proper dredge elevation below the water surface. The dredge will be equipped with other electronic devices, including a boom angle indicator and pulse generator to facilitate accurate tracking of the vertical position of the dredge bucket. The vertical position of the bucket will be combined with the electronic tide gauge data to determine the actual bucket elevation (Z). The dredge bucket wires will also be painted in 1-foot increments to provide for a check on the electronically calculated vertical position.

The size of the bucket used to conduct dredging will depend on the depth of cut and whether the dredge area is flat or sloped. Flat and gently sloping areas will be dredged with a 7.5-cy Atlas level-cut environmental clamshell bucket and sloped areas will be dredged using a 4.5-cy Esco round-nosed environmental clamshell bucket.

Dredge production rates will depend on the type of bucket, the type of material being removed, the depth of sediment to be removed, the depth of water, results of water quality monitoring, and effects from adjacent shipyard operations. The highest dredging production will occur during horizontal cuts of 3 to 5 feet. Shallow slope cuts will require more precise dredging that will result in slower dredge rates. An average production rate will be on the order of 500 to 1,000 cy per 12-hour shift.

Sediments will be dredged to the design dredge depths to achieve SQS criteria at the post-dredge surface. The depth of over dredging will be anticipated to be on the order of 9 to 12 inches. Dredging will be conducted following BMPs to minimize water and sediment quality effects and water quality monitoring will be conducted during dredging. Recovered sediments will be placed onto a receiving barge, allowed to passively dewater, and transported to an upland transload facility for offloading, transportation, and disposal at an approved upland disposal facility Recovered debris will either be recycled or disposed of in an approved upland landfill. Debris may be segregated for recycling or disposal depending on the quantity and nature of the material.

1.2.2.4 Barge Dewatering

Project specifications will require that dredging efforts be accomplished in a manner that minimizes the amount of water added to recovered sediment. In practice this is accomplished by taking full depth cuts whenever possible so that the dredge bucket is completely full of sediment and by pausing as the dredge bucket breaks the water surface during bucket retrieval to allow excess water to drain before sediment is discharged onto the receiving barge.

Dredged sediment placed onto the receiving barge will be allowed to passively dewater prior to being transferred upland. To facilitate sediment dewatering the receiving barge will be ballasted so that its deck slopes from bow to stern. Sediment will be loaded onto the high end of the barge and contained within a three-sided fenced area that opens to a "water maze" constructed of concrete weirs and straw bales and/or geotextile fabric. Water that drains from recovered sediment will be restrained by and will flow over the concrete weirs (allowing for settling of larger sediment particles) and then filtered through straw bales or geotextile fabric (to capture fine-grained materials) before being returned to waters within the TSSOU. Water quality monitoring will be conducted to verify that water quality parameters do not exceed ambient conditions or water quality criteria at the point of compliance. BMPs will be followed during barge dewatering and water quality monitoring will be conducted under EPA's supervision. Discharge of drainage water from barges will not be allowed once the barges are transported outside of the TSSOU (to the transload site).

1.2.2.5 Upland Transfer of Dredged Sediment

Dredged sediment will be transported by barge to a nearby waterfront transload facility. Sediment will be transferred upland from the barge using either shore-based or floating equipment consisting of either a crane and clamshell bucket or a hydraulic excavator fitted with a clamshell bucket. During offloading, the swing of the clamshell bucket will not be allowed to travel over open water. This restriction will be met by placing a "capture barge" or other temporary structure between the pier and the haul barge or by placing "spill aprons" between the haul barge and the adjacent pier. Once offloaded, sediment and debris will be placed into lined gondola type railcars or into lined containers, which are in turn loaded onto rail cars. Depending on dredge production and railcar availability offloaded sediments may be temporarily stockpiled in a contained stockpile area prior to being loaded onto rail.

Sediment will be transported by rail to, and permanently disposed of at, a permitted Resource Conservation and Recovery Act Subtitle D (non-hazardous waste) facility that accepts municipal solid waste, construction and industrial waste, and contaminated soils.

Return water and/or contact stormwater within the transload facility area will not be allowed to drain directly back into the waterway or into storm drains. All water within the stockpile area, including stormwater, will be collected in a temporary storage tank and tested for compliance with Washington State marine acute water quality criteria. Based on the analytical results, the water will either be discharged within the TSSOU boundary or discharged to the Seattle Public Utilities sanitary sewer system for treatment at the King County Industrial Waste Treatment Plant. BMPs that will be followed during upland transfer of dredged sediment and debris.

1.2.3 Under-pier Cap Placement

A clean sand cap will be placed underneath piers not scheduled for demolition. Cap material will provide environmental benefits that include reduced exposure to contaminated sediment, source control (by reducing the movement of underlying sediments), improved substrate conditions for fish, and other habitat enhancement benefits. No remedial activities will be conducted in under-pier areas where existing riprap contains minimal or no sediment.

Where existing timber piers are critical for continued shipyard operations and are in fair to good condition with remaining operational life (*e.g.,* Piers 1, 1A, 2P, 3, 6P, and 6 and the Building

Berth), approximately 12 inches of medium to coarse sand (with less than one percent fine-grained sediment) will be placed to cover contaminated sediment areas below the piers. Approximately 3 feet of sand cap material will be placed beneath the existing concrete piers (Piers 4N and 5).

Placement of under-pier sand cap material will be accomplished after dredging of open water areas adjacent to the pier has occurred. Sand cap material will be placed using a "throwing" conveyor that is mounted onto a small barge. Throwing conveyors operate at very high belt speeds (speeds are variable, up to 2800 feet per minute) and are capable of "throwing" granular material 30 to 40 feet off the end of the conveyor. This equipment is typically mounted on a self-contained truck-based unit that can carry and spread sand or aggregate. These machines were developed for spreading or placing sand or aggregate into hard to reach areas, and are therefore considered a perfect match for placing sand beneath the pier structures at the TSSOU.

A shotcrete cap will be placed over the consolidated mound of shipyard waste and debris located beneath the Pier 6P during periods of low tide. This cap will provide environmental benefits that include reduced exposure to contaminated materials and source control (by reducing the movement of underlying materials). Because the base of the debris mound terminates at approximately elevation zero feet MLLW, the entire mound is above water during periods of low tide. Once preparations for placing the shotcrete are complete, actual shotcrete operations to cap the mound can be completed during a four to six hour period. This will allow the entire shotcrete application to be completed in one tide cycle. An accelerator admixture will be used in the shotcrete mix to insure that the shotcrete is sufficiently cured by the time it is inundated by the next tide cycle.

1.2.4 Fill Placement

1.2.4.1 Modification of Armored Slopes

Habitat mix will be placed above riprap at all elevations shallower than minus 10 feet MLLW on:

1. the reconstructed armored buttress fill slope between Pier 6 and the eastern property boundary (*e.g.,* Northeast Shoreline area),

2. the armored buttress fill slope beneath the new Pier 4S, and

3. the steep slope waterward of the habitat bench beneath the new Pier 4S.

In addition, habitat mix will be placed above riprap for the full extent of the existing armored buttress fill slope between Pier 4N and Pier 6. The approximate limits of habitat mix placement are shown on Figure 2. The goal of placing this material on armored slopes is to plug the interstitial spaces within the riprap. This eliminates hiding places for organisms that prey on juvenile salmonids and improves substrate conditions for fish and other aquatic species. Habitat mix will be placed at a rate of 25 tons per 1,000 square feet. This rate of coverage has been approved by the EPA at sites containing similar riprap armoring, such as Martinac Shipyard, the Wheeler-Osgood Waterway, and Thea's Park (Peterson Lee 2003).

Habitat mix will be clean, naturally occurring round or sub-angular river sandy gravel, primarily (greater than 80%) igneous or metamorphic rock. Bulk material will be free of soil, clay balls, debris, wood, organic matter, and other extraneous material. Habitat mix will be placed using a bottom dump skip box controlled from a derrick barge. The derrick barge will be equipped with WINOPS to allow precise placement of habitat mix over a specified area. Placement quality control will be tracked by employing lead-line soundings conducted from a skiff. Habitat mix placement will be conducted according to the BMPs described in section 2.8 of the BA.

1.2.4.2 Pier 4S Nearshore Habitat Improvements

After demolition of Pier 4S, contaminated sediments in SMA 6 will be dredged to depths below SQS. Following dredging, a habitat bench will be constructed in the area to be open to sunlight following reconstruction of the new pier at this location. Remaining areas (*e.g.,* the buttress fill immediately adjacent to the shore-based bulkheads and the steep slope beneath the future pier) will be backfilled with clean riprap (meeting specifications for "Light Loose Riprap" per section 9-13.1(2) of the Standard Specifications for Road, Bridge and Municipal Construction [WSDOT 2002]). Riprap areas above minus 10 feet MLLW will be modified with habitat mix as described above.

The configuration of the new pier will reduce over-water coverage by approximately 50,366 square feet, allowing light passage to the nearshore areas that are beneath the current pier. Following dredging, backfill will be placed to construct a habitat bench at the base of the bulkhead buttress. The habitat bench is designed to maximize the area of gently sloping intertidal beach between elevations minus two and plus two feet MLLW. Substrate for the habitat bench surface will be habitat mix as described above. The habitat bench will extend throughout the entire length of the Pier 4S area at a width of approximately 50 to 60 feet for a total of about 0.6 acre.

1.2.4.3 Northeast Shoreline Reconstruction

After demolition of the side-launch shipways, the Northeast Shoreline will be dredged to allowable depths, given geotechnical constraints, and to achieve cleanup criteria. Following dredging, the entire Northeast Shoreline area will be backfilled with clean fill material and armored with light-loose riprap. The shoreline will be backfilled to create a slope of 1.75 to one (horizontal to vertical) from the toe of the slope to minus 10 feet MLLW. The slope will be backfilled from minus 10 to plus 10 feet MLLW to create as gently a sloping surface as possible given the geometry of this shoreline area. Then, from plus 10 to plus 14 feet MLLW, the slope will be backfilled to create a 1.75 to one (horizontal to vertical) buttress slope to provide lateral support to the adjacent bulkhead. Riprap areas above minus 10 feet MLLW will be modified with habitat mix. A new ship launching facility will be constructed in this area following cleanup dredging and shoreline reconstruction.

1.2.4.4 Filling of Subtidal Depressions

Existing subtidal depressions located west of Pier 4 and east of Pier 5 will be filled with clean sediment generated by the berth deepening and/or with capping sand. These depressions, currently approximately 5 to 10 or more feet deep, will be filled to avoid becoming sediment traps once the TSSOU cleanup is complete.

1.2.5 Reconstruction of Over-water Structures

1.2.5.1 Pier 4S Replacement Structure

Because Pier 4S is critical to shipyard operations it will be rebuilt following completion of cleanup activities within its current footprint. Phasing of demolition, cleanup and reconstruction will be carefully scheduled so as to minimize effects on Todd's operations.

Operations conducted within the buildings currently located on the Pier 4S deck will be permanently relocated to other locations within the shipyard uplands. As a result, Pier 4S will be able to be reconstructed in a new configuration that meets shipyard operational requirements (by providing a continuous pier at the location of the existing berth), while reducing over-water coverage and allowing light penetration to intertidal areas as a habitat enhancement benefit.

Pier 4S will be reconstructed with a new footprint, approximately 26,800 square feet in size. The new footprint provides a significant reduction in over-water coverage of approximately 50,366 square feet when compared to the existing pier (the existing pier has plan area of 76,125 square feet). This over-water coverage area reduction is achieved by constructing a marginal wharf configuration that is accessed by two trestles from shore. The length of the reconstructed pier is 220 feet shorter than the existing pier. The marginal wharf configuration provides for large areas that are open to sunlight between the access trestles.

The replacement structure at Pier 4S will be an all-concrete structure consisting of an approximately 45-foot wide main pier running north/south along the Duwamish West Waterway frontage. This pier will match the existing Pier 4S pierhead line and will align with Pier 4N to the north and continue approximately 440 feet to the south. This length combined with the existing Pier 4N frontage will provide approximately 1,190 lineal feet of berth area along the Duwamish West Waterway. In addition, a new small mooring dolphin and access walkway will be constructed approximately 70 feet south of the south end of the redeveloped pier.

To access the main Pier 4S pier, two access (trestle) piers will be constructed from the shore bulkhead. The north access pier is proposed to be on the order of 51 feet wide and will be constructed in two phases. The south access pier will be approximately 40 feet wide. The north trestle will be supported by 29 plumb steel piles (approximately 19 for Phase 1). The north trestle deck will be approximately 24-inch cast-in-place concrete.

The north access trestle must be constructed first, to allow continued access for vehicles and utilities to Pier 4N, while the existing Pier 4S is demolished. Piling installation for the north access trestle must be installed in July 2003. Piles in the first phase 4N trestle (approximately 19 total) will be steel piles driven with a vibratory hammer, two of which will be proofed by using an impact pile hammer. Piles in the main Pier 4S will be both concrete and steel and will be driven using a derrick barge, piling leads, and an impact pile hammer.

The remaining sections of reconstructed Pier 4S will be supported on approximately 164 piles (plumb and batter piles). Plumb piles will be 24-inch precast, prestressed concrete octagonal piles. Batter piles will be steel pipe piles, 24 inches in diameter. The deck will be made up of precast, prestressed concrete panels. All pile caps will be constructed with cast-in-place concrete.

The nominal finished deck elevation of the working apron will be set at plus 18.75 feet MLLW. The two approach trestles will slope toward shore as required to match existing working surfaces at the Todd facility. The working berth depth at a point 11 feet offshore of the pier face will be minus 40 feet MLLW.

1.2.5.2 Dry Dock 2 Replacement and Pier 6 Modifications

The existing timber Dry Dock 2 will be replaced with a steel-surfaced dry dock. The dry dock will be relocated to the east side of Pier 6 to allow for continued ability to berth post-Panamax ships at Pier 5 East. The dry dock will be approximately 84,000 square feet in plan area and will require a berth depth of minus 45 feet MLLW. Additional berth deepening in this area will be conducted following completion of cleanup dredging in this area.

Pier 6 will be modified to accommodate the new dry dock by the addition of two new dolphin pier supports located immediately east of the eastern face of the pier. The southern most dolphin pier will be centered approximately 315 feet south of the north end of Pier 6. This dolphin pier, consisting of a concrete deck supported by approximately 16, 24-inch concrete octagonal plumb and battered piles, will be approximately 16 feet wide and 28 feet long. The northern-most dolphin pier will be centered approximately 90 feet north of the north end of Pier 6. This structure, consisting of a concrete deck supported by approximately 30, 24-inch concrete octagonal plumb and battered piles, will be approximately 35 feet square.

Additionally, a new access platform will be constructed to support a gangway bridge accessing the new dry dock. The new access platform will be located approximately 25 feet east of Pier 6, and will extend from the top of the slope along the Northeast Shoreline toward the new dry dock. The access platform structure will be approximately 20 feet wide and 100 feet long and will consist of a concrete deck with approximately 30, 24-inch concrete octagonal plumb and battered piles. A removable gangway bridge will be constructed to span between the access pier and the dry dock.

1.2.5.3 Ship Launching Facility Replacement Structure

Demolition of existing side-launch shipways at the Northeast Shoreline has been identified as a required remedial action to facilitate cleanup of nearshore sediments. Following demolition of the side-launch shipways, dredging of underlying contaminated sediments, and reconstruction of the Northeast Shoreline, a replacement ship launching facility will be constructed. The replacement ship launching facility will consist of two parallel piers that will be level with and have a deck elevation equal to the existing upland grade. These piers will be approximately eight feet wide and spaced approximately 25 feet on center. The piers will be centered on the existing side-launch shipways centerline. Concrete bracing beams will be constructed level with the pier deck that would connect the two piers together laterally. The new piers will extend approximately 100 feet north of the existing bulkhead. The piers will be constructed with a concrete deck supported by approximately 54, 24-inch concrete octagonal plumb and battered piles. A fendering system will be constructed along the north of the launch way piers. The fendering system will consist of approximately 14 steel piles faced with rub strips and two, 2-inch diameter, 10-foot long, removable floating fenders. The in-water footprint and extent of over-water coverage of the replacement ship launching facility is significantly reduced from the existing side-launch shipways.

In summary, 400 concrete and steel piling will replace portions of the 2,770 creosote-treated timber piling removed. The 24-inch concrete pilings will be driven using an impact hammer and three steel wide flange piles will be driven by vibratory hammer. The 63, 16-inch hollow steel plumb fender piles will be driven by vibratory hammer and 5-10% proofed with the impact hammer. The 182, 24-inch diameter hollow steel plumb (84 vertical) and battered (98 angled) piles will be driven by both vibratory (57 piles) and impact hammer (125 piles).

<u>1.2.6 Duration and Timing of Construction Activities</u>

Project construction is not expected to adversely affect juvenile salmonids, as in-water construction activities would occur during a time when few juvenile salmonids are present. Construction of the remedial activities is expected to begin in the summer of 2003 and continue for 2.5 years, with completion in 2005. The construction schedule allows the least intrusive activities, which would have a negligible effect on listed species, to be completed during a broader timeframe (July 1 through February 14), while limiting activities with a higher risk of environmental effect to a narrower in-water work period (August 15 through February 14). Activities between July 1 and August 15, 2003, include installing 19 steel plumb piles at Pier 4 and between July 15 and August 15, 2004, will include concrete and steel piling installation for the main Pier 4S. Should unforeseen circumstances require, any of the project elements, could be delayed for one year under this Opinion.

1.3 Description of the Action Area

The Action Area for the proposed project includes all portions of the Elliott Bay east of a line drawn between Alki Point and West Point and the Duwamish Waterway upstream to the

Turning Basin at the head of navigation located at about River Mile (RM) 7 (Figure 1). The effects of the project are described within a broader setting than the Project Area to provide a context for evaluating the effects of the project. This broader area is termed the "Action Area" to distinguish it from the Project Area, which is the area where construction activities will occur. 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 action and not merely the immediate area involved by the action."

The TSSOU is located on the northwest corner of Harbor Island, approximately 1 mile southwest of downtown Seattle, along the right descending bank of the Duwamish West Waterway at the mouth and at the southern terminus of Elliott Bay, as shown in Figure 1. The total TSSOU Project Area includes approximately 38.9 acres of marine sediment consisting of approximately 33.4 acres of open water sediments and 5.4 acres of under-pier sediments, as shown in Figure 2.

2.0 ENDANGERED SPECIES ACT BIOLOGICAL OPINION

2.1 Evaluating Proposed Actions

The purpose of consultation under ESA is to ensure that any action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of threatened or endan- gered species. Formal consultation concludes with the issuance of an Opinion under section 7(b)(3) of the ESA.

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). NOAA Fisheries must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify habitat. This analysis involves the initial steps of: (1) defining the biological requirements and current status of the listed species; and (2) evaluating the relevance of the environmental baseline to the species' current status.

From that, NOAA Fisheries evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NOAA Fisheries must consider the estimated level of injury and mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed species' life stages that occur beyond the action area. A finding of jeopardy is appropriate if the action, together with the baseline conditions and cumulative effects appreciable reduces the species' likelihood of survival or recovery by reducing the numbers, distribution, or reproduction of the species. If NOAA Fisheries finds that the action is likely to jeopardize, NOAA Fisheries must identify reasonable and prudent alternatives for the action.

For this specific action, NOAA Fisheries' analysis considers the extent to which the proposed action impairs or improves the function of habitat elements necessary for rearing, refugia, and migration of PS chinook. The Duwamish Estuary, site of the proposed project, is part of the major migratory pathway for chinook salmon in the Green/Duwamish Basin.

2.1.1 Status of the Species

Puget Sound chinook salmon was listed as threatened under ESA on March 24, 1999 (64 FR 14308). The ESU includes all naturally spawned populations of chinook salmon from rivers and streams flowing into PS. The area also includes the Straits of Juan de Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington State. The species status review identified the high level of hatchery production which masks severe population depression in the ESU, as well as severe degradation of spawning and rearing habitats, and restriction or elimination of migratory access as causes for the range-wide decline in PS chinook salmon stocks (NOAA Fisheries 1998a, and 1998b).

Overall abundance of chinook salmon in this ESA has declined substantially from historical levels. Many populations are small enough that genetic and demographic risks are likely to be relatively high. Long-term trends in abundance are predominately downward, with several populations exhibiting short-term declines. Factors contributing to the downward trend are widespread stream blockages, degraded habitat, with upper tributaries widely affected by poor forestry practices and lower tributaries and mainstream rivers affected by urbanization and agriculture. Hatchery production and releases of chinook salmon in PS are widespread and more than half of the recent total PS escapement returned to hatcheries.

2.1.1.1 Factors Affecting the Species in the Action Area

The Action Area is a highly industrialized, salt wedge estuary influenced by river flow and tidal cycles. The urbanization and industrialization of this portion of the Green River watershed has resulted in an extensive system of filled tidelands and flood control revetments that have eliminated connectivity to the historic floodplain and decreased or eliminated stream channel complexity, functional riparian zones, and floodplain habitats. In the Duwamish Estuary, about 98% of the once available emergent marsh and intertidal mudflat and 100% of the tidal marsh habitats believed necessary for estuarine lifestage (smoltification) of salmonids have been lost (Blomberg *et al.* 1988).

Of the Duwamish Waterway shoreline between the mouth and RM 6.5, 44% is riprapped, 34% covered by pier aprons and seven percent faced with vertical sheet piling (Tanner 1991). Dredging for navigational purposes coupled with industrial activities has resulted in adverse changes in the substrate characteristics and the amount of shallow water habitat available for fishery resources utilizing this estuary (Meyer *et al.* 1981). Furthermore, a considerable portion of the remaining intertidal and shallow subtidal portions of the Lower Duwamish Waterway are covered by barges (Muckleshoot Indian Tribe Fisheries Department, unpub. data). The historical distribution of juvenile 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 from stormwater and wastewater effluents in certain areas of the Waterway has compromised the function of the small amounts of habitat surviving (EPA 2002).

2.1.1.2 Status of the Species in the Action Area

Chinook salmon migrating through the Duwamish River estuary are divided into two main stocks: the Duwamish/Green River summer/fall stock and the Duwamish/Green River-Newaukum Creek summer/fall stock (WDFW 1994). Spring chinook were historically present in the Green/Duwamish River basin. However, returns from this run are in such low numbers that they are difficult to detect. It is possible that the spring run became extirpated by the original construction effects of the Tacoma Headworks Dam in 1911, or became isolated from the basin by the diversion of the White River in 1906 (Kerwin and Nelson 2000).

Green/Duwamish summer/fall chinook salmon remain relatively abundant because of hatchery production. Although the Washington State Salmon and Steelhead Stock Inventory (WDFW 1994) rated the Green/Duwamish summer/fall chinook as "healthy," the overall trend in abundance of PS chinook is predominately downward. Stream spawning escapement estimates which includes hatchery strays can lead to significant overestimation of the natural chinook run. The confounding effect of hatchery strays on wild chinook production in systems such as the Green/Duwamish River was identified in the NOAA Fisheries review as a key concern leading to the listing of chinook salmon (BRT Draft status review February 2003). http://www.nwfsc.noaa.gov/trt/brt/brtrpt.cfm

Summer/fall chinook salmon in the Duwamish/Green system are ocean-type fish that rear in freshwater for a few months after emerging from the gravel before migrating to the ocean in the spring as sub-yearling smolts. Juveniles are abundant in the mainstem of the Green River from March through April and occur in the Lower Duwamish Waterway from early March through late July (Meyer *et al.* 1981; Low and Myers 2002). Other studies have found juvenile chinook salmon in the Duwamish as early as mid February (K. Fresh, pers. comm., 2003). Although juvenile chinook are present in the Lower Duwamish Waterway over an 8-month period, catch data show an abrupt increase in smolts in mid-May followed by an equally abrupt decrease. This indicates that most of the fish represented in the pulse of abundance were not in the Lower Duwamish Waterway for more than two weeks (Warner and Fritz 1995).

Seiler (1999) found that chinook salmon preferred nighttime migration in the Cedar and Bear Rivers. For the first four weeks of trap operation, beginning January 23, weekly day/night ratios for chinook varied from 17% to 59% and declined as the season progressed. A comparison of the passage timing data with lunar data for Lake Washington and the Hiram M. Chittenden Locks suggested a strong correlation between moon location relative to the earth and emigration timing, particularly in the case of chinook and coho salmon. This correlation appeared to be stronger than the correlation between emigration and moon phase (illumination). Migration through the Locks increased markedly within a day or two of the moon being at apogee (*i.e.,* when the moon is farthest from the earth). Emigration decreased by the time of the next apogee (R2 Resource Consultants 2002). Juvenile chinook salmon in the Duwamish/Green River would be expected to exhibit similar timing to Cedar River chinook, since the two rivers were connected until about 1917.

Similar to timing of juvenile chinook emigration peaks in the Duwamish estuary, increasing abundances of juvenile chinook have been observed in Elliott Bay, but only through the summer months. Taylor *et al.* (1999) found the greatest numbers of juvenile chinook at Terminal 5, located immediately to the west of the Project Area, in mid-May, and at Pier 91, located 4 miles north of the Project Area, in early June. Beamish *et al.* (1998) sampled salmonids throughout PS and observed that some juvenile chinook salmon remain in PS through fall and winter (Starkes 2001).

Generally, chinook salmon remain at sea for two to four years before returning to freshwater to spawn. The summer/fall stock migrate upstream through the Lower Duwamish Waterway to spawning grounds from late June into early November, with large numbers entering the river by July (Williams *et al*. 1975; Frissell *et al*. 2000; Kerwin and Nelson 2000). Adults primarily spawn between mid-September and October (Williams *et al.* 1975; WDFW 1994). No chinook salmon spawning is known to occur in the Lower Duwamish Waterway or in the smaller streams flowing into the estuary and lower reaches of the waterway (Weitkamp and Ruggerone 2000).

2.1.2 Biological Requirements

The first step NOAA Fisheries uses when conducting the ESA section 7(a)(2) analysis is to define the species' biological requirements within the action area. NOAA Fisheries then considers the current status of the listed species taking into account species information, *e.g.,* population size, trends, distribution, and genetic diversity. To assess the current status of the listed species NOAA Fisheries starts with the determinations made in its decision to list for ESA protection the ESUs considered in this Opinion and also considers any new data that are relevant to the determination.

Biological requirements are those necessary for the listed ESU's to survive and recover to naturally reproducing population sizes at which protection under the ESA would become unnecessary. This will occur when populations are large enough to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. The biological requirements for PS chinook include adequate food (energy) source, flow regime, water quality, habitat structure, passage conditions (migratory access to and from potential spawning and rearing areas), and biotic interactions (Spence *et al.* 1996). The specific biological requirements for PS chinook that are influenced by the action considered in this Opinion include food, water quality, habitat structure, and biotic interactions.

2.1.3 Environmental Baseline

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 actions 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 actions which are contemporaneous with the consultation in process" (50 CFR 402.02).

Lingering effects of more than a century of human development combined with numerous ongoing activities, form the present environmental baseline conditions in the Action Area. These activities include urban development and redevelopment, railroads, shipping, logging, agriculture, and other industries. These land uses result in the delivery of industrial wastes, stormwater runoff from impervious surfaces, freshwater diversions for industrial and domestic use, and flood control, such as the Howard Hanson Dam (RM 64) and numerous levees.

Development began to affect the lower Duwamish River in the early 1900s. Diversion of tributaries reduced the river's drainage basin by 71% and its average flow by more than 70%. At about the same time, the river was dredged to create the Duwamish Waterway, replacing nine meandering miles of river with a straight, deep, four-mile-long navigation channel (EB/DRP 1994).

As discussed earlier (section 2.1.1.1), the hardening of the intertidal shorelines in the Duwamish Waterway has been followed by the coverage of remaining intertidal and shallow subtidal substrates by fill material and barges. The effects of eliminating natural shorelines were compounded by the filling of marshes and mudflats, the creation of steep bulkhead and riprap banks, the removal of vegetation, the construction of buildings, piers, and impervious pavement, and the moorage of barges. Altogether, these actions eliminated about 98% of the lower Duwamish River's emergent marshes and intertidal mudflats and 100% loss of tidal marshes (Blomberg *et al.* 1988). The surviving highly modified habitats generally provide poor habitat for salmon (Spence *et al.* 1996).

The Duwamish River was a large natural river estuary before 1853. Typically such an estuary provides habitat elements necessary for the survival of juvenile chinook salmon by providing osmoregulatory transitions (conversion from freshwater to saltwater habitats) and rearing habitat as well as holding habitats for adult salmon waiting to ascend the river to spawning grounds. Juvenile chinook salmon normally use side channels for feeding, avoiding predators, and resting, while undergoing their physiological change to salt water. Rapid growth also occurs in estuaries due to the abundance of preferred food. 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).

In the Lower Duwamish Waterway, the riverbanks have been straightened, steepened, hardened, and denuded of riparian vegetation. Warner and Fritz (1995) found the greatest abundance of juvenile salmon using shallow, sloping, soft mud beaches, compared to sites having sand, gravel, or cobble substrates. The habitat throughout the TSSOU provides a low level of function and is mostly homogenous steep, riprapped upper intertidal zone, with slight differences in function controlled by slope, shade from piers, and relative location (West Waterway versus Elliott Bay). The intertidal habitat facing Elliott Bay is mostly unshaded riprap while the intertidal habitat along the West Waterway consists entirely of shaded riprap. Approximately 73% of the TSSOU shoreline is covered by structures (piers and pier platforms) (Landau 2001).

Surface sediment composition is variable throughout the Duwamish River estuary ranging from sands to mud, depending on the sediment source, current speed, and elevation. Within the TSSOU, riprap covers much of the surfaces between plus 10 and minus 5 feet MLLW; substrate below the riprap consists primarily of sand mixed with shell fragments and scattered riprap. Subtidal substrate is mostly silty sand, except in areas near the northern and western boundaries of the TSSOU, where substrate is mostly gravel and cobble mixed with some finer-grained sediment (FSM Team 2002).

The TSSOU intertidal substrate is composed of approximately 85% of large-grained material (riprap, concrete/asphalt, and other large debris) (Landau 2001). The intertidal habitat also contains site structural features including bulkheads (concrete, timber, and steel) and pier pilings. Subtidal habitat substrate was observed to be mostly silty sand, except in the areas near the northern and western boundaries of the study site, where substrate is mostly gravel and cobble mixed with some finer-grained sediment. Landau noted debris (*e.g.,* concrete, wood, bricks, rubber, wire cables, and metal) in many intertidal and all subtidal areas of the TSSOU. Abrasive sand blast grit from shipyard operations was also observed in some intertidal areas (Landau 2001).

Additionally, the chemical contamination of sediments in certain areas of the Waterway has compromised the effectiveness of the small amount of available habitat (EPA 2002). Chemicals of concern found at elevated concentrations included the polynuclear aromatic hydrocarbons, polychlorinated biphenyls (PCBs), metals (arsenic, mercury and zinc), phthalates, phenols, and pesticides (DDT, DDE, DDD). Varanasi *et al.* (1993) found juvenile chinook salmon from the Duwamish Waterway displayed a lower immune system response compared to juvenile chinook salmon from the Nisqually River, a comparable estuary without significant industrial contaminants. Species such as salmon often spend several weeks in urban estuaries where they can be exposed to urban-related contaminants that reside in the sediments and accumulate in the prey species. There is concern that these contaminants could bioaccumulate to levels that may affect the ability of the individual salmon to grow and mature properly (NOAA Fisheries 2002).

The EPA listed the marine sediments around Harbor Island in 1983 as part of that Superfund Site. Subsequently, the EPA listed Lower Duwamish Waterway as a Federal Superfund site in 2001, and the clean up of contaminants in the Action Area has been a high priority. A Record of Decision (ROD) governing the Shipyard Sediment Operable Unit for Harbor Island was issued in November 1996 (EPA 1996). An Administrative Order on Consent (AOC) and associated Statement of Work (SOW) for Remedial Design Sampling was signed in June 1997. Phase 1A characterization activities were completed as defined in the 1997 SOW. The EPA conducted additional characterization (Phase 1B) in January 1999. Based on the characterization results, the EPA prepared an Explanation of Significant Differences (ESD) in December 1999 (EPA 1999). The ESD designated the TSSOU as a distinct cleanup unit and expanded the TSSOU boundaries. In April 2000, an AOC (EPA 2000) and associated SOW was finalized for Remedial Design. The EPA issued another ESD in March 2003 that further defined the selected remedy for the under-pier areas, established confirmational numbers characteristic of contamination present in the West Waterway for the purpose of adjusting the TSSOU boundary, adjusted the TSSOU boundary, summarized the long-term operational, maintenance, and monitoring parameters for the TSSOU, defined "predominantly abrasive grit blast", and identified the disposal approach for contaminated sediments (EPA 2003a). At the time of this writing, a Consent Decree and associated SOW for remedial action and long-term monitoring for the TSSOU are under review at the Department of Justice (EPA 2003b).

In summary, the environmental baseline is substantially degraded. Ninety-eight percent of historically available intertidal marsh and mudflat habitat, necessary for the estuarine lifestage (smoltification) of juvenile salmonids, has been lost due to the above described human activities. The remaining two 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 believed to be a major factor in the current depressed status of PS chinook salmon in WRIA 9.

2.1.4 Effects of the Proposed Action

NOAA Fisheries must consider the estimated level of injury and mortality from the effects of the proposed Action. ESA implementing regulations define "effects of the action" as "the direct and indirect effects of an action on the species or habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 CFR 402.02). "Indirect effects" are those that are caused by the proposed Action and are later in time, but are still reasonably certain to occur.

2.1.4.1 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 actions. 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 which juvenile salmonids use. Negative effects may occur during various construction activities, including the dredging of highly contaminated sediments and the capping of the remaining contaminated sediments underneath. However, these effects are confined to a relatively small area and short time period.

2.1.4.1.1 Demolition of Piers, Shipways, and Piling Removal. Pier demolition will be conducted following strict BMPs to limit the amount of debris entering the waterway and minimize accidental spills. Therefore, effects on water quality resulting from this work are not anticipated. Any material that enters the water will be collected and removed for proper disposal. If non-floatable demolition debris enters the waterway and sinks to the bottom before it is removed, the material will be removed during follow-on environmental dredging activities.

Pier 2 and 4S demolition and subsequent dredging will result in the removal of almost the entire benthic community associated with the pier structures. Pier 2 will not be reconstructed allowing for increased light passage to newly exposed clean sediments. Pier 4S reconstruction will include creation of an approximately 10.6-acre day-lighted intertidal habitat bench. This newly-created, clean intertidal sediment bench is expected to provide habitat conducive to benthic prey colonization. In addition, new concrete and steel piling will provide non-toxic substrate for sessile biota to colonize thereby creating a contaminant-free food web which should directly benefit juvenile listed species and their food organisms as they migrate past these structures when leaving the Duwamish River.

Through the disassembly process of side-launch shipways on the Northeast Shoreline and Piers 2 and 4S, some demolition debris may fall into the water and piling removal may result in temporary increases in turbidity and by the processes described for dredging affect turbidity and dissolved oxygen. However, BMPs during piling removal and dredging should minimize or eliminate the effects of this activity. Thus, few affects on turbidity or dissolved oxygen are anticipated. For this project, all areas where piling are to be removed, either by full extraction or by shearing, will be covered with riprap and habitat mix and/or deepened by dredging, which will minimize piling exposure at the post-project bottom and fill in any holes left behind during piling removal. Piling removal will be conducted following BMPs to limit aquatic effects, including the amount of debris entering the waterway. Therefore, effects on water quality resulting from this work are not anticipated. Pier 2, Pier 4S, and side-launch shipway demolition will include the removal of approximately 2,770 creosote-treated timber piles. Extraction of pilings from sediment may cause some resuspension and settling of sediments. The addition of approximately 193 new piles associated with Pier 4S reconstruction and dredging east of Pier 5 may also resuspend sediments, but to a lesser degree than piling removal. All areas where pilings are to be removed, either by full extraction or by cutoff, will be covered with riprap and habitat mix and/or deepened by dredging. These activities will minimize exposure of cutoff piling at the post-project bottom and fill in any holes left behind during piling removal resulting in a chemically-clean habitat for listed species and an improved sediment surface for increased production of their food organisms.

2.1.4.1.2 Dredging. The remedial dredging of the TSSOU will remove approximately 195,000 cy from 33.4 acres and dispose of the contaminated sediments at an approval upland landfill. The chemicals of concern in the sediments are arsenic, copper, nickel, tributyl tin, and PCBs. Biological effects on PS chinook salmon may result from: 1) temporary reduction in water quality and increased noise disturbance associated with dredging that potentially could exclude chinook salmon from estuarine habitat; 2) seasonal loss of benthic organisms and other prey due to disturbance of the channel substrate; 3) short term alteration to near shore habitat; and, 4) potential exposure to contaminated sediments or water.

Active dredging results in temporary turbidity increases to varying degrees. The degree of turbidity at the dredge site is a function of a combination of factors including substrates, currents, and operational parameters. Suspended sediment concentrations will vary throughout the water column with larger plumes typically occurring at the bottom closer to the actual dredging action and plume sizes decreasing exponentially with both vertical and horizontal distance from the dredging site (Nightingale and Simenstad 2001). Nightingale and Simenstad (2001) presented total suspended sediment (TSS) data for three mechanical dredge operations. Maximum TSS ranged from 168 to 400 milligram/liter (mg/l) within 300 meters of the dredge and approached background levels within 300 to 700 meters. Literature studies show that adverse effects on fish from suspended sediments are highly species-specific. Some species show lethal effects at several hundred mg/l in 24 hours and others show no effect at concentrations greater than 10,000 mg/l for 7 days (Nightingale and Simenstad 2001).

Dredging activities disturb and suspend sediment creating discoloration of the water, reducing light penetration and visibility, and changing the chemical characteristics of the water. The size of the sediment particles and tidal currents are typically correlated with the duration of sediment suspension in the water column. Larger particles, such as sand and gravel, settle rapidly, but silt and very fine sediment may be suspended for several hours. LaSalle (1990) described a downstream plume that extended 900 feet at the surface and 1,500 feet at the bottom. LaSalle (1990) also noted an increase in sediment levels upwards of 70% from the effect of the pressure wave created by the bucket as it descended through the water.

The effects of dredging on water quality (suspended sediments and chemical composition) can be detrimental effect on salmonids. Suspended sediments can have an adverse effect on migratory and social behavior as well as foraging opportunities (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985). Servizi (1988) observed an increase in sensitive biochemical stress indicators and an increase in gill flaring when salmonids were exposed to high levels of turbidity (gill flaring allows the fish to create sudden changes in buccal cavity pressure, which acts similar to a cough). Chemical composition of the water with suspended sediments is also affected by dredging activities. Estuarine sediments are typically anaerobic and create an oxygen demand when suspended in the water column, and in turn would decrease dissolved oxygen levels (Morton 1976; Hicks *et al.* 1991). Decreases in dissolved oxygen levels have been shown to affect swimming performance levels in salmonids (Bjornn and Reiser 1991). The decrease of swimming performance due to decreases in dissolved oxygen could directly affect the chinook salmon's ability to escape potential predation or could affect their ability to forage. LaSalle (1990) found a decrease in dissolved oxygen levels from 16-83% in the mid to upper water column and nearly 100% close to the bottom. Smith *et al.* (1976) found dissolved oxygen levels up to 2.9 mg/l during dredging activities in Grays Harbor. Hicks (1999) observed salmon avoidance reactions when dissolved oxygen levels dropped below 5.5 mg/l. Dredging fine sediments such as those found in the lower Duwamish Waterway will create a sediment plume that may not disperse rapidly because of tidal fluctuations, especially during incoming tides. This could create poor water quality (*i.e.,* decreased dissolved oxygen levels) that might preclude chinook salmon from immigrating into the Duwamish River to gain access to foraging, rearing, and/or spawning grounds. Meaningful changes in dissolved oxygen levels are not anticipated.

The effects of remedial activities at the TSSOU are likely to temporarily increase turbidity to levels greater than ambient conditions. However, effects are likely to be short-term. Because dredging activities are scheduled for the work window (between August 15 through February 14) when few outmigrating juvenile chinook salmon are likely to be present, turbidity is not likely to adversely affect juvenile chinook as they outmigrate through the TSSOU. Small numbers of juvenile chinook have been present in the Duwamish River estuary during August and September (Shannon 2001). Thus, dredge-associated increases in turbidity could potentially affect these fish, but they would likely avoid any potential sediment plume. Quinn (1988) identified an extraordinary ability on the part of salmonids to detect and distinguish turbidity and other water quality gradients. Simenstad (1990) reported a consensus amongst scientists that in the case of salmonids, disruption of juvenile migration would be more vulnerable to turbidity effects from dredge plumes than adult migration. By following BMPs, these activities have a low, but not negligible, likelihood of affecting chinook salmon.

Approximately 33 acres of physical habitat will also be affected by dredging. Even though the sediment composition at the mouth of the Duwamish River is primarily sand and silt, chinook salmon must forage and migrate through the estuarine environment (J. Chan, FWS pers. comm., 2001). Dredging will temporarily eliminate littoral and shallow subtidal habitat for chinook salmon and will likely reduce foraging opportunities. This may cause chinook salmon to migrate into deeper waters where there is greater vulnerability to predation and less foraging opportunities.

Dredging will inevitably result in removal of some of the existing habitat area within the TSSOU; however, the habitat being removed is contaminated and thus offers limited benthic benefits. Dredged areas will either be capped with clean fill materials or the newly exposed clean subsurface sediment will become the new surface habitat. The new clean surface sediment will likely provide improved habitat for benthic organisms when compared to the existing contaminated sediment.

Dredging will also result in permanently increasing the depth of certain areas within the TSSOU beyond their current range to accommodate dry dock upgrades. The permanent depth increases are not expected to dramatically affect the habitat area for chinook salmon since the areas affected by permanent depth increases are already deeper than the minus 20 feet MLLW depth thought to be the extent of benthic primary and secondary production for the juvenile salmonids food web, and the migration corridor for juvenile salmonids.

Disruption of the channel bottom and entrainment by dredging has a generally negative effect on benthic biota and forage fish. Dredging physically disturbs the channel bottom, eliminating or displacing established benthic communities, thus reducing prey availability to chinook salmon or their forage species. Filter feeding benthic organisms can suffer from clogged feeding structures, reduced feeding efficiency, and increased stress levels (Hynes 1970). Dredging may also suppress the ability of some benthic species to colonize in the dredged area, thus creating a loss of benthic diversity and food source for the chinook salmon prey species. However, benthic communities at the proposed site are expected to recover within one year after dredging activities are completed.

The dredging will use a 4.5 or 7.5 cy mechanical environmental clamshell bucket (Section 1.2.2.3). Clamshell dredging causes limited, short-term localized turbidity, the magnitude of which should be reduced using the closed environmental bucket. No long-term effects would result from this turbidity. The amount and duration of turbidity during mechanical dredging will be controlled by adhering to the procedures and standards set forth in the Water Quality Criteria and Ecology's Water Certification. Potential turbidity effects would be minimized by implementing BMPs that include proper anchor handling, dredge bucket operations, and dredge material filtering. However, turbidity would still increase in the project area during dredging operations, even with implementation of the proposed BMPs. To limit turbidity effects on juvenile chinook salmon, the EPA will ensure that dredging of contaminated sediments will not occur between February 15 and August 15, of any year, so that in-water work will occur when few juvenile chinook salmon are expected to be present in the Action Area.

While dredging normally causes a short-term decrease in abundance and diversity of the littoral and subtidal benthic community, the benthic community in the project area is already seriously low in diversity and number of biota due to the level of contamination and the physical quality of the substrate. Therefore, the typical reduction in benthic prey from this type of dredging is not expected within the project area. The existing substrate is highly contaminated and therefore not considered good quality habitat. The remaining dredged surface or intertidal clean cap material (medium to fine sand) that would replace the existing contaminated sediments would provide improved substrate for benthic species in the project area over the long-term.

Any increased chemical concentrations associated with dredging are likely to be short lived and will not be distinguishable from background when dredging is completed. BMPs to reduce chemical contamination of the TSSOU will be applied as will water quality monitoring to ensure compliance with water quality standards and performance monitoring to ensure successful removal of contaminated sediments.

In summary, the EPA will minimize the adverse effects of dredging on listed fish while providing long-term increase in ecological functions by requiring timing restrictions to minimize fish presence and employing appropriate BMPs, as described in Section 2.8 of the BA.

2.1.4.1.3 Transport of Dredged Material. Dredged contaminated sediments will be placed on haul barges for transporting to the local upland transfer facility. If flat-top haul barges are used, water that is deposited on the barge with the dredged material would be allowed to drain back to the river after being filtered through hay bales and/or filter fabric per routine contaminated sediments BMPs. Experience has shown the incremental increase in turbidity using this technology is minimal (Romberg, 2000). Vessel traffic at the mouth the Lower Duwamish Waterway could increase by approximately one tug and barge operation per day for the duration of the project. This increase in vessel traffic should not have demonstrable effects on listed species.

2.1.4.1.4 Capping and Fill Placement. Capping material will be obtained from an upland commercial borrow source; clean fill material may come from clean relic sediments dredged during the deepening for the future dry docks. Cap and fill material will be placed in several areas within the TSSOU. Cap materials are placed to cover contaminated sediments beneath over-water structures that will remain in place, while fill materials are placed over clean materials. Placement of cap and fill material will cause transient increase in turbidity in the immediate area as the sediments disperse through the water column. However, placement in compliance with the BMPs should minimize the adverse effects of resulting turbidity. No adverse effect on dissolved oxygen and contaminant levels in the water column are anticipated from these activities.

Sand caps placed over target sediment areas below existing pier structures will cover and smother existing benthic and epibenthic organisms by smothering. However, the sediment and associated benthic community are contaminated and should be removed from the area. Rapid re-colonization of the new clean substrate is likely. The clean substrates will also likely support a more diverse and productive benthic and epibenthic community over time, resulting in increased prey abundance for juvenile salmonids. Placement of the sand cap will benefit habitat, reducing exposure of contaminated sediment, and providing potential source control by restricting movement and resuspension of underlying contaminated sediments. Cap and fill placement will change the character of the existing shoreline of the TSSOU, modifying the riprapped slopes and improving the shoreline along existing Pier 4S. In addition, the clean sand cap will provide improved substrate conditions for juvenile salmonid benthic prey production compared to the existing contaminated sediment.

Proposed backfilling of the intertidal region beneath the existing Pier 4S will result in the creation of an intertidal bench. The bench will extend from plus 2 feet MLLW approximately 50 feet to the west, encompassing an area of approximately 0.6 acre. This newly created intertidal habitat will substantially improve existing benthic conditions along the West Waterway shoreline of the TSSOU by providing the fine-grained, clean, gently sloping intertidal habitat preferred by juvenile salmonids and their benthic prey, which is currently not available. Additionally, the steep armored buttress fill slope between Pier 4N and Pier 6 will be top-dressed with habitat mix, as will the reconstructed slope along the Northeast Shoreline.

One of the goals of the design of the reconstructed shoreline areas was to minimize loss of intertidal acreage. For both the Northeast Shoreline and the reconstructed shoreline in the area of Pier 4S, an evaluation of critical intertidal elevation zones was made to determine pre-construction and post-construction areas. Removal of contaminated substrates, reconstruction of shoreline edges, and modification of riprap areas will benefit nearshore habitat. The engineered intertidal bench along the existing Pier 4S shoreline will restore intertidal habitat beneficial for juvenile salmonids.

2.1.4.1.5 Reconstruction of Over-Water Structures. The reconstruction of Pier 4S will significantly reduce existing over-water coverage, increasing intertidal macroalgae and benthic production. The new Pier 4S will include a large nearshore area, totaling approximately 50,366 square feet, from which over-water coverage will be removed. Increased light passage will also be facilitated because of the increased bent spacing and the significant reduction in the number of piles supporting the new Pier 4S structure. Increased light passage coupled with the newly created intertidal bench will improve the habitat along the West Waterway shoreline of the TSSOU for juvenile salmonids in comparison to existing conditions.

Reconstruction of Pier 4S, approaches to Pier 4N, fender piles, mooring dolphins, Pier 6 dry dock access pier, and the rebuilt launchway piers and fenders will require that 400 new piles be installed. Both concrete and steel piling will be used which will have none of the chemical concerns associated with the removal of the old creosote timber piles. Pile driving could temporarily increase the turbidity of surrounding waters, but much less so than the dredging activities. In addition, pile driving hollow steel pipe piles will temporarily increase the noise within the Project Area and create overpressure waves adjacent to the pile driving activity. While a vibratory hammer will routinely be used, it may be necessary to "proof" 5-10% of the steel piles with an impact hammer to determine bearing capacity. Biological effects to PS chinook may result from the high sound pressures produced when driving hollow steel piles with an impact hammer. Extensive discussions of the impacts 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 2003a), portions of which are incorporated below.

Impact driving of steel piles can produce intense sound pressure waves that can injure and kill fishes (*e.g.*, Longmuir and Lively 2001; Stotz and Colby 2001; Stadler, pers. obs. 2002; Blomberg pers. comm. 2003; Carman pers. comm. 2003; Desjardin, pers. comm. 2003). The injuries caused by such pressure waves are known as barotraumas, and include hemorrhage and rupture of internal organs, including the swimbladder and kidneys in fish, and damage to the auditory system. Death can be instantaneous, occur within minutes after exposure, or occur several days later. Fishes with swimbladders (which include salmonids) are sensitive to underwater impulsive sounds (sounds with a sharp sound pressure peak occurring in a short interval of time) because of swimbladder resonance, which is believed to occur in the frequency band of most sensitive hearing (usually 200 to 800 Hz) (Caltrans 2002). As the pressure wave passes through a fish, the swimbladder is rapidly squeezed due to the high pressure and then rapidly expanded as the underpressure component of the wave passes through the fish. At the high sound pressure levels (SPL) associated with pile driving, the swimbladder may repeatedly expand and contract, hammering the internal organs that cannot move away since they are bound by the vertebral column above and the abdominal muscles and skin that hold the internal organs in place below the swimbladder (Gaspin 1975). This pneumatic pounding may result in the rupture of capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2002).

Another mechanism of injury and death is "rectified diffusion," which is the formation and growth of bubbles in tissue caused in areas of high SPLs. Growth of bubbles in tissue by rectified diffusion can cause inflammation and cellular damage because of increased stress and strain (Vlahakis and Hubmayr 2000; Stroetz *et al.* 2001), and blockage or rupture of capillaries, arteries and veins (Crum and Mao 1996).

Hastings (2002) expects little to no physical damage to aquatic animals for peak SPLs below 190 dB (re: 1 µPa at 1 meter), the threshold for rectified diffusion (Crum and Mao 1996) (*note: all decibel levels discussed hereafter will be with a reference pressure of 1 µPa*). However, much uncertainty exists regarding the level of adverse effects to fish exposed to sound between 180 and 190 dB_{peak} due to species-specific variables. Turnpenny *et al.* (1994) reported a mortality rate of 57% for brown trout (*Salmo trutta*), 24 hours after exposure to 90-second bursts of pure tones at 95 Hertz at peak pressures below 173 dB. The authors suggested that the threshold for continuous sounds was lower than that for pulsed sounds such as seismic airgun blasts. This difference is thought to be due to the longer duty cycle of the pure tone bursts. The literature also suggests there may be adverse effects stemming from shifts in hearing, physical hearing damage, or equilibrium problems (Turnpenny *et al.* 1994; Hastings *et al.* 1996). Based on this information, NOAA Fisheries has established the threshold for physical injury at 180 dB_{peak} for this project.

Sound pressure levels expressed as "root-mean-squared" (rms) values are commonly used in behavioral studies. Sound pressure levels in excess of 150 dB_{rms} are expected to cause temporary behavioral changes such as elicitation of a startle response or behavior associated with stress. These SPLs are not expected to cause direct permanent injury, but, as discussed above, may decrease a fish's ability to avoid predators. Shin (1995) reports that pile driving may result in "agitation" of salmonids indicated by a change in swimming behavior. Observations by Feist et al. (1992) suggest that sound levels in this range may disrupt normal migratory behavior of juvenile salmon. They also noted that when exposed to the sounds from pile driving, juvenile pink and chum salmon were less likely to startle and flee when approached by an observer than were those that were shielded from the sounds. Based on this information, NOAA Fisheries has established the threshold for behavioral disruption at 150 dB_{rms} for this project.

Most reports of fish-kills associated with pile driving are limited to those fishes that were immediately killed and floated to the surface. However, physical harm to juvenile salmonids is not always expected to result in immediate, mortal injury – death may occur several hours or days later, while other injuries may be sublethal. Necropsy results from Sacramento blackfish exposed to high SPLs showed fish with extensive internal bleeding and a ruptured heart chamber were still capable of swimming for several hours (Abbott and Bing-Sawyer 2002). Sublethal injuries can interfere with the ability to carry out essential life-functions, such as feeding and avoiding predators.

Small fish subjected to high SPLs might be more vulnerable to predation, and the predators themselves may be drawn into the potentially harmful field of sound by following injured prey. The California Department of Transportation (cited in NOAA Fisheries 2003b) reported that the stomach of a striped bass killed by pile driving contained several freshly consumed juvenile herring. This striped bass appeared to have fed heavily on killed, injured, or stunned herring as it, too, swam into the zone of lethal sound pressure. Because adult salmonids are piscivorous they might be attracted to areas of dangerously high SPLs by the smaller fishes that are injured or killed.

Not all fishes killed by pile driving float to the surface. At the Port of Vancouver, British Columbia, divers found a large number of dead fishes, including salmonids, had sunk to the bottom (Desjardin, pers com). Teleki and Chamberlain (1978) found that up to 43% of the fishes killed by underwater explosions sank to the bottom. With few exceptions, fish-kills are reported only when dead and injured fishes are observed at the surface. Thus, the frequency and magnitude of such kills may be underestimated. The potential for fish injury from pile driving depends on the type and intensity of the sounds produced. These are greatly influenced by a variety of factors, including the type of hammer, the type of substrate and the depth of the water. Firmer substrates require more energy to drive piles into, and produce more intense sound pressures.

The small range of physical injury, combined with the expected low numbers of the smallest, shore-bound PS chinook outmigrants at the time of pile driving and the assumption that larger juvenile and adult PS chinook are less affected by the behavioral changes brought by pile driving, leads NOAA Fisheries to believe that this activity will have negligible adverse effect to listed salmonids. However, as discussed below, the EPA will implement measures to minimze these effects.

2.1.4.1.6 Interrelated and Interdependent Actions. Effects of the action are analyzed together with the effects of other activities that are interrelated to, or interdependent with the proposed action. An interrelated action is one that is part of the proposed action, or depends on the proposed action for its justification. An interdependent action is one that has no independent utility apart from the proposed action. Guidance developed by NOAA Fisheries to assist biologists conducting interagency consultation suggests that as a practical matter, the determination of whether other actions are interrelated to, or interdependent with the proposed action, should be made using the “but for” test. That is, the biologist should ask the question whether the potentially interrelated or interdependent actions would occur but for the occurrence of the proposed action. If the action in question would not occur but for the occurrence of the proposed action, then the effects of action in questions must be analyzed taken with the effects of the proposed action.

For this consultation, NOAA Fisheries finds that the proposed action includes several actions that would not occur, but for the occurrence of the proposed action. The effects of these actions are beneficial to listed salmonids in the action area and are analyzed below.

The proposed action inlcudes removing approximately 195,000 cubic yards of contaminated sediment from 33.4 acres of the Duwamish River estuary. Chemical concentrations in surface sediment within the TSSOU exceeded the SQS and Cleanup Screening Levels (CSL) at the majority of sampling locations. Of the 86 locations sampled for SMS chemicals, detected concentrations of one or more chemicals exceeded the SQS at 84 locations and the CSL at 69 locations. As a result of removing the sediment, overall contamination of the Duwamish River estuary will be reduced. Dredging will also improve the substrate for aquatic organisms that are prey for juvenile chinook salmon and other species in the Duwamish River estuary. Additional beneficial effects include:

- Pier 4S will be reconstructed in a manner that substantially decreases over-water coverage (50,366 square feet) and increase light passage.
- Pier 2 will be permanently removed (22,790 square feet).
- The side-launch shipway reconstruction frees up 2,271 square feet of over-water coverage and uses state-of-the-art construction materials.
- A habitat bench between minus 2 and plus 2 feet MLLW will be constructed in the area of Pier 4S, about 0.6 acres.
- Habitat mix will be placed over existing riprap armored areas.
- Clean sand will placed beneath all piers and other over-water structures not scheduled for demolition, resulting in improved substrate conditions.
- 2,770 creosote-treated piles will be replaced with 400 concrete and steel piles.
- Dredging for drydock modernization will avoid future disturbances.

The overall effect of these activities will be to reduce contaminant exposure and improve the prey availability, and habitat access for juvenile chinook salmon and other components of the Duwamish estuary aquatic community.

2.1.4.2 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably to occur (50 CFR 402.02). Indirect effects may occur outside the area directly affected by this action. For this consultation, the indirect effects are mostly those that would occur from future operations enabled by completing the proposed action.

A result of replacing the ship launching facility will be its future use for ship launching. Future operation would cause no additional construction effects on aquatic resources at Todd. Like the existing side-launch shipways, the replacement structure is designed for launching of vessels newly constructed at the shipyard. The replacement structure is a "level-launch" facility. When used, one of the existing dry docks at Todd will be temporarily moved and moored at the north end of the ship launching facility. A newly constructed ship can then be slid from the upland construction area, across the ship launch structure, onto the waiting dry dock. The dry dock would then be relocated to its normal berth for submergence and undocking of the ship. The dredging conducted during the cleanup effort, and reconstruction of the Northeast Shoreline, will provide depths suitable for operation of the ship launch facility. However, if any additional in-water work is required for operation of the ship launch facility, all necessary permitting would be acquired by Todd, including permit review and interagency consultation where appropriate.

Another result of the additional berth deepening on the west side of Pier 6 may be the future relocation of Dry Dock 1 to this location, stimulated by replacement of the existing Dry Dock 3 (at the west side of Pier 5) with a larger dry dock. While a replacement dry dock may increase over-water coverage in deeper subtidal areas which could removal some littoral zone habitat for listed species, the removal of nearshore overwater structure coverage under this action would greatly exceed anticipated future losses. At such time as Todd may replace Dry Dock 3 and relocate Dry Dock 1, all necessary permitting for dry dock replacement and relocation would be acquired by Todd, including permit review and interagency consultation where appropriate.

2.1.5 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 proposed Action is within a portion of the Duwamish Waterway, which has been previously altered by dredging, filling and other anthropogenic activities. However, future Federal actions 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.

The Duwamish Waterway is a major urban industrial waterway which supports marine container and barge shipping, fishing, rail and highway transportation, cement production, shipbuilding and repair, marine construction, transport related to aircraft manufacturing, sand and gravel operations, and recreational boating, to name a few on-going non-federal activities. The face of the waterway is continually changing as new waterfront facilities and uses occur. The ongoing operation of the waterway's facilities may increase the number of truck and rail trips on existing roads and railroads. These are within the local or private actions that are considered to create potential cumulative effects. In this case, these uses are not expected to have substantial additional effect on the species of concern or their habitat.

Other effects in the Action Area are those from other restoration actions taking place as a part of Elliott Bay/Duwamish Restoration Program pursuant to a 1991 Consent Decree (EB/DRP 1994). The Green/Duwamish Ecosystem Restoration Program has identified several potential landscape and watershed scale restoration sites to increase connectivity between important salmon habitat transition regions (COE 2000).

2.1.6 Conclusion

Having evaluated the collective effects of the proposed Action, the environmental baseline, and any indirect or cumulative effects, and taking into account measures for survival and recovery specific to the listed species' life stage, NOAA Fisheries finds that the proposed Action may result in short-term adverse impacts to chinook salmon due to in-water work activities. Of the 10 salmonid indicators, six were found to maintain, five (water quality chemical contaminants, sediment quality, estuarine habitat access, shoreline modification, benthic prey, and forage fish) were found to restore or improve baseline in the long-term and three were found to temporarily degrade then return back to baseline conditions or better. Due to the potential for benthic impacts, NOAA Fisheries agrees with the EPA's conclusion that the Action could temporarily degrade the baseline condition for turbidity, benthic prey, and forage at the point of Project dredging and capping. Measures to avoid work in the juvenile salmonid migration period, and engineering (BMPs) controls, will help minimize adverse short-term effects to salmonids.

Over the long-term, removal of highly contaminated sediments and creosote-treated pilings are beneficial aspects of the proposed Action that will restore the baseline condition for water quality. The baseline condition for benthic prey would also be temporarily degraded but will improve long-term from restoration of shorelines. NOAA Fisheries agrees with the EPA's conclusions that the remedial action will address risks to the environment and public health, reduce the levels of chemical constituents in sediment and thereby help improve and restore salmon habitat in Elliott Bay.

Based on the foregoing, it is NOAA Fisheries' biological opinion that the proposed Action is not likely to jeopardize the continued existence of PS chinook. In arriving at a non-jeopardy conclusion for this Action, the minimization measures were important to consider as is the establishment of clean substrates which supports increased benthic diversity and productivity. NOAA Fisheries finds that short-term potential negative effects associated with the actual construction activities are expected to be minimized or eliminated through the adherence to the project design objectives, BMPs, and conservation measures.

2.1.7 Reinitiation of Consultation

This concludes formal consultation on this proposed Action in accordance with 50 CFR 402.14(b)(1). The EPA must reinitate this ESA consultation if: (1) new information reveals effects of the Action that may affect listed species in a way not previously considered; (2) new information reveals the Action causes an effect to listed species that was not previously considered; or (3) a new species is listed or critical habitat designated that may be affected by the identified actions. In instances where the amount or extent of authorized incidental take is exceeded, any operation causing such take must cease pending conclusion of the reinitiated consultation.

2.2 Incidental Take Statement

The ESA at section 9 [16 USC 1538] prohibits take of endangered species. The prohibition of take is extended to threatened anadromous salmonids by section 4(d) rule [50 CFR 223.203]. Take is defined by the statute as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." [16 USC 1532(19)] Harm is defined by regulation as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." [50 CFR 222.102] Harass is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." [50 CFR 17.3] Incidental take is defined as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." [50 CFR 402.02] The ESA at section 7(o)(2) removes the prohibition from any incidental taking that is in compliance with the terms and conditions specified in a section 7(b)(4) incidental take statement [16 USC 1536].

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

2.2.1 Amount or Extent of Take Anticipated

The in-water dredging, capping, and habitat construction activities of the proposed action are generally scheduled to occur during a period of time (August 15 - February 14) when few individuals of the listed species are expected to be present in the action area. However, PS chinook use the action area in a way that they are highly likely to experience the various environmental effects of the activities that will be carried out under the proposed action. Therefore, the incidental take of PS chinook is reasonably certain to occur.

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 PS chinook to projects effects to the fewest individuals possible, and because incidental take is likely mainly from habitat modification, NOAA Fisheries cannot quantify the precise number of individual fish that might be taken. In such circumstances, NOAA Fisheries characterizes the take as unquantifiable and uses a surrogate to estimate the extent of take. The extent of habitat affected by an action can be a surrogate measure for take.

In this Action, the amount of habitat modification anticipated can be assigned by the construction activity based on the amount of change or activity in the littoral zone where juvenile chinook salmon could be found. Dredging will remove contaminated sediments in approximately 33 acres of open, deep water where even fewer juvenile chinook would be expected to occur during their usual shoreside, seaward migration. The capping footprint is approximately 5.4 acres, most of which is below minus 10 feet MLLW and shaded by existing over-water structures. Habitat improvements in the narrow shoreline band above minus 10 feet MLLW along the Northeast Shoreline and under the downsized Pier 4S are 1.74 acres (part included in the capping footprint area above and partially converted from depths below minus 10 feet MLLW).

Harm is also likely from exposure of fish to pile-driving and other in-water operations. In this proposed action, juvenile chinook salmon are reasonably certain to be harmed throughout the 38.9 acres of the project footprint but with different levels of potential harm. NOAA Fisheries anticipates, and would exempt from the take prohibition, a 10% exceedence of the openwater dredging area (3.3 acres), 10% exceedence of the capping footprint (0.54 acres), 12 piling change in the total of the 125 hollow steel piling driven by impact hammer, but no reduction in the improvements of the 1.74 acres of littoral habitat. Any amount of dredging over 10%, capping over 10%, piles more than 12 beyond those planned, or habitat improvements less than 1.74 acres, would exceed the anticipated extent of incidental take and require reinitiation per the provisions in 2.1.7, above.

2.2.2 Reasonable and Prudent Measures

The following RPMs are necessary and appropriate to minimize the take of PS chinook:

1. The EPA will minimize incidental take during construction by avoiding or minimizing adverse effects of dredging and disposal activities on PS chinook salmon.

2. The EPA will minimize incidental take during construction by avoiding or minimizing adverse effects of demolition and reconstruction of over-water structures activities on PS chinook salmon.

3. The EPA will minimize incidental take during construction by avoiding or minimizing adverse effects of cap and fill placement activities on PS chinook salmon.

2.2.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the EPA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms are non-discretionary. The EPA should include these terms and conditions as remedial requirements under Superfund orders to Todd.

1. To implement RPM No. 1:

   a) The EPA shall comply with the in-water work window detailed of August 15 through February 14 when the chance of encountering chinook salmon is minimal

   b) The EPA shall comply with all conservation measures (section 2.9) and BMPs (sections 2.8.4, 2.8.5, and 2.8.6) appropriate for dredging and disposal from the BA Addendum.

2. To implement RPM No. 2:

   a) The EPA shall comply with the in-water work window generally from August 15 through February 14, with limited work outside the designated in-water work window in accordance with Construction Schedule (section 2.10) in the BA, when the chance of encountering chinook salmon is minimal.

   b) The EPA shall comply with all the conservation measures (section 2.9) and BMPs (sections 2.8.1, 2.8.2, and 2.8.2) appropriate for demolition and reconstruction of over-water structures from the BA Addendum.

   c) The EPA shall ensure that, providing substrate conditions are appropriate, vibratory hammers are used to drive all piles. If substrate conditions are not appropriate, impact hammers may be used. Impact hammers will require hydroacoustic monitoring and use of a bubble curtain if the pressure thresholds are exceeded, as described below, or the automatic use of a bubble curtain without monitoring.

   d) The EPA will have Todd's contractor develop an acceptable design for a bubble curtain to be used during in-water driving of hollow steel piles with an impact hammer, equivalent or better than that described by Longmuir and Lively (2001).

   e) The EPA will have Todd develop and implement an hydroacoustic monitoring plan if bubble curtains are not routinely deployed. The plan should monitor for peak and rms sound pressure level generated during the impact driving of steel piles. The plan shall be reviewed and approved by NOAA Fisheries. No monitoring or sound attenuation measures will be required for piles driven in the dry beach at low tide, vibratory driving of any type of pile, or impact driving concrete piles. During hydroacoustic monitoring, the hydrophone shall be positioned at mid-depths, 10 meters distant from the pile being driven.

      i) If sound pressure levels exceed 150 dB_{rms} (re: 1 μPa)(0.032 KPa) for fewer than 50% of the impacts and never exceed 180 dB_{peak} (re: 1 μPa at 1 meter)(1 KPa), pile driving may proceed without further restriction; or

      ii) If rms sound pressure levels exceed 150 dB for 50% or more of the impacts, or peak pressures ever exceed 180 dB, pile driving may continue, but only with the use of a bubble curtain.

iii) If an unconfined bubble curtain is used, monitoring must show that it functions at all tidal stages. If it does not, then the confined bubble curtain must be utilized. If a confined bubble curtain is used, no other sound attenuation measures will be required, regardless of the attenuation it provides, or the tidal conditions during use.

iv) Within 60 days of completing the hydroacoustic monitoring, a report shall be submitted to NOAA Fisheries, Washington Habitat Branch, Lacey, Washington (Attn. Dr. John Stadler). The report shall include a description of the monitoring equipment and for each pile monitored, the peak and rms sound pressure levels with and without a bubble curtain, the size of pile, the size of hammer and the impact force used to drive the pile, the depth the pile was driven, the depth of the water, the distance between hydrophone and pile, and the depth of the hydrophone.

v) The EPA shall have a fisheries-qualified biologist observing and sampling for serious fish impacts during the proofing of two steel piles with an impact hammer during the July 2003, project activities. Should any chinook salmon demonstrate mortality or obvious stress, piling driving will cease and the EPA will notify NOAA Fisheries (Attn. Dr. Robert Clark, 206-526-4338)

3. To implement RPM No. 3:

a) The EPA shall comply with the in-water work window detailed of August 15 through February 14 when the chance of encountering chinook salmon is minimal.

b) The EPA shall comply with all conservation measures (section 2.9) and BMPs (section 2.8.7) appropriate for cap and fill placement from the BA Addendum.

3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 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 Essential Fish Habitat (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 (section 305(b)(2));

- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (section 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 (section 305(b)(4)(B)).

Essential Fish Habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA section 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 which 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.

3.2 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 U.S. exclusive economic zone (370.4 km) (PFMC 1998a, 1998b). Freshwater EFH for Pacific salmon includes all 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 kilometers) 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 action is based on these descriptions and information provided by the EPA.

3.3 Proposed Action

The proposed action and action area are detailed above in section 1 of this Opinion, are within the marine waters of Elliott Bay, and include habitats which have been designated as EFH for various life stages of 46 species of groundfish, four coastal pelagic species, and three species of Pacific salmon (Table 1).

Table 1. Species of fishes 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*

3.4 Effects of Proposed Action

As described in detail in section 2.1.5 of this document, the proposed action may result in detrimental short- and long-term effects to a variety of habitat parameters. These adverse effects are:

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

2. 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 and over-water construction activities.

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

3.5 Conclusion

NOAA Fisheries believes that the proposed action may adversely affect the EFH for the groundfish, coastal pelagic, and Pacific salmon species listed in Table 1.

3.6 Essential Fish Habitat Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions that would adversely affect EFH. NOAA Fisheries was invited by the EPA and Todd to recommend conservation measures during the preparation of the BA so that all of NOAA Fisheries' concerns have been addressed by the stated conservation measures (section 2.9) and BMPs (section 2.8) in the BA. These conservation measures are sufficient to minimize, to the maximum extent practicable, the adverse effects of the project to the EFH of the species in Table 1, and no additional conservation recommendations are necessary.

Because NOAA Fisheries is not providing conservation recommendations at this time, no 30-day response from the EPA is required (MSA section 305(b)(4)(B)).

3.7 Supplemental Consultation

The EPA must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR. 600.920(l)).

4.0 REFERENCES

Abbott, R. and E. Bing-Sawyer. 2002. Assessment of pile driving impacts on the Sacramento blackfish (*Othodon microlepidotus*). Draft report prepared for Caltrans District 4. October 10, 2002.

Beamish, R.J., M. Folkes, R. Sweeting, and C. Manken. 1998. Intra-annual changes in the abundance of coho, chinook, and chum salmon in Puget Sound in 1997. Pages 531-541 *in* Puget Sound Water Quality Action Team, Puget Sound Research 1998. Olympia, WA.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Bisson, P. A., and R. E. Bilby. 1982. Avoidance of suspended sediments by juvenile coho salmon. North American Journal of Fisheries Management 2:371-374.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19:83-139.

Blomberg, G. 2002. E-mail message to Shandra O'Haleck, NOAA Fisheries, regarding observations of fishes killed during impact driving of steel piles at Port of Seattle. January 18, 2003.

Blomberg, G., C. Simenstad, and P. Hickey. 1988. Changes in Duwamish River Estuary Habitat Over the Past 125 Years. Proceed. First Annual Meeting Puget Sound Research, Vol. 2, pp. 627-632. Puget Sound Water Quality Authority, Seattle WA.

Caltrans. 2002. Biological Assessment for the Benicia Martinez New Bridge Project for NOAA Fisheries. Prepared by Caltrans for U.S. Department of Transportation. October 2002. 37 pp.

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, WA.

Carman, R. 2003. Personal Communication to J. Stadler, NOAA Fisheries Lacey, WA. Fishery Biologist, Washington Department of Fish and Wildlife. Olympia WA.

Chan, J. 2001. Personal communications. U.S. Fish and Wildlife Service. Western Washington Office, Lacey, WA.

Crum, L. A. and Mao, Y. 1996. Acoustically enhanced bubble growth at low frequencies and its implications for human diver and marine mammal safety. Journal of the Acoustical Society of America 99(5): 2898-2907.

Desjardin, D. 2003. Personal Communication to J. Stadler, NOAA Fisheries, Lacey, WA. Port of Vancouver, British Columbia.

EB/DRP. 1994. Elliott Bay/Duwamish Restoration Program. Concept Document. Panel Publ. 7. Seattle WA. June 1994.

Feist, B.E., Anderson, J.J., and R. Miyamota. 1992. Potential impacts of pile driving on juvenile pink *(Oncorhynchus gorbuscha)* and chum *(O. keta)* salmon behavior and distribution.

Floyd Snider McCarthy Team (FSM Team). 2002. Preliminary Design Report, Todd Shipyards Sediment Operable Unit. Seattle, WA. December 5.

Fresh, K. 2003. Personal Communication to Shandra O'Haleck, NOAA Fisheries, Lacey, WA. Fish Biologist, Washington Department of Fish and Wildlife. Olympia, WA.

Frissell,C.A., P.H. Morrison, S.B. Adams, L.H. Swope, and N.P. Hitt. 2000. Conservation Priorities: An Assessment of Freshwater Habitat for Puget Sound Salmon. The Trust for Public Lands. Seattle WA. 138 pp.

Gaspin, J.B. 1975. Experimental investigation of the effects of underwater explosions on swimbladder fish, 1: 1973 Chesapeake Bay Tests. Naval Surface Weapons Center, Silver Spring, MD 20910. NSWC/WOL/TR 75-58.

Hastings, M.C. 2002. Clarification of the meaning of sound pressure levels and the known effects of sound on fish. August 26, 2002; revised August 27, 2002. pp 8.

Hastings, M.C., A.N. Popper, J.J. Finneran, and P. Lanford. 1996. Effects of low frequency sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus*. Journal of the Acoustical Society of America 99(3): 1759-1766.

Hicks, M. 1999. Evaluating criteria for the protection of aquatic life in Washington's surface water quality standards (preliminary review draft). Washington State Department of Ecology. Lacey, WA. 48p.

Hicks, B. J., J. D. Hall, P. A. Bisson, and J. R. Sedell. 1991. Responses of salmonids to habitat change. American Fisheries Society Special Publication 19:483-519.

Hynes, H. B. N. 1970. The ecology of running waters. Liverpool University Press, Liverpool, U.K. Healey, M.C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pp. 311-393 *In*: C. Groot and L. Margolis, (eds.) Pacific Salmon Life Histories.

University of British Columbia Press, Vancouver, BC, Canada.

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

Kerwin, J. and T. S. Nelson. 2000. Habitat Limiting Factors and Reconnaissance Assessment Report, Green/Duwamish and Central Puget Sound Watersheds (WRIA 9 and Vashon Island). Washington Conservation Commission and the King County Department of Natural Resources. Seattle WA.

Landau Associates, Inc. (Landau). 2001. Draft Technical Memorandum: Habitat Evaluation, Todd Shipyards Sediment Operable Unit, Seattle, Washington. Prepared for Todd Pacific Shipyards Corporation. Seattle, WA. October 5.

LaSalle, M. W. 1990. Physical and chemical alterations associated with dredging: an overview. Pp. 1-12. *In* C. A. Simenstad (ed.) Effects on dredging on anadromous Pacific Coast fishes. Workshop Proceedings. Washington Sea Grant Program, University of Washington, Seattle, WA. Published in 1990. 160p**.**

Longmuir, C. and T. Lively. 2001. Bubble curtain systems for use during marine pile driving. Report by Fraser River Pile & Dredge Ltd., 1830 River Drive, New Westminster, British Columbia, V3M 2A8.

Low**,** D. L. and K. Q. Myers. 2002. Elliott Bay/Duwamish Restoration Program: Year 1 Intertidal habitat projects monitoring report. U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office, Lacey, WA.

Lyman Burk and Associates (LBA). 2003. WINOPS, Dredge Positioning, Offshore Construction, and Hydrographic Survey Software and Systems. Available at http://www.winops.com**.**

Meyer, J. H., T. A. Pearce, and S. B. Patlan. 1981. Distribution and food habits of juvenile salmonids in the Duwamish Estuary, Washington. U.S. Fish and Wildlife Service, Fisheries Assistance Office, Olympia, WA.

Morton, J. W. 1976. Ecological effects of dredging and dredge spoil disposal: a literature review. Technical Paper 94. U.S. Fish and Wildlife Service. Washington D.C. 33 p.

National Marine Fisheries Service (NOAA Fisheries). 1998a. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. NOAA Tech. Memo NOAA Fisheries-NWFSC-35. 443p.

National Marine Fisheries Service (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, OR.

National Marine Fisheries Service (NOAA Fisheries). 2002. Use of tissue and sediment-based threshold concentrations of polychlorinated biphenyls (PCBs) to protect juvenile salmonids listed under the US Endangered Species Act. NOAA Fisheries Environmental Conservation Division, Northwest Fisheries Science Center. Seattle, WA.

National Marine Fisheries Service (NOAA Fisheries). 2003a. Biological Opinion for the Hood Canal Bridge Refit and Replacement Project. Northwest Region, Lacey, WA. NOAA Fisheries No. 2002-00546.

National Marine Fisheries Service (NOAA Fisheries). 2003b. Biological Opinion for the Benicia-Martinez New Bridge Project. Southwest Region. Santa Rosa, CA. Admin. Rec. 151422SWR02SR6292.

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

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

Pacific Fishery Management Council (PFMC). 1998b. The Coastal Pelagic Species Fishery Management Plan: Amendment 8. Portland, OR.

Pacific Fishery Management Council (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, OR.

Peterson Lee, Piper L. 2003. Habitat Mix Coverage for Thea Foss Remediation Areas – Thea Foss and Wheeler – Osgood Waterways, Commencement Bay/Nearshore Tideflats, Tacoma, Washington. Prepared by United States Environmental Protection Agency for the Public Works Department, Tacoma, Washington. March 31.

Quinn, T.P. 1988. Migratory behavior of Pacific salmon in estuaries: recent results with ultrasonic telemetry. In: C. A. Simenstad (ed.) Effects of dredging on anadromous Pacific Coast Fishes. 1990.

Romberg, P. C. 2000. Duwamish/Diagonal CSO site assessment report. King County Department of Natural Resources, Seattle WA.

R2 Resource Consultants. 2002. PIT Tagging of Juvenile Salmon Smolts in the Lake Washington Basin: Second Year (2001) Pilot Study Results. Final Report. Prepared for the US Army Corps of Engineers.

Seiler, D. 1999. Evaluation of Downstream Migrant Salmon Production in 1999 from Two Lake Washington Tributaries: Cedar River and Bear Creek. Draft.

Servizi, J. A. 1988. Sublethal effects of dredged sediments on juvenile salmon. Pp. 57-63. *In* C. A. Simenstad (ed.) Effects on dredging on anadromous Pacific Coast fishes. Workshop Proceedings. Washington Sea Grant Program, University of Washington, Seattle, WA. Published 1990. 160p.

Shannon, J. 2001. Personal communication (telephone conversation with Matt Luxon, Windward Environmental LLC, Seattle, WA, regarding bull trout captured in the lower Duwamish River). Fisheries Biologist, Taylor and Associates, Seattle, WA. April 11.

Shin, H.O. 1995. Effect of the piling work noise on the behavior of snakehead (*Channa argus*) in the aquafarm. J. Korean Fish. Soc. 28(4): 492-502.

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

Simenstad, C.A. 1990. *Effects of dredging on Anadromous Pacific Coast Fishes*: Workshop Proceedings, Seattle, September 8-9, 1988.

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.

Stadler, J. 2002. Personal Observations. Fishery Biologist, NOAA Fisheries, Lacey, WA.

Starkes, J. 2001. Reconnaissance Assessment of the State of the Nearshore Ecosystem: Eastern Shore of Central Puget Sound, including Vashon and Maury Islands (WRIAS 8 and 9). Prepared for the King County Department of Natural Resources, Seattle, WA.

Stotz, T. and J. Colby. 2001. January 2001 dive report for Mukilteo wingwall replacement project. Washington State Ferries Memorandum. 5 pp. + appendices.

Stroetz, R.W., N.E. Vlahakis, B.J. Walters, M.A. Schroeder, and R.D. Hubmayr. 2001. Validation of a new live cell strain system: Characterization of plasma membrane stress failure. Journal of Applied Physiology 90:2361-2370.

Teleki, G.C. and A.J. Chamberlain. 1978. Acute effects of underwaer construction blasting on fishes in Long Point Bay, Lake Erie. J. Fish. Res. Bd. Can 35:1191-1198.

Tanner, C. D. 1991. Potential Intertidal Habitat Restoration Sites in the Duwamish Estuary. Prepared for the Port of Seattle Engineering Department and The U.S. Environmental Protection Agency, Environmental Evaluations Branch. Seattle WA.

Taylor Associates. 1999. Duwamish East Waterway channel deepening project, alternative dredge disposal sites, juvenile salmonid and epibenthic prey assessment. Technical report prepared for the Port of Seattle, WA, by Taylor Associates, Seattle, WA.

Turnpenny, A.W.H., K.P. Thatcher, and J.R. Nedwell. 1994. The effects on fish and other marine animals of high-level underwater sound. Fawley Aquatic Research Laboratory, Ltd., Report FRR 127/94, United Kingdom.

U.S. Army Corps of Engineers (COE). 2000. Programmatic Biological Assessment for Green/Duwamish Ecosystem Restoration Program, King County, Washington. June, 2000. Seattle, WA.

United States Environmental Protection Agency EPA). 1996. Record of Decision. Declaration, Decision Summary, and Responsiveness Summary for the Shipyard Sediment Operable Unity, Harbor Island, Seattle, Washington. Seattle, WA. November.

United States Environmental Protection Agency (EPA). 1999. Explanation of Significant Difference to the Harbor Island – Todd Shipyards Portion of the Shipyard, Sediments Operable Unit, Record of Decision Seattle, WA. December.

United States Environmental Protection Agency (EPA). 2000. Administrative Order on Consent for Remedial Design Todd Shipyard Sediment Operable Unit. Seattle, WA. April 26.

United States Environmental Protection Agency (EPA). 2002. The health and ecological effects of endocrine disrupting chemicals: A framework for planning. EPA working Group.

United States Environmental Protection Agency (EPA). 2003a. Explanation of Significant Differences to the Harbor Island – Shipyard Sediment Operable Unit, Todd Shipyard Sediments, Seattle, WA, Selected Remedial Action. March.

United States Environmental Protection Agency (EPA). 2003b. Statement of Work, Remedial Action and Long-Term Monitoring, Todd Shipyard Sediment Operable Unit, Harbor Island Superfund Site, Seattle, WA. April.

Varanasi, U., E. Casillas, M. R. Arkoosh, T. Hom, D. A. Misitano, D. W. Brown, S. L Chan, T. K. Collier, B. B. McCain, and J. E. Stein. 1993. Contaminant exposure and associated biological effects in juvenile chinook salmon (*Oncorhynchus tshawytscha*) from urban and nonurban estuaries of Puget Sound. NOAA Technical Memorandum NMFS-NWFSC-8.

Vlahakis, N.E. and R.D. Hubmayr. 2000. Plasma membrane stress failure in alveolar epithelial cells. Journal of Applied Physiology 89:2490-2496.

Warner E. J and R.L. Fritz. 1995. The distribution and growth of Green River Chinook salmon and chum salmon outmigrants in the Duwamish Estuary as a function of water quality and substrate. Muckleshoot Indian Tribe. Auburn, WA.

Washington Department of Ecology (WDOE). 1995. Washington Administrative Code (WAC) Chapter 173-204, Washington State Sediment Management Standards. 29 December.

Washington Department of Fish and Wildlife (WDFW). 1994. Washington salmonid stock inventory.

Washington Department of Transportation (WSDOT). 2002. Standard Specifications for Road, Bridge and Municipal Construction, Section 9-13.1(2) Riprap, Quarry Spalls, Slope Protection, and Rock Walls.

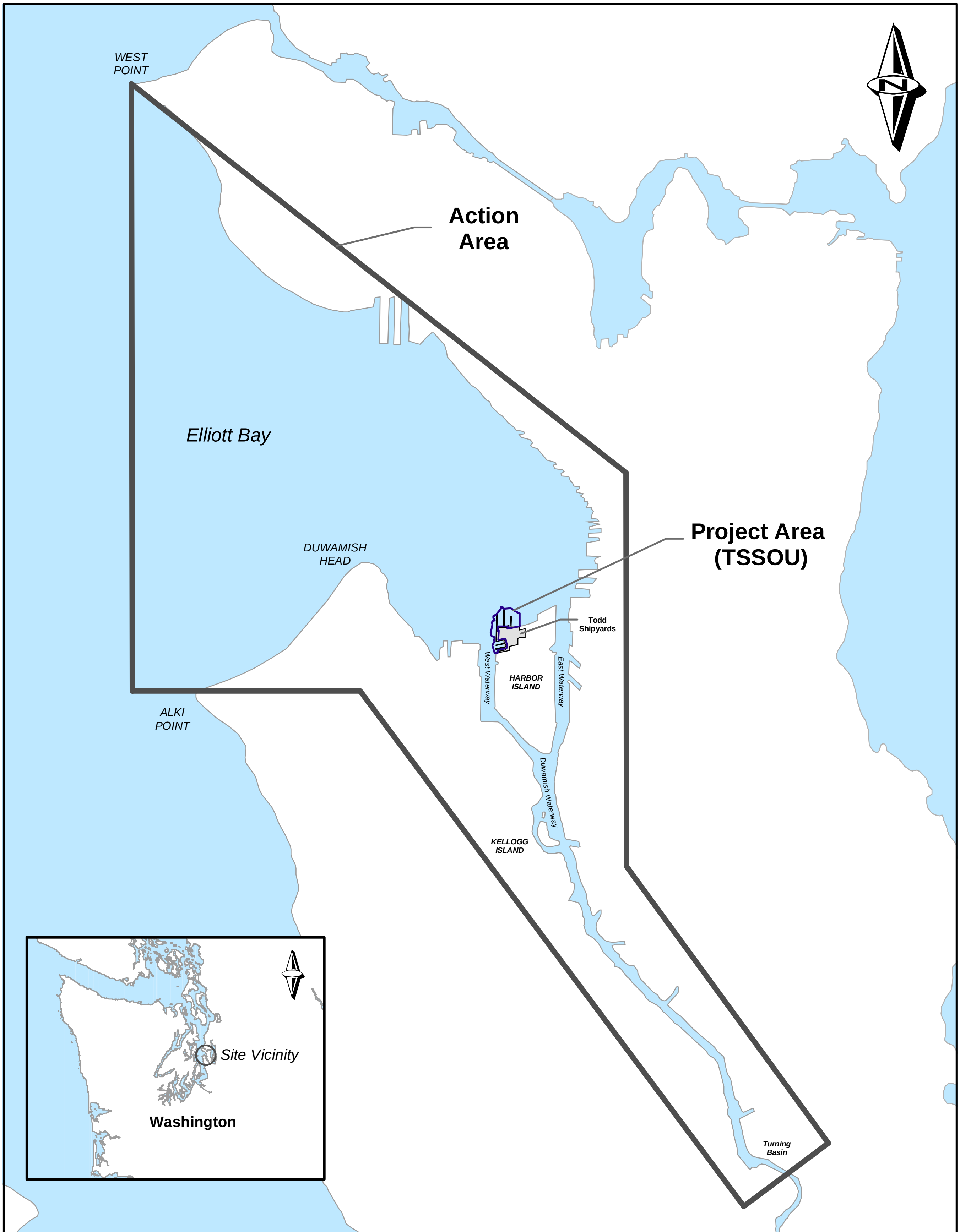
Weitkamp, D. and G. Ruggerone. 2000. Factors affecting chinook populations. Report to the City of Seattle, Seattle, WA.

Williams, R.W., R. M. Laramie, and J. J. James. 1975. A catalog of Washington streams and salmon utilization. Vol. 1 - Puget Sound. Wash. Dept. Fish. Olympia, WA.

FIGURE 1 - PROJECT AREA AND ACTION AREA MAP

FIGURE 2 - REMEDIAL ACTION SUMMARY

FIGURE 3 - TODD PACIFIC SHIPYARDS FACILITY BASE MAP

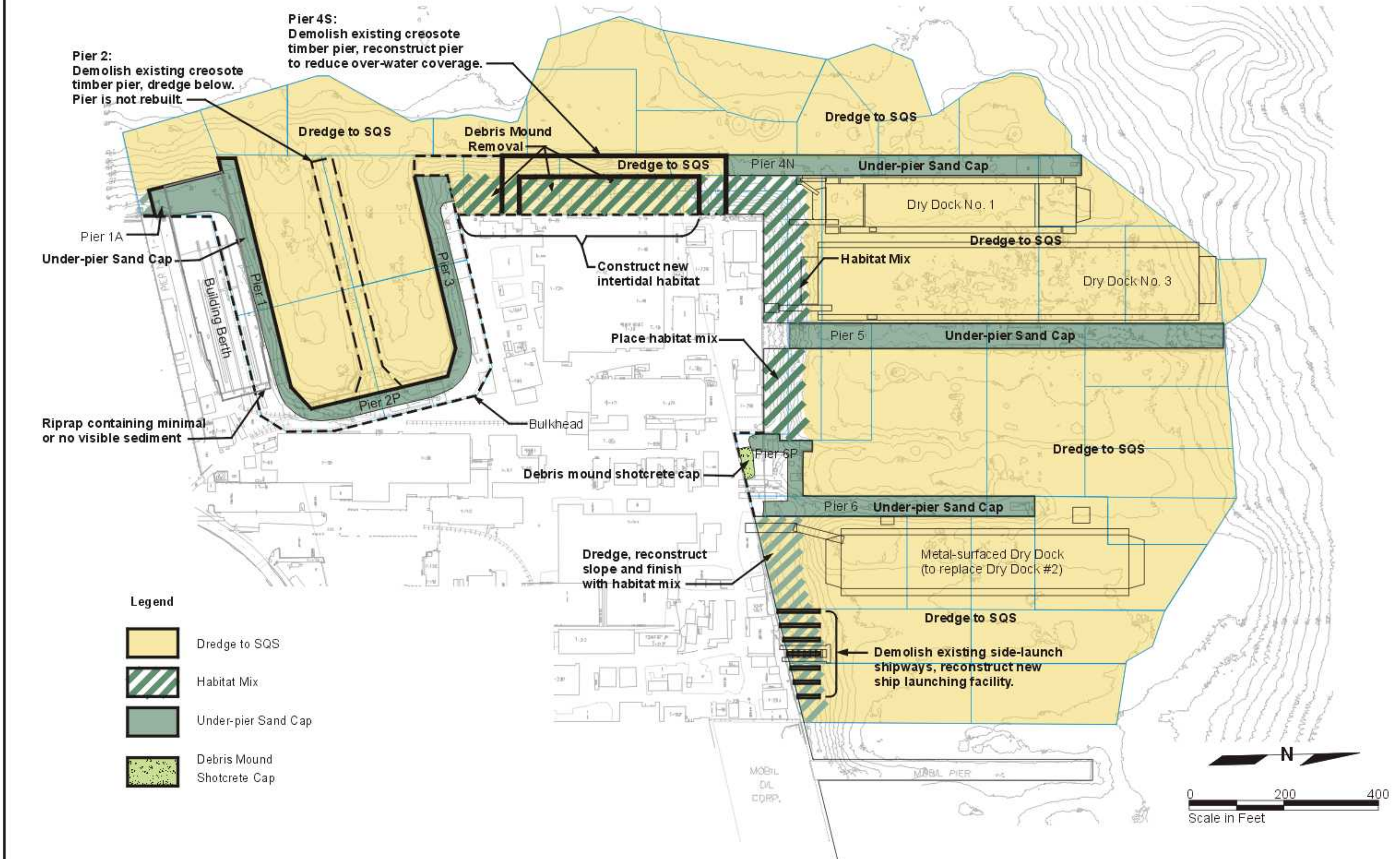


Floyd Snider McCarthy, Inc.
Strategy and Technical Solutions for Contaminated Properties

Biological Assessment
Todd Shipyards
Sediment Operable Unit

Figure 1
Project Area and Action Area Map

DATE: 4/30/2003 16:40:37
MXD NAME: \\Server02\Data\projects\TODD-NPL\GIS\BA - Figure 1.1.mxd



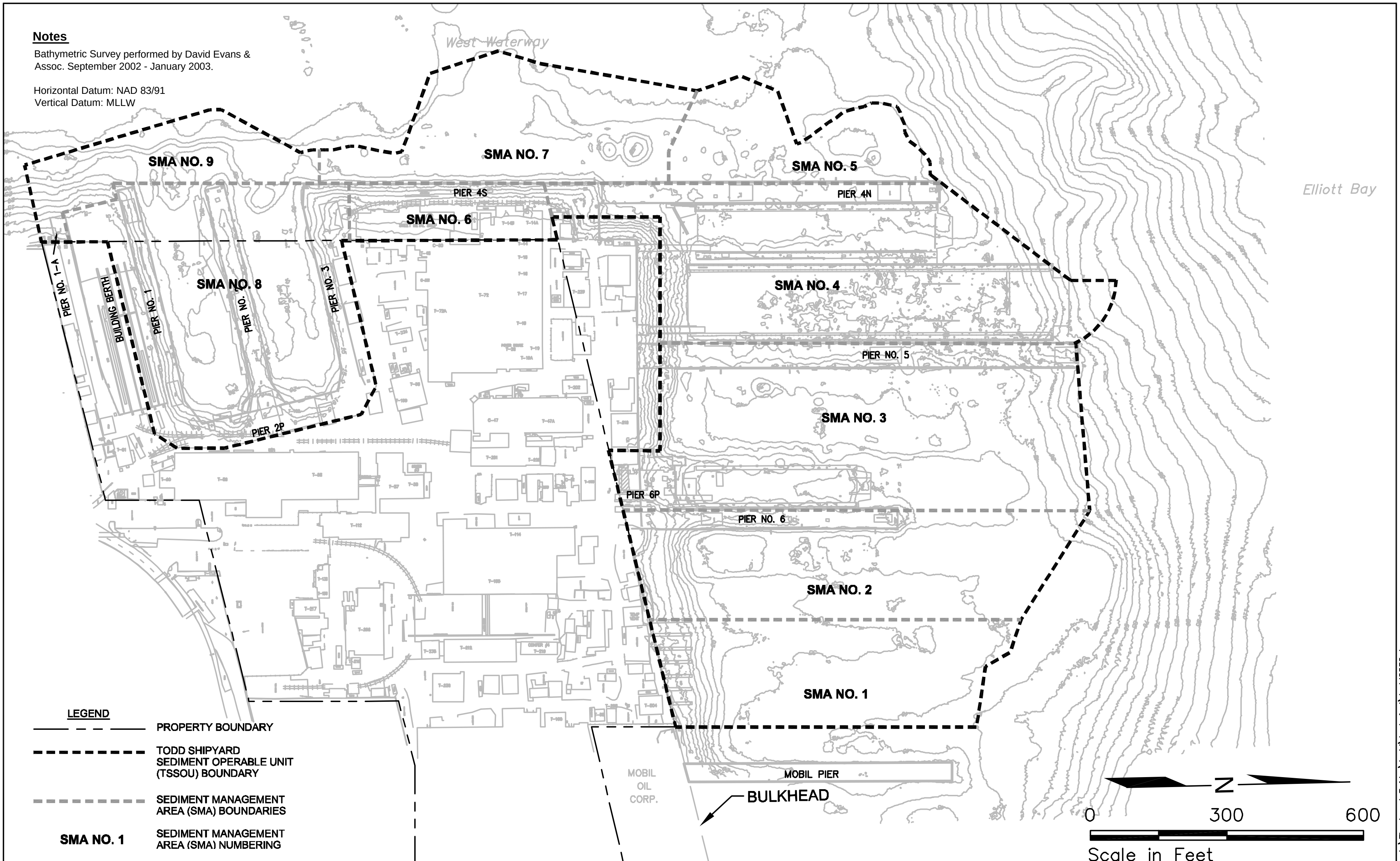
Floyd Snider McCarthy, Inc.
Strategy and Technical Solutions for Contaminated Properties

Biological Assessment
Todd Shipyards
Sediment Operable Unit

Figure 2

Remedial Action Summary

G:\project\Clients\Floyd and Snider\todd\NewCorelFigures\Draft Final\Figure2_1.cdr 07/22/03



Floyd Snider McCarthy, Inc.
Strategy & Technical Solutions for Contaminated Properties

Biological Assessment
Todd Shipyards
Sediment Operable Unit

Figure 3
Todd Pacific Shipyards Facility Base Map

DWG NAME: G:\project\Clients\Floyd and Snider\todd\technical\todd0089.dwg
DATE: 07/21/03 10:41am