Port of Seattle

East Waterway Harbor Island Superfund Site

EAST WATERWAY OPERABLE UNIT
PHASE 1 REMOVAL ACTION
COMPLETION REPORT

For submittal to

The U.S. Environmental Protection Agency
Region 10
Seattle, WA

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Anchor	Anchor Environmental, L.L.C.
AOC	Administrative Order on Consent
BMPs	best management practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
COC	contaminants of concern
CSL	Cleanup Screening Level
CQAP	Construction Quality Assurance Plan
CQCP	Construction Quality Control Plan
CWA	Clean Water Act
cy	cubic yards
DDTs	DDT and its metabolites
DMMP	Dredged Material Management Program
DMMUs	Dredged Material Management Units
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ESA	Endangered Species Act
EWW	East Waterway
GPS	Global Positioning System
Manson	Manson Construction Company
MLLW	mean lower low water
NTCRA	non time-critical removal action
NTP	Notice to Proceed
NTU	Nephelometric Turbidity Unit
OU	Operable Unit
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
Port	Port of Seattle
PRPs	Potential Responsible Parties
QA/QC	quality assurance/quality control
QAP	Quality Assurance Plan

QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SL	DMMP screening level
SMS	Sediment Management Standards
SQOs	sediment quality objectives
SQS	sediment quality standards
SRI	Supplemental Remedial Investigation
TAU	TAU, L.L.C.
TOC	Total Organic Carbon
Windward	Windward Environmental, LLC
WSDOT	Washington State Department of Transportation
WSOU	Waterway Sediments Operable Unit
WQC	Water Quality Certification

Completion Report
Record of Preparation, Review, and Approval

East Waterway Harbor Island Superfund Site
East Waterway Operable Unit
Phase I Removal Action

Report Prepared By:	PRP Agent	*Signature* _____ *Name/Title/Company* _____ *Date* _____
Approved By:	EPA Region 10 Approving Official:	*Signature* [illegible] *Name/Title/Company* EPA *Date* 9/30/05

1 INTRODUCTION

This report was prepared on behalf of the Port of Seattle (Port) and describes early action remedial activities performed by the Port at the direction of the U.S. Environmental Protection Agency (EPA) within the East Waterway (EWW) Operable Unit (OU) of the Harbor Island Superfund site. These activities, known as the Phase 1 Removal Action, include dredging and disposal of contaminated sediment and other work as described in the Phase 1 Engineering Evaluation/Cost Analysis (EE/CA; Anchor and Windward 2003b); the Nature and Extent of Sediment Contamination, Removal Boundaries Memo (Windward 2003a); and the Removal Design Report (Anchor and Windward 2003a). The work was performed by a remedial contractor selected by the Port through a competitive bidding process.

The EWW OU is part of the Harbor Island Superfund site, which was listed as an EPA National Priorities List Site in 1983 due to the contaminants released from a secondary lead smelter, as well as the releases of other hazardous substances from other industrial operations on Harbor Island. The Harbor Island Superfund site includes the following seven OUs:

- The petroleum storage tank facilities
- Soil/groundwater
- Lockheed Shipyard
- Lockheed Shipyard Sediments
- Todd Shipyard Sediments
- West Waterway
- East Waterway

EPA is the lead agency for all of these OUs except the petroleum storage tank facilities. The EPA site ID number for the Harbor Island Superfund site is WAD 980722839.

Following the listing of Harbor Island as a Superfund Site, the EPA performed a Remedial Investigation (RI), which included the sediments as a Waterway Sediments Operable Unit (WSOU). The sediment portion of the RI was completed in 1994.

In late 1994, a group of Potential Responsible Parties (PRPs) proposed a Supplemental RI (SRI) for the sediment areas. This led to an Administrative Order on Consent (AOC) with EPA covering additional sampling and analysis. SRI No. 1 was completed in 1996; it showed

different levels of concern for the different sediment areas. The group continued with SRI No. 2 tasks that covered bioaccumulation and human health risk assessment work, specified in the Scope of Work.

SRI No. 2 included a limited risk assessment for EWW as well as one for West Waterway to support the lower risk present in the West Waterway. SRI No. 2 eventually lead to the "No Action" Record of Decision for the West Waterway. It also highlighted elevated risks in the East Waterway.

During relatively the same time frame, but as a separate effort, the Port began evaluating dredging the EWW to improve navigation access for Terminals 18, 25, and 30. Sediment sampling conducted for dredging characterization showed a large area from the mouth of the river through the middle of the waterway that would require relatively modest quantities of dredging due to the existing depth and only moderate levels of contamination, and an area in the south that would require large dredge volumes due to relatively high levels of contamination.

Based on these findings, it was decided to move forward with dredging the area of generally lower contamination, which resulted in deepening the mouth, the middle, and a portion south along T-18 in the East Waterway. This effort was referred to as the Stage 1 dredging, and was conducted in cooperation with the U.S. Army Corps of Engineers as channel maintenance activity. The remaining, more contaminated areas south of the Stage 1 dredging area that were identified during the dredge investigations were not dredged at that time.

At that time, the EPA decided to allow the Stage 1 dredging to move forward in the hope that the dredging would address the issues in that area. A post-dredge monitoring plan was required by the EPA to estimate how well the dredging addressed the contamination in that area. The post dredge monitoring that was conducted about a month after the Stage 1 dredging showed that the chemical concentration of the sediments had generally decreased, although not as much as expected, and the bioassays showed that at that time the toxicity had increased.

Based on these findings, along with the general levels of contamination and potential risk in the EWW, the EPA decided that any additional cleanup dredging in the EWW should be performed

as an EPA-lead cleanup. The Port offered to work with the EPA on this effort. After discussions with the EPA, the Port singed an AOC for SRI No. 3 to assemble the existing data and to conduct the additional investigation necessary in EWW to identify and address the remaining contamination.

One of the results of SRI No. 3 was the delineation of eight areas of potential concern. The area containing the greatest mass of contamination and the highest total levels of contamination was the area in the middle to south portion of the EWW that had not been addressed in the maintenance dredging. Based on the work that had been performed to date, this area did not require additional study, characterization, or design investigation prior to remediation. The EPA decided to move forward with a non time-critical removal action (NTCRA) to address this area. The results of this action, referred to as the Phase 1 Removal Action, are documented in this report. The Port signed an AOC in September of 2003 to perform this Phase 1 Removal Action for the EPA.

Although work in the EWW OU continues, the Phase 1 Removal Action remedial activities have been completed. The purpose of this report is to document the completion of these activities. This report includes the following information, as described in the Close Out Procedures for National Priorities List Sites (EPA 2000):

- Section 2: Phase 1 Removal Action Background
- Section 3: Construction Activities
- Section 4: Chronology of Events
- Section 5: Performance Standards and Construction Quality Assurance and Quality Control
- Section 6: Field Inspection and Certification
- Section 7: Operations and Maintenance
- Section 8: Summary of Project Costs
- Section 9: Observations and Lessons Learned
- Section 10: Operable Unit Contact List
- Section 11: References

1.1 Project Setting

The EPA has ordered the Port to address sediment contamination issues in the EWW OU of the Harbor Island Superfund site per the process defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund. As part of this process, the Port will conduct a remedial investigation/feasibility study (RI/FS) that will ultimately lead to an EPA Record of Decision (ROD) outlining cleanup actions to address threats to human health and the environment in the EWW. Based on a review of preliminary data collected, the EPA determined that a NTCRA was warranted for a portion of the EWW. This NTCRA was defined as the Phase 1 Removal Action, and covered approximately 20 acres in the southern portion of the EWW. Cleanup of the remainder of the EWW will be addressed in Phase 2.

1.2 Description of EWW and Phase 1 Removal Action Area

The EWW is located in Puget Sound's Elliott Bay in Seattle, Washington (Figure 1). The EWW is part of the greater Duwamish River estuary, which also includes the West Waterway (on the western side of Harbor Island) and the Lower Duwamish Waterway (which extends from the southern tip of Harbor Island to Turning Basin 3 approximately 5 miles south of Harbor Island). The bed of the EWW is owned by the State of Washington and managed by the Department of Natural Resources. The EWW is channelized, has a south to north orientation, and is approximately 7,600 feet long and 750 feet wide. The southern 1,500-foot section of the EWW varies in width from 225 feet to approximately 130 feet near the West Seattle Bridge (Weston 1993). The elevation of most of the EWW ranges from -29 to deeper than -51 feet mean lower low water (MLLW; Weston 1993). Elevations increase to -7.2 feet MLLW at the southern end, in the vicinity of the West Seattle Bridge (Weston 1993). Figure 2 presents the pre-project bathymetry in the EWW.

The former Duwamish River delta/mudflat and surrounding floodplains were filled and graded to form the present day topography. Dredging from 1903 through 1905 created the EWW and the West Waterway, and dredged material from the river was used to create Harbor Island (Weston 1993). The present urban and developed shoreline is primarily composed of piers, riprap bank lines, and constructed bulkheads for industrial and commercial use.

The Phase 1 Removal Action area is bounded on the west by Terminal 18 and on the east by Terminals 25 and 30. It covers approximately 20 acres and had an average pre-project depth of approximately -42 feet MLLW. The Phase 1 Removal Action area was characterized by shallower depths as compared to the deeper berths at the surrounding Terminals 18 and 25 (Figure 2).

1.3 Surrounding Land Use

The EWW is surrounded by container terminal apron and supports heavy manufacturing, wholesale, and maritime industries associated with docking services, cargo handling, fish processing, shipbuilding, and cold storage. The resulting deep-draft vessel and barge traffic on the EWW transports millions of tons of manufacturing materials and other cargo every year.

Harbor Island forms the west bank of the EWW. Used for heavy industry since its formation in the early part of the 20th century, Harbor Island has supported land uses that have included ocean and rail transport operations, bulk petroleum shipment and storage, metal fabrication, food processing, solid waste transfer, wood processing, and shipbuilding. Warehouses, laboratories, and office buildings are now (and historically have been) located on the island. There are currently 35 buildings on the island, and 95 percent of the island's surface is covered by impervious material.

Based on a review of tax lots, the closest residential properties to the EWW are approximately 0.5 mile away. Public access to the EWW is limited to a small street end park on the east shoreline at Terminal 30 and a fishing bridge at the very southern end of the waterway.

1.4 Recap of Previous Investigations

EWW sediments have been characterized during multiple investigations, as summarized in the Phase 1 EE/CA (Anchor and Windward 2003b). Three of these investigations in particular provided data to support the final Dredged Material Management Program (DMMP) suitability determination for this project. Suitability determinations identify which sediments are suitable for unconfined open water disposal at a DMMP Open Water Disposal Site and which sediments are unsuitable for open water disposal.

DMMP suitability determinations were made during the following three investigations:

- Sediment Characterization and Analysis Results (EVS 1998)
- Channel Deepening Sediment Characterization (SAIC 1999)
- Recency Data Report (Windward 2003b)

Results of these DMMP suitability determinations are provided in the Recency Data Report (Windward 2003b).

Based on these investigations, all surface (i.e., upper 4 feet) Dredged Material Management Units (DMMUs) within the Phase 1 Removal Action area were determined to be unsuitable for open water disposal. In some areas, DMMP-unsuitable sediments were also present in the subsurface DMMU to a depth of -51 feet MLLW.

Sediment chemistry concentrations in the Phase 1 Removal Action area exceeded Washington State Sediment Management Standards (SMS) sediment quality standards (SQS) for multiple chemicals, with several chemicals having exceedance factors greater than 10 times their respective cleanup screening level (CSL) standards in both surface and subsurface sediments. The chemicals with the greatest number of exceedances were mercury, total polychlorinated biphenyls (PCBs), dieldrin, and total DDTs. In addition, toxicity testing of both surface and subsurface sediments clearly showed both lethal and sublethal effects in benthic test organisms. Most of the data available for this area was the result of 0 to 4 foot and greater than 4 foot cores collected for DMMP characterization. Relatively few 0 to 15 centimeter surface sediment samples were collected, which typically characterize the biologically active zone for surface sediments.

2 PHASE 1 REMOVAL ACTION BACKGROUND

2.1 Background

The Phase 1 Removal Action area boundary was established in the Phase 1 EE/CA submitted to EPA and finalized on July 29, 2003 (Anchor and Windward 2003b). The Removal Design Report (Anchor and Windward 2003a) described dredging an estimated 260,000 cubic yards (cy) of sediments to -51 feet MLLW to meet cleanup standards and to achieve navigation channel depths; additional dredging was planned if necessary to meet cleanup standards. Of the 260,000 cy, approximately 200,000 cy were estimated to be unsuitable for open water disposal. These sediments were rehandled to an upland staging area and were stockpiled and dewatered by gravity before being transported by rail to an existing solid waste landfill facility. That facility had to be approved by the Port and the EPA, and regulated under the Resource Conservation and Recovery Act (RCRA) as a Subtitle D landfill.

The remaining estimated 60,000 cy of sediments dredged during the Phase 1 Removal Action were characterized under guidelines established in the DMMP suitability determinations and found to be suitable for unconfined open water disposal. These sediments were transported by barge to the Elliott Bay Unconfined Open Water Disposal Site (Figure 1) for final disposal.

2.2 Goals and Objectives of the Phase 1 Removal Action

The Phase 1 EE/CA established the objectives and goals of the Phase 1 Removal Action (Anchor and Windward 2003b). The Removal Design Report provided the basis of design for the Phase 1 Removal Action and considered the removal action objective, cleanup standards, and other factors (Anchor and Windward 2003a). As described in the EE/CA and Action Memo (EPA 2003), the specific objective of the removal action was to:

- Reduce the concentrations of contaminants in sediments to below the cleanup standards in the biologically active zone (0 to 10 cm).

The specific cleanup standard to which the Phase 1 Removal Action area was remediated, as presented in the EE/CA (Anchor and Windward 2003b, Section 4.4), is:

- The chemical concentrations in the newly exposed surface sediments will be less than the SQS or screening level (SL) as appropriate for all chemicals (the DMMP SL will be used where there is no SQS value).

In addition to achieving those standards, the following restrictions and controls were important considerations during implementation of the Phase 1 Removal Action:

- Sediment resuspension and recontamination were to be minimized during the removal action by using best management practices (BMPs).
- Consistent with State Hydraulic Code Rules and Endangered Species Act (ESA) requirements, dredging and other in-water work could not occur during identified "fish window" closure periods. The specific dates of these closures were identified in consultation with the natural resource trustees. At the time the project was bid, dredging was prohibited between February 15 and August 16. These dates were later revised; see Section 3.
- Consistent with Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (CWA), the selected alternative could not prevent the use of the EWW as a working navigation channel. The federal navigation channel depth of -51 feet MLLW must be maintained.
- The Phase 1 Removal Action had to be coordinated with tribal net fishing in the EWW.
- If possible, the Phase 1 Removal Action was to begin in 2003. The Phase 1 Removal Action was bid in 2003, but began in January 2004.
- The Phase 1 Removal Action was to be designed to minimize the chance of a contaminated sediment surface being exposed between the two construction seasons in which the Phase 1 Removal Action occurs.
- To the extent practicable, the Phase 1 Removal Action was to contribute to the efficient performance of the anticipated remedial action for the EWW OU.

2.3 Summary of the Removal Action Design

The Phase 1 Removal Action design included the following major components:

- Mechanical dredging and upland permitted landfill disposal of an estimated 200,000 cy of sediment characterized as unsuitable for unconfined open water disposal at a designated open water site.
- Mechanical dredging and open water disposal of an estimated 60,000 cy of sediment suitable for unconfined open water disposal at a designated open water site.
- Contingency measures to meet cleanup objectives, including additional dredging and placing clean cover, as determined necessary upon completion of the planned dredging.
- Dredging sequenced such that the contractor had to achieve depths to allow commerce activities in the westernmost region (Region W) first, then move to the west central region (Region W'), and finish in the east region (Region E).

Based on the volume of sediment that was to be removed, the work was planned to span two in-water construction seasons. The construction seasons were separated by a fish-closure window, when in-water construction was not allowed, as a resource protection measure for migrating juvenile salmon.

Specific measures were taken to minimize potential environmental impacts while completing the work, and to ensure that the project objectives would be met to the maximum extent possible. As described in the Removal Design Report (Anchor and Windward 2003a), these measures included:

- BMPs utilized by the contractor during dredging to control turbidity and loss of contaminated sediment.
- Water quality monitoring during construction, as required by the EPA and its Water Quality Certification (WQC). All water quality results were directly relayed to the contractor for feedback on operations.
- Phasing the work so that between construction seasons the newly-exposed dredged surface would likely meet the anti-degradation goal of the Washington State Department of Ecology. This goal stipulated that the new dredge surface should not have contaminant concentrations that are greater than the original (prior to dredging) mudline surface concentrations.

- Collecting post-dredge confirmatory sediment samples to delineate areas where additional dredging passes were required, with subsequent placement of a minimum 6-inch clean sand layer over these contingency dredge areas.

Complete details of all of these project elements are provided in the Removal Design Report (Anchor and Windward 2003a).

3 CONSTRUCTION ACTIVITIES

This section discusses contractor work plans, dredging activities during both seasons while dredging unsuitable and suitable sediment, and clean cover placement operations.

The Port awarded the EWW Phase 1 Removal Action construction contract to Manson Construction Company (Manson) on December 5, 2003. After the Port and the EPA reviewed Manson's pre-construction submittals, a pre-construction conference was held on January 9, 2004, and the Port issued the Notice to Proceed (NTP) the same day. Manson began mobilization and offloading site preparation prior to the NTP on December 29, 2003, and began dredging on January 12, 2004. Construction activities included:

1. Mobilization
    - Preparing the offloading site
    - Preparing the work plan and other submittals
    - Conducting a pre-dredge survey
2. In-water work
    - Dredging unsuitable material
    - Offloading unsuitable material
    - Dredging suitable material
    - Placing suitable material at the Elliott Bay Unconfined Open Water Disposal Site
    - Conducting progress surveys and final project bathymetric survey
    - Dredging contingency material (unsuitable disposal)
    - Placing clean sand cover
    - Placing clean gravel cover over the mound toe at Slip 27
3. Upland work
    - Stockpiling and dewatering
    - Water collection, treatment, and discharge into King County waste water collection lines
    - Rehandling to rail car
    - Transporting to disposal site
    - Decontamination of site and demobilization

3.1 Mobilization and Offload Site Preparation

To facilitate operations for rehandling unsuitable dredged material to the upland, Manson contracted with TAU, L.L.C. (TAU). TAU, a joint venture between Wilder Construction and the Regional Disposal Company (Rabanco), leased a portion of Terminal 25 from the Port in the fall of 2003 and transformed it into a marine transfer station for contaminated sediment and debris. Contaminated material from different dredge sites in the Puget Sound would be offloaded at their facility, rehandled into rail cars, and transported to a Rabanco Subtitle D landfill in Klickitat County, Washington.

Before rehandling operations started, TAU protected all stormwater outlets and placed barriers around the outer perimeter of the site to prevent contaminated sediment transport outside the site, and to prevent direct discharge of sediment or water into the EWW. TAU designed the transloading facility to collect, store, and treat all water contacting the sediments, including precipitation in the footprint of the facility. TAU obtained a permit from King County to discharge treated site water to municipal sanitary sewer lines, and that permit specified allowable chemical concentrations and discharge rates. Other discharge conditions were imposed by Seattle Public Utilities. TAU provided specific BMPs for operation of their facility as part of the required Environmental Protection Plan (EPP) submitted by Manson. The EPA approved the EPP as part of the Remedial Action Work Plan for this project (Anchor 2004).

3.2 Work Plan Preparation and Submittal

As required by the construction contract, Manson prepared multiple work plans to separately describe their methodology for various operations. These work plans were reviewed by the engineer and by the EPA for compliance with contract and regulatory requirements. The work plans submitted by Manson included:

- Contractor Health and Safety Plan
- Dredging and Disposal Work Plan
- Environmental Protection Plan
- Construction Quality Control Plan (CQCP)
- Contingency Capping Sand Cover Work Plan

Work plans included information on sequence, equipment, means and methods of performance, BMPs, and other pertinent information.

3.3 Dredging and Disposal

As described in the contractor's work plans, the dredging and disposal operation had the basic components presented below.

3.3.1 Equipment

Dredging was accomplished using barge-mounted derrick cranes and clamshell buckets. A variety of buckets were used depending upon the material type, derrick capability, availability of equipment, and other factors. Most of the unsuitable sediment was excavated with an "environmental bucket," or closed bucket (as manufactured by Cable Arm). Standard 5 and 10 cy digging buckets were used for material that could not be excavated with the closed bucket. Major support equipment included a flat deck haul barge, bottom-dump scow, a tug boat, and a survey boat.

Flat deck barges had fences with fabric line scuppers to allow gravity drainage of sediment. The filter fabric was used to remove particulates from the drained water prior to discharging into the EWW. Barges loaded with unsuitable material were moved to the offloading facility. Material was lifted from the barge deck by the dredge derrick or land mounted crane, hoisted over a "dribble barge" and across a terminal-mounted spill apron, and placed in the sediment storage area. With these BMPs in place, any material that drops is prevented from reentering the waterway. All sediment was subsequently scooped up by a loader and dumped into lined rail cars. Photographs of the equipment in operation are provided in Appendix A.

3.3.2 Landfill Disposal

Unsuitable material offloaded by TAU at Terminal 25 was transported by rail to the Subtitle D landfill in Klickitat County, Washington. Other than gravity dewatering, no sediment dewatering process or treatment with additives was required. It is understood that the sediment moisture content was welcome at the semi-arid landfill facility to help generate decomposition and methane generation/collection at the landfill.

3.3.3 Open Water Disposal

Suitable material was placed in a dump scow and discharged in the Elliot Bay Unconfined Open Water Disposal Site. Standard location and notification procedures were used, as required by permit, to ensure dumping occurred at the permitted location.

3.4 In-Water Construction Season 1—Unsuitable Sediment Dredging

Manson started Phase 1 dredging operations on January 12, 2004, in Region W, with Derrick 8, which was equipped with a 10 cy cable arm bucket. Manson's project personnel normally consisted of a project manager and a four-person crew, composed of a dredge captain, an operator, a deck engineer, and an apprentice. The crew normally worked a 12-hour shift.

Manson's operations, from their start on January 12, were similar to what was described in their work plan, with dredging one day and offloading the next. Starting January 28, 2004, TAU agreed to offload Manson's material the same day it was dredged, using a land-based crane. From then on, Manson conducted dredging operations during the day, moored its barge against the Terminal 25 wharf at the end of the 12-hour shift, and TAU personnel offloaded material during the night.

During the first few weeks of dredging, the average cycle time for Manson's cable arm bucket was approximately 2.5 minutes; approximately 970 cy of material was dredged each day of dredging. After a few weeks of dredging, Manson indicated that they were encountering material near the bottom of the required dredge prism that the cable arm bucket was unable to remove, and that Manson was planning to remove this material at a later date with a standard digging clamshell bucket. This was consistent with their dredge plan.

The Port asked Manson to finish dredging all unsuitable material in Regions W and W' to minimize the risk that the contractor would leave a more contaminated newly exposed surface at the end of the first in-water construction season. This decision supported the anti-degradation goal expressed by the Washington State Department of Ecology. Late in Season 1, it was discovered through survey reviews that Manson lost some of their horizontal and vertical control of the dredge bucket. The control problem was not reported by their dredge operator, and surveys did not allow discovery until late in Season 1. The dredge control

problem resulted in an over-excavated area (deeper than -53 feet MLLW). The over-excavated area is evidenced on the bathymetry map in Figure 4 (roughly between Station 38+50 and Station 41+00 in Region W). Once discovered, and to prevent unsuitable sediment from being left exposed at the end of Season 1, Manson fixed the control problem and continued dredging to meet seasonal dredge limit requirements. The Port sought and received an extension of the construction window to allow Manson to complete dredging the exposed unsuitable material in Regions W and W′. Consequently, Manson was authorized to dredge until March 15, 2004, instead of February 15, which was the original date that in-water construction was to stop. Manson was able to complete the unsuitable material dredging for the first in-water construction season on March 3, 2004.

3.5 In-Water Construction Season 2—Unsuitable Sediment Dredging

The Port recognized that Manson required more time in Season 2 to complete the work due to the relatively low production rates achieved in Season 1. The Port sought the EPA's assistance to allow the contractor more dredging time. In order to keep the project on schedule, the EPA, in consultation with resource agencies, authorized Manson to resume dredging activities on July 15, 2004. This was 30 days prior to the planned Season 2 start date for construction. Manson resumed dredging operations on July 20, 2004, in Region W with a cable arm bucket. A new dredge operator was introduced to the job site, and horizontal and vertical controls on the derrick were in good working order. During July and August, the average production rate was approximately 1,330 cy per day.

Manson dredged unsuitable material in Regions W and W′ with the cable arm bucket until August 17. On August 18, 2004, Manson equipped Derrick 8 with a 5 cy digging bucket and began dredging to grade in the material that could not be removed by Derrick 8 equipped with the cable arm bucket. Dredging with the digging bucket lasted until September 7, during which time Manson concentrated on removing the remaining unsuitable material above the design grade. The average production rate was approximately 445 cy per day. After unsuitable material dredging operations were completed in Regions W and W′, Manson moved to Region E with the 10 cy cable arm bucket. At that time, to increase daily production, Manson added another crew shift, thus changing from one 12-hour crew to two 8-hour crews. Each crew had the same number of personnel working 8 hours each shift, to increase the number of hours worked daily from 12 to 16 hours.

Dredging activities in Region E were similar to the activities in Regions W and W′. The cable arm bucket was used to remove most of the unsuitable material; however, there were unsuitable sediments above design grade that Manson stated they were unable to dredge with Derrick 8 and the cable arm bucket.

Nighttime and weekend tribal fishing occurred as expected in August. However, due to strong fish runs through mid-September, tribal fishermen continued to deploy fish nets in the waterway, and did not conclude their fishing activities until early October. This extended level of tribal fishing was not anticipated. Active communication between Manson, the Coast Guard, the Port, and the tribes reduced Manson's downtime, but still resulted in 3 full days and several partial days of lost dredging time during that period.

Manson finished dredging with the cable arm bucket on November 10, 2004, and continued dredging the remaining unsuitable material with Derrick 8 equipped with the 5 cy digging bucket. On December 14, 2004, Manson mobilized the Viking, which has a heavier lift capacity and was equipped with a 14 cy digging bucket. The contractor also re-configured the rigging of the bucket to improve efficiency.

Changes in derricks, types of buckets, type of material, number of crews/hours worked, and dredge operation modes all affected the dredging production rates. The average production rate in Region E with the cable arm bucket was approximately 1,800 cy per day in unsuitable material. The average production rate was approximately 435 cy per day when Manson used Derrick 8 equipped with the 5 cy digging bucket doing "clean up" passes. The average production rate was approximately 1,500 cy per day when the Viking was used with a 14 cy bucket. Manson completed all dredging activities in Region E on January 20, 2005. Approximately 180,000 cy of unsuitable material was removed from Regions W, W′, and E, as measured by pre- and post-bathymetric surveys (Figures 2 and 3). The contract estimated volume was 200,000 cy. The contract estimate included 1 foot of allowable overdepth that, if dredged, the Port would compensate the contractor for. Due to equipment tolerances in normal dredging operations, it is common to allow 1 to 2 feet of overdepth. On this project, the contractor was very careful to limit overdredging in areas with unsuitable material, which kept total dredging below estimated quantities.

3.6 In-Water Construction Season 2—Suitable Sediment Dredging

Following equipment decontamination procedures, Manson started dredging suitable material 24 hours per day, using two 12 hour shifts. Suitable dredging activities started on January 20, 2005, and ended on February 1, 2005. The Viking, equipped with a 14 cy digging bucket, was used to remove suitable sediments. Sediments were loaded onto a bottom dump scow, transported to the Elliott Bay Open Water Disposal Site, and placed there. Approximately 67,300 cy of suitable material was removed from Regions W, W', and E. Bathymetric contours following the removal of the suitable material are provided in Figure 4. The contract estimated volume was 60,000 cy. The higher volume of suitable material was removed due to the contractor being careful to dig to design grades and minimize the allowable overdepth volume when dredging the overlying unsuitable material. The total volume of all dredged material removed prior to sampling and contingency dredging was 247,300 cy, slightly less than the 260,000 planned.

3.7 Post-Dredge Monitoring Sampling

At the conclusion of the planned dredge activities, the post-dredge monitoring sampling was conducted to confirm that sediment quality objectives (SQOs) were met at the post-dredge design grades. Results from the sampling were used to determine that contingency actions were required. Contingency actions included additional dredging of approximately 1 foot of material and placement of a layer of clean sand material. Sampling was originally planned to occur at the conclusion of all dredging, during a stand-by period of up to 7 days. However, in consultation with the EPA at the conclusion of unsuitable dredging, sediment sampling activities were coordinated with suitable sediment dredging activities to minimize stand-by time for the contractor. Sampling of the northern portion of the site occurred while the contractor was dredging suitable material in the southern portion of the site. Sediment sampling occurred after surveys showed design grades were achieved and the survey results were accepted by the EPA. After all suitable material had been dredged, only 1 stand-by day was necessary to complete the post-dredge monitoring sampling. This coordination enabled the Port and the EPA to quickly delineate a contingency dredging area where additional removal was required. The boundary of the contingency dredge area was defined by the results of chemical analysis of the post-dredge monitoring samples. A discussion of the results of the post-dredge monitoring sampling is provided in Section 5.4.

3.8 Contingency Dredging and Placing Clean Cover

The contract contingency actions were bid and in place, should post-dredge monitoring sampling indicate that the chemistry of the newly dredged bottom sediment still had elevated levels of contaminants. The contingency dredge area boundaries were delineated by the EPA in consultation with the Port and Ecology, based on the post-dredge monitoring sampling chemistry results and project time constraints. The contingency actions included dredging approximately 1 foot of additional material (to -53 feet MLLW) and placing a minimum of 6 inches of clean sand cover in the contingency dredge areas. The contingency dredge areas are depicted in Figure 5. No contingency dredging occurred on the mound slope, as it was not necessary to achieve project goals. In addition to the contingency dredge area, the cut-back surface on the mound was also considered for placement of cover material. Angular material was selected as cover material for the newly exposed surface of the mound, because it was believed to be more stable on the mound slope face than sand. No contingency dredging was conducted on the mound, because the reduced depth (resulting from the placement of cover material) was not critical for navigation, and because dredging in this area was considered likely to expose subsurface contamination.

Contingency dredging began on February 3, 2005. The contingency dredge area boundaries were delineated as the post-dredge monitoring samples were analyzed and the results were discussed with the EPA. The contractor stated that they would not be able to complete all contingency dredging and clean cover placement before the closure of the construction window on February 15, 2005. Therefore, the EPA, in consultation with resource agencies, authorized the Port to allow Manson to perform in-water construction activities until the end of March. It was understood that contingency dredging activities were expected to be done by the end of February and clean sand cover placement was expected to be completed by the end of March. During contingency dredging activities, Manson utilized both Derrick 8 and the Viking. Contingency dredging activities were completed on February 28, 2005. Approximately 26,000 cy of unsuitable material was dredged during contingency dredging activities (Figure 6). The total volume dredged, including this contingency volume, was 273,300 cy.

Derrick 8 was used to place a clean sand cover over all areas where contingency dredging had been conducted. Clean cover placement began on March 1, 2005, and consisted of placing a minimum 6-inch layer of clean sand over the contingency dredge areas. In addition, angular gravel material was placed (at the direction of the EPA) as clean cover material on the nearshore mound at the mouth of Slip 27. Slip 27 is located on the eastern border of the dredge prism (Figure 1), located approximately between Station 39+00 and Station 42+50. Following completion of the dredging work for the Phase 1 Removal Action, the EPA expressed a desire to include the newly excavated areas of the mound as part of the contingency cover. The resource agencies expressed concern that the newly exposed mound surface may have higher concentrations of contaminants of concern (COC) than those associated with the existing surface sediment layer. An angular material was selected for the cover, as it was believed to be more stable on the mound slope face than sand.

Clean cover material characteristics for the contingency dredged area matched what was specified in the contract. Clean cover material for the mound was specified based on Washington State Department of Transportation (WSDOT) Standard Specification 9-03.9(3) Base Course. This standard specification was modified to reduce fines to a maximum 2 percent passing U.S. No. 200 sieve, thereby minimizing the chance of creating excess turbidity during placement. The modified WSDOT specification for Base Course is provided below.

Sieve Size	Percent Passing
1 1/4″ square	100
1″ square	80 to 100
5/8″ square	50 to 80
U.S. No. 4	25 to 45
U.S. No. 40	3 to 18
U.S. No. 200	2 maximum
% fracture	75 minimum

Clean sand cover placement started on February 28, 2005, and was completed on March 16, 2005. The contract specifications required placement of sand to a minimum elevation of -52.5 feet MLLW, which would have resulted in a minimum 6 inch sand layer thickness.

The specification had a payment tolerance of up to 1 foot (-52 feet MLLW) of sand. However, due to concerns regarding survey accuracy (measurement tolerances of .5 foot) the contractor was instead requested to place the volumetric equivalent of sand to average approximately 10 inches of sand cover depth. In order to fulfill this request, the contractor tracked the mass of material placed each day within each area (Figure 7). Spreadsheets generated by the contractor and checked by the engineer documented that an average of 10 inches of sand was placed on the contingency dredge areas (Appendix B). A comparison of post sand cover bathymetry (Figure 8) and post contingency dredge bathymetry (Figure 7) confirmed the sand layer was evenly distributed. The thickness of the sand layer will be further assessed by coring in the planned recontamination monitoring (see Section 7). Approximately 19,100 cy of sand was placed over the contingency dredging area, and 750 cy of angular sand/gravel material was placed over the mound area. Following completion of the clean cover placement operations, Manson demobilized its equipment and left the site.

4 CHRONOLOGY OF EVENTS

Construction NTP was issued on January 9, 2004. In-water operations began on January 12, 2004 and lasted until March 16, 2005. That time span includes "fish window" closure periods. As explained in Section 3, the contractor encountered delays during dredging and did not complete all unsuitable and suitable dredging until February 1, 2005. Contingency dredging and clean cover placement operations were completed by March 16, 2005 (Figure 9).

Table 1 presents the Phase 1 Removal Action chronology of events at EWW from the beginning of construction to completion, including "fish window" extensions in Season 1 and Season 2. Despite the additional time accumulated by the contractor (due to their claimed inability to remove medium dense to dense material), there were no major disrupting events that delayed the project. Cumulatively, 51 hours of dredging time was lost because of tribal fish net conflicts (3 full days and several partial days). Only 1.5 stand-by days were used (instead of the planned 7, due to sediment sampling activities) and there were no work shutdowns due to water quality exceedances.

With respect to schedule, with the exception of the previously discussed contractor-claimed difficulties due to the nature of the material dredged and tribal fish net conflicts, construction proceeded without major problems and site cleanup goals were achieved. Although this was a NTCRA, the work was generally completed as planned.

Table 1
Chronology of Events

Event	Date	Equipment	Comment
EE/CA Issued for Public Comment	29-July-03		
EPA and Port Sign Consent Order	29-Sept-03		
Action Memo Signed	Sept-03		
RD Approved by EPA	18-Dec-03		
Port issues NTP to contractor	9-Jan-04		
Start of Season 1 Dredging in Regions W and W'	12-Jan-04	D8 and 10 CY CA	
End of Season 1 Dredging in Regions W and W'	3-Mar-04	D8 and 10 CY CA	EPA gave 1 month extension beyond February 15 fish closure window
Start of Season 2 Dredging in Regions W and W'	20-Jul-04	D8 and 10 CY CA	EPA gave 1 month extension prior to scheduled August 15 start date
No Dredging Because of Fish Nets	12-Aug-04		
No Dredging Because of Fish Nets	13-Aug-04		
Removal of Medium/Dense Material in Regions W and W'	17-Aug-04	D8 and 5 CY	Manson removed material that the cable arm bucket was unable to dredge in Regions W and W'
Unsuitable Dredging in Region W and W' Complete	7-Sep-04		
Start Unsuitable Dredging in Region E	7-Sep-04	D8 and 10 CY CA	
No Dredging Because of Fish Nets	26-Sep-04		
Removal of Medium/Dense Material in Region E	10-Nov-04	D8 and 5 CY	Manson removed material that the cable arm bucket was unable to dredge in Region E
Removal of Medium/Dense Material in Region E	10-Dec-04	V and 14 CY	Manson changed equipment to improve dredging productivity
Unsuitable Dredging in Region E Complete	20-Jan-05		
Start Suitable Dredging in Regions W, W', and E	20-Jan-05	V and 14 CY	Manson started to dredge material suitable for open water disposal 24 hours per day
Completion of Suitable Dredging Activities	1-Feb-05		
Standby: 1.5 Days	2-Feb-05		Stand-by time was used to conduct confirmatory sampling
Start Contingency Dredging	3-Feb-05	D8 and 5 CY	
Change of Equipment for Contingency Dredging	9-Feb-05	V and 25 CY CA	
Official Start of Fish Window Period	15-Feb-05		EPA gave extension until end of March
Addition of a Second Piece of Equipment	18-Feb-05	D8 and 5 CY and V and 25 CY CA	Manson mobilized Derrick 8 to the job site to meet project deadline
Confirmatory Sediment Coring	25-Feb-05 through 28-Feb-05		Windward collected cores prior to placement of sand cover

Event	Date	Equipment	Comment
Departure of Derrick 8	26-Feb-05	V and 25 CY CA	Manson demobilized Derrick 8 from the job site
Contingency Dredging Complete	28-Feb-05		Manson demobilized the Viking from the job site
Start Sand Cover Activities	1-Mar-05	D8 and 7 CY	
End of Sand Cover Activities	16-Mar-05	D8 and 7 CY	
Contractor Demobilization	17-Mar-05		

D8: Derrick 8
V: Viking
10 CY CA: 10 Cubic Yard Cable Arm Bucket
25 CY CA: 25 Cubic Yard Cable Arm Bucket
5 CY: 5 Cubic Yard Digging Bucket
7 CY: 7 Cubic Yard Digging Bucket
14 CY: 14 Cubic Yard Digging Bucket

5 PERFORMANCE STANDARDS AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL

5.1 Approach to Quality Assurance/Quality Control Procedures

Quality assurance/quality control (QA/QC) procedures were conducted in cooperation with the EPA and in accordance with the EPA-approved Construction Quality Assurance Plan (CQAP) for the EWW OU Phase 1 Removal Action, including the CQAP's Water Quality Monitoring Quality Assurance Plan (QAP) and the Post Dredge Sediment Monitoring Quality Assurance Project Plan (QAPP) submitted as part of the Removal Design Report (Anchor and Windward 2003a).

QA/QC requirements outlined in the CQAP focused on actual construction activities and on achieving consistency with the final design documents. QA/QC requirements outlined in the Water Quality Monitoring QAP and the Post Dredge Sediment Monitoring QAPP focused on field sampling and laboratory analysis. The contractor's CQCP detailed the personnel, procedures, and documentation to be used to control the work and verify compliance with the contract documents.

QA/QC procedures were implemented through activities to monitor and verify performance standards, including construction oversight, confirmation surface sediment sampling, and water quality monitoring. The Port's resident engineer and inspectors provided QA/QC oversight of the contractor throughout all elements of construction. Their oversight activities included reviewing project material submittals to ensure compliance with the final design documents and contract documents, clarifying details in the technical specifications and plans, meeting weekly to review construction activities, and inspecting and verifying all work performed by the contractor. QA/QC documentation requirements included daily QC reports prepared by the contractor to document the work performed and any deviations from the specifications, as well as daily inspections. The daily inspections verified that construction was proceeding according to the EPA-approved final design documents; immediate action was sought to correct activities that were not in accordance with the design documents. Any substantial deviations from the various plans are described in the following sections.

Additional activities to monitor and verify performance standards included post-dredge monitoring sampling in each dredge area to confirm that sediments with chemical concentrations above SQS were removed, as well as water quality monitoring to confirm that construction operations were in compliance with conditions in the EPA-issued WQC. All sediment and water quality collection procedures and all laboratory analysis procedures detailed in the Water Quality Monitoring QAP and the Post Dredge Sediment Monitoring QAPP were followed during the post-dredge monitoring sampling and water quality monitoring activities.

The EPA and their oversight contractor regularly evaluated QA/QC information throughout the project. EPA's oversight activities included review of all project documents; participation in weekly construction meetings; periodic field oversight of construction activities; periodic field oversight of sediment and water quality sampling; and review of QA/QC documentation and results including surveys, water quality data, sediment chemistry data, and import material test results.

5.2 Dredging Surveys

Bathymetric surveys were used to verify completion of dredging unsuitable and suitable sediment. Unsuitable material was dredged first, followed by dredging the suitable material. The removal zones were identified with coordinates and grades that defined the dredge limits (x, y, and z values). The contractor was required to dredge to the required grades within given coordinates to ensure the unsuitable material was fully removed prior to dredging suitable material. The contractor performed surveys on a daily basis and survey grades were reviewed by the engineer. The engineer had an independent survey performed and bathymetry maps prepared and reviewed by the EPA prior to shifting from unsuitable dredging zones to suitable dredging zones. The EPA also reviewed surveys at the completion of each dredge season, as well as before and after contingency dredging and the placement of clean cover. Quantity calculations from the independent survey were utilized for payment purposes.

Surveys were performed using a boat-mounted single beam transducer linked to a real time tide gage to determine dredge depths (z value). Location coordinates (x and y values) were

provided by a Global Positioning System (GPS) that was used for horizontal control. HYPAK software was used to convert x, y, and z values into bathymetry data.

5.3 Dredging Below Required Depths

Due to problems encountered by their bathymetric survey subcontractor, Manson was unable to conduct and provide consistent daily post-dredge survey results to the Port for several weeks in February 2004. After a post-Season 1 dredge survey was completed, it became clear that Manson had dredged material below required dredge elevations in certain locations. The dredge control problem resulted in an over-excavated area (deeper than -53 feet MLLW). The over excavated area is evidenced on the bathymetry map in Figure 4 (roughly between Station 38+50 and Station 41+00 in Region W). Once it was discovered that there was a positioning control issue, the problem was immediately addressed and the contractor made corrections as required (see Section 3.4).

5.4 Results of Post-Dredge Monitoring Sampling and Pre-Sand Placement Sampling

The post-dredge monitoring sampling of the new sediment surface in the EWW OU Phase 1 Removal Action area was conducted in accordance with the Post-Dredge Sediment Monitoring QAPP (Appendix B of Anchor and Windward 2003a). The results of the sampling were compared to SQOs to identify the area that required further contingency dredging.

This section presents a summary of the results of the post-dredge monitoring sampling, which includes sampling conducted following the completion of the Phase 1 Removal Action as well as sampling conducted after the contingency dredging, which will be referred to as the pre-sand placement sampling. The complete sediment chemistry data report for both of these sampling events is presented in Appendix C. The results of the post-dredge monitoring sampling are summarized in Table 2. The locations that are shaded in the table represent areas that were identified for contingency dredging following consultation with the EPA. The chemicals most commonly detected at concentrations above the CSL were PCBs and mercury. The chemicals that were most commonly not detected with reporting limits above the CSL were 2,4-dimethyl phenol and 1,2,4-trichlorobenzene. The results for PCBs and mercury are presented in Figures 10 and 11, respectively. SQS and CSL exceedances for all analytes in the post-dredge monitoring samples are presented in

Figure 12. Contingency dredging was then performed to remove additional unsuitable material in those areas and to ensure that the depth throughout the area was -52 feet MLLW after the placement of clean cover material.

Table 2
Post-Dredge Monitoring Results That Exceeded the Corresponding SQS and CSL

Monitoring Location	Chemicals That Exceed SQS	Chemicals That Exceed CSL
1	PCBs	
2	PCBs, dieldrin[a]	
3	PCBs, DDTs[a], dieldrin[a], hexachlorobenzene[a]	
4	1,4-Dichlorobenzene, PCBs, hexachlorobenzene[a], DDTs[a], dieldrin[a]	1,2,4-Trichlorobenzene, 2,4-dimethylphenol[a]
5	PCBs, dieldrin[a], 1,2,4-trichlorobenzene[a]	
6	Hexachlorobenzene[a], dieldrin[a]	PCBs, 1,2-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], DDTs[a]
7	1,4-Dichlorobenzene, Acenaphthene, Dibenzofuran, Fluorene, PCBs, Phenanthrene, hexachlorobenzene[a], DDTs[a], dieldrin[a]	2,4-dimethylphenol[a]
8	Hexachlorobenzene[a], DDTs[a], dieldrin[a]	Mercury, PCBs 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,2,4-trichlorobenzene[a]
9	Mercury, PCBs, hexachlorobenzene[a], DDTs[a], dieldrin[a]	2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a]
10	PCBs, DDTs[a], dieldrin[a]	Mercury, 1,2,4-trichlorobenzene[a], 2,4-dimethylphenol[a]
11[b]	PCBs, hexachlorobenzene[a], DDTs[a], dieldrin[a]	2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,2,4-trichlorobenzene[a]
12	PCBs, hexachlorobenzene[a], DDTs[a], dieldrin[a]	2,4-dimethylphenol[a]
13	PCBs, hexachlorobenzene[a], DDTs[a], 1,2,4-trichlorobenzene[a]	2,4-dimethylphenol[a]
14	PCBs, DDTs[a], dieldrin[a]	2,4-dimethylphenol[a]
15	PCBs, hexachlorobenzene[a], DDTs[a]	2,4-dimethylphenol[a]
16	Bis(2-ethylhexyl)phthalate, PCBs, hexachlorobenzene[a], DDTs[a], dieldrin[a], butylbenzyl phthalate[a]	2,4-dimethylphenol[a], 2-methylphenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
17	1,4-Dichlorobenzene, PCBs , hexachlorobenzene[a], DDTs[a], dieldrin[a]	2,4-dimethylphenol[a]
18	1,4-Dichlorobenzene, hexachlorobenzene[a], DDTs[a], dieldrin[a]	PCBs, 2,4-dimethylphenol[a]
19	Acenaphthene, Dibenzofuran, Fluorene, Phenanthrene, hexachlorobenzene[a], aldrin[a], dieldrin[a], gamma-BHC[a], alpha-chlordane[a], heptachlor[a]	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, Mercury, PCBs, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], DDTs[a]
20	1,4-Dichlorobenzene, Acenaphthene, Dibenzofuran, Fluorene, Mercury, Phenanthrene , DDTs[a], hexachlorobenzene[a], aldrin[a], dieldrin[a], gamma-BHC[a], alpha-chlordane[a], heptachlor[a]	1,2,4-Trichlorobenzene, PCBs, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a]
21	DDTs[a], aldrin[a], dieldrin[a], gamma-BHC[a], alpha-chlordane[a], heptachlor[a]	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, PCBs, 2,4-

Monitoring Location	Chemicals That Exceed SQS	Chemicals That Exceed CSL
		dimethylphenol[a], 1,2-dichlorobenzene[a], hexachlorobenzene[a]
22	1,4-Dichlorobenzene, hexachlorobenzene[a], DDTs[a], dieldrin[a]	1,2,4-Trichlorobenzene, PCBs, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a]
23	Acenaphthene, Bis(2-ethylhexyl)phthalate, Mercury, 1,3-Dichlorobenzene, DDTs[a], dieldrin[a]	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, PCBs
24	DDTs[a], dieldrin[a]	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, Mercury, PCBs, 2,4-dimethylphenol[a]
25	1,4-Dichlorobenzene, PCBs, 1,2,4-trichlorobenzene	Mercury, 2,4-dimethylphenol[a]
26	1,4-Dichlorobenzene, Zinc, 1,2,4-trichlorobenzene, benzyl alcohol[a], DDTs[a], dieldrin[a]	Mercury, PCBs, 2,4-dimethylphenol[a]
27	1,4-Dichlorobenzene, hexachlorobenzene[a], DDTs[a], dieldrin	Mercury, PCBs, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a]
28	PCBs, 1,4-dichlorobenzene[a], DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	Mercury, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
29	PCBs, hexachlorobenzene[a], dieldrin[a], butyl benzyl phthalate[a]	Bis(2-ethylhexyl)phthalate, Mercury, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,4-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a], DDTs[a]
30	Mercury, PCBs, hexachlorobenzene[a], pentachlorophenol[a], DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,4-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a]
31	Hexachlorobenzene[a], DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	Bis(2-ethylhexyl)phthalate, Mercury, PCBs, 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,4-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
32	Bis(2-ethylhexyl)phthalate, Mercury, DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	PCBs 2,4-dimethylphenol[a], 1,2-dichlorobenzene[a], 1,4-dichlorobenzene[a], 1,2,4-trichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a], nitrosodiphenylamine[a]
33	PCBs, dieldrin[a]	Mercury, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a]
34	DDTs, dieldrin[a]	Mercury, PCBs, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a]
35	Mercury, PCBs, dieldrin[a]	2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a]
36	1,3-dichlorobenzene[a] , 1,4-dichlorobenzene[a], DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	Mercury, PCBs, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a], 1,2-dichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
37[a]	Bis(2-ethylhexyl)phthalate, PCBs, 1,3-dichlorobenzene[a] , 1,4-dichlorobenzene[a], DDTs[a], dieldrin[a], butyl benzyl phthalate[a]	Mercury, PCBs , 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a], 1,2-dichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
38	Mercury, 1,4-dichlorobenzene[a], pentachlorophenol[a], butyl benzyl phthalate[a]	2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a], 1,2-dichlorobenzene[a], 2-

Monitoring Location	Chemicals That Exceed SQS	Chemicals That Exceed CSL
		methyl phenol[a], benzoic acid[a], benzyl alcohol[a]
39	DDTs, 1,2,4-trichlorobenzene[a], dieldrin[a]	Bis(2-ethylhexyl)phthalate, Mercury, PCBs, 2,4-dimethylphenol[a]
40[a]	PCBs, 1,2,4-trichlorobenzene[a], dieldrin[a], DDTs[a]	Mercury, dieldrin[a], DDTs[a], 2,4-dimethylphenol[a]
41	Bis(2-ethylhexyl)phthalate, PCBs, dieldrin[a], DDTs[a]	Mercury,1,2,4-trichlorobenzene[a], 2,4-dimethylphenol[a]
42	Mercury, PCBs	1,2,4-trichlorobenzene[a], 2,4-dimethylphenol[a]
43	Bis(2-ethylhexyl)phthalate, 1,4-dichlorobenzene[a], hexachlorobenzene[a], butyl benzyl phthalate[a], dieldrin[a]	Mercury, PCBs, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a], 1,2-dichlorobenzene[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a], DDTs[a]
44	Bis(2-ethylhexyl)phthalate, DDTs[a], aldrin[a], dieldrin[a], gamma-BHC[a], alpha-chlordane[a], heptachlor[a], hexachlorobenzene[a], butyl benzyl phthalate[a]	Mercury, PCBs, 2,4-dimethylphenol[a], 1,2,4-trichlorobenzene[a], 1,2-dichlorobenzene[a], 1,4-dichlorobenzene[a] 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], pentachlorophenol[a]
45[c]	1,4-Dichlorobenzene, Bis(2-ethylhexyl)phthalate, Zinc, dieldrin[a], DDTs[a], 1,2,4-trichlorobenzene[a]	Mercury, PCBs, 2,4-dimethylphenol[a]
46[c]	PCBs, dieldrin[a], DDTs[a], 1,2,4-trichlorobenzene[a]	Mercury, 2,4-dimethylphenol[a]
47[c]	1,4-Dichlorobenzene, Bis(2-ethylhexyl)phthalate, Zinc, dieldrin[a], DDTs[a], 1,2,4-trichlorobenzene[a]	Mercury, PCBs, 2,4-dimethylphenol[a]

[a] Chemical was not detected with a reporting limit above the corresponding SQS or CSL
[b] EPA discretionary sample also sampled in this area; summary includes results from both samples
[c] Sample located on the mound, contingency dredging not necessary, cover material was placed
Shading: Areas that were identified for contingency dredging following consultation with the EPA

Following contingency dredging, the areas that were subject to contingency dredging were resampled. The results are summarized in Table 3. It should be noted that the pre-sand placement samples were analyzed for only those chemicals with SQS and CSL exceedances in the initial post-dredge monitoring sampling. In general, there were fewer CSL exceedances in the pre-sand placement sampling results than there were in the initial post-dredge monitoring sampling. PCBs and mercury were the chemicals most commonly detected at concentrations above the corresponding CSL, and the results for these chemicals are presented in Figures 13 and 14, respectively. Hexachlorobenzene was the chemical most commonly not detected with a reporting limit above the corresponding SQS. The SQS and CSL exceedances for all analytes in the pre-sand placement samples are presented in Figure 15.

Table 3
Results of Pre-Sand Placement Sampling
(by Location that Exceeded the Corresponding SQS and CSL Values)

Monitoring Location	Chemicals That Exceed SQS	Chemicals That Exceed CSL
4	1,3-Dichlorobenzene	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, PCBs
6	PCBs , 1,2,4-trichlorobenzene[a]	
7	Fluoranthene, Total HPAH, butyl benzyl phthalate[a], hexachlorobutadiene[a], pentachlorophenol[a]	Mercury, Acenaphthene, Dibenzofuran, Fluorene, Phenanthrene, Total LPAH, Bis(2-ethylhexyl)phthalate, PCBs, 2,4-dimethyl phenol[a], 2-methyl phenol[a], benzoic acid[a], benzyl alcohol[a], hexachlorobenzene[a]
8	Mercury, 1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene	PCBs
14	Mercury, PCBs	
15	Mercury, PCBs	
16	Mercury, PCBs	
17		
18	PCBs	
19	PCBs, hexachlorobenzene[a]	
20	Acenaphthene, Fluorene, PCBs, hexachlorobenzene[a]	
21	1,4-Dichlorobenzene, PCBs	1,2,4-Trichlorobenzene
22		Mercury, PCBs
23	1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, hexachlorobenzene[a]	PCBs
24	1,2,4-Trichlorobenzene, PCBs	Mercury
25	PCBs	Mercury
26	Mercury, PCBs	
27	PCBs	Mercury
28	Mercury, PCBs	
29	Mercury, PCBs, hexachlorobenzene[a]	
30	Mercury, PCBs	
31	PCBs, hexachlorobenzene[a]	Mercury
32	Mercury, 1,2,4-Trichlorobenzene, PCBs, hexachlorobenzene[a]	
33	Mercury, PCBs	
34	PCBs	
35	PCBs	
36	PCBs	1,2,4-Trichlorobenzene
37	Mercury, PCBs, hexachlorobenzene[a]	
38	Mercury	
39	Mercury, PCBs, total DDTs[a], dieldrin[a]	
40	Mercury, 1,2,4-Trichlorobenzene, PCBs	
41	PCBs, hexachlorobenzene[a]	Mercury
42	Mercury, PCBs	
43	Hexachlorobenzene[a]	Mercury
44	PCBs, hexachlorobenzene[a]	Mercury

[a] Chemical was not detected with a reporting limit above the corresponding SQS or CSL

In general, the concentrations of the contaminants that exceeded SQS and CSL in the post-dredge monitoring sampling decreased in the pre-sand placement sampling. The post-dredge monitoring and pre-sand placement results for mercury, total PCBs, and total organic carbon (TOC) are presented for each location that was sampled in both events in Table 4. In addition, the mean concentrations of mercury, organic carbon normalized PCBs, and TOC from the post-dredge monitoring sampling of the contingency dredge area are compared to the mean concentrations of these chemicals measured at the same locations in the pre-sand placement sampling. The mean values for organic carbon normalized PCB and mercury concentrations are lower in the pre-sand placement samples. TOC does not appear to have been affected by the contingency dredging (Table 4).

Table 4
Comparison Between Post-Dredge Monitoring and Pre-Sand Placement of Mercury, Total PCBs, and TOC by Station Location

Station Location	Mercury (mg/kg dw)		PCBs (total calculated) (mg/kg OC dw)		Total Organic Carbon (% dw)	
	PDM	PSP	PDM	PSP	PDM	PSP
EW-PDM-S4	0.20	0.32	**20**	**260**	0.940	*1.16*
EW-PDM-S6	0.25	0.09	**110**	**14**	1.18	0.638
EW-PDM-S7	0.31	**0.64**	**34**	**91**	1.23	2.32
EW-PDM-S8	**1.68**	**0.43**	**70**	**91**	1.68	1.52
EW-PDM-S9	**0.58**	**0.53**	**29**	**37**	1.67	2.06
EW-PDM-S10	**0.92**	**0.58**	**48**	**61**	2.23	*1.68*
EW-PDM-S14	0.31	**0.44**	**52**	**16**	1.08	1.94
EW-PDM-S15	0.30	**0.43**	**55**	**18**	1.16	1.62
EW-PDM-S16	**0.43**	**0.47**	**43**	**28**	1.64	1.76
EW-PDM-S18	0.25	0.10	**170**	**28**	1.02	0.702
EW-PDM-S19	**3.65**	0.13	**90**	**33**	1.34	1.01
EW-PDM-S20	**0.48**	0.20	**180**	**15**	1.22	1.35
EW-PDM-S21	0.27	0.25	**2,600**	**54**	0.997	1.18
EW-PDM-S22	0.24	**0.85**	**77**	**180**	1.09	3.08
EW-PDM-S23	**0.48**	*0.12*	**320**	**860**	1.48	0.641
EW-PDM-S24	***12***	**10.9**	**110**	**36 J**	*1.66*	0.890
EW-PDM-S25	**0.66**	**0.64**	**66**	**48**	1.71	2.03
EW-PDM-S26	**1.9**	***0.45***	**190**	**22 J**	4.00	1.44
EW-PDM-S27	**0.93**	**0.82**	**190 J**	**48**	2.22	2.29
EW-PDM-S28	**1.7**	**0.56**	**65**	**24**	2.37	1.80
EW-PDM-S29	**0.89**	**0.59**	**67**	**17**	1.89	1.99
EW-PDM-S30	**0.51**	**0.52**	**46**	**31**	1.31	1.85
EW-PDM-S31	**0.77**	**0.73**	**120**	**32**	1.72	1.98
EW-PDM-S32	**0.56**	**0.51**	**91**	**30 J**	1.44	1.84
EW-PDM-S33	**0.62**	**0.58**	**34**	**16**	1.49	1.78
EW-PDM-S34	**0.69**	0.38	**69**	**20**	1.69	1.53
EW-PDM-S35	**0.51**	*0.31*	**29**	**29**	1.43	*1.33*
EW-PDM-S36	**1.03**	0.32	**160**	**53**	*2.41*	1.40
EW-PDM-S37	***1.32***	**0.47**	**56**	**12 J**	*2.36*	1.46
EW-PDM-S38	**0.56**	**0.54**	12 J	12	1.44	1.65
EW-PDM-S39	***1.0***	**0.45**	**79**	**32**	2.54	1.61
EW-PDM-S40	**0.92**	**0.45**	**40 J**	**19**	2.48	1.71
EW-PDM-S41	**0.97**	**0.94**	**65**	**27**	1.85	3.22
EW-PDM-S42	***0.60***	**0.57**	**25**	**16**	1.67	2.09
EW-PDM-S43	**0.88**	**1.93**	**77**	3.1	2.25	2.00
EW-PDM-S44	**0.64**	**1.09**	**74**	**41 J**	1.74	1.38
Mean values	1.11 ± 1.97	0.81 ± 1.76	150 ± 420	65 ± 144	1.71 ± 0.60	1.66 ± 0.57

Bold indicates an SQS exceedance
Underline indicates a CSL exceedance
Italics indicate a value that is the mean of laboratory replicates

Table 5 provides the final concentration for every chemical that exceeded the corresponding SQS either as a detected value or as a reporting limit associated with a nondetected value. The values obtained from the post-dredge monitoring sampling are provided for all locations except for areas within the contingency dredge area where the concentrations of a subset of chemicals were measured in the pre-sand placement samples (shaded in Table 5). If concentrations of a chemical were measured in both the post-dredge monitoring and pre-sand placement samples, then the pre-sand placement sampling result is provided because that result is more representative of the surface prior to the placement of the sand layer. The SQS and CSL exceedances in the combined post-dredge monitoring and pre-sand placement data sets are provided in Figure 16.

Table 5
Combined Post-Dredge Monitoring and Pre-Sand Placement Sample Results for All Locations for All Analytes that Exceeded SQS

Chemical	SQS	CSL	Unit	EW-PDM-S1	EW-PDM-S2	EW-PDM-S3	EW-PDM-S4	EW-PDM-S5	EW-PDM-S6	EW-PDM-S7	EW-PDM-S8	EW-PDM-S9	EW-PDM-S10	EW-PDM-S11
Mercury	0.41	0.59	mg/kg dw	*0.13*	0.06	0.24	0.32	0.10	0.09	**0.64**	**0.43**	**0.53**	**0.58**	*0.19 J*
Zinc	410	960	mg/kg dw	*45.2*	27.2	38.1	66.3	40.0	60.8	98	260	127	254	*73.0*
Acenaphthene	16	57	mg/kg OC-dw	3.5 U	3.4 U	2.0	6.4	4.3 U	2.9	**340**	6.5	2.3 U	2.2 U	2.4 U
Fluoranthene	160	1,200	mg/kg OC-dw	10	15	12	37	9.9	25	**520**	45	15	28	10
Fluorene	23	79	mg/kg OC-dw	3.5 U	3.4 U	2.6	7.4	4.3 U	4.2	**360**	7.1	2.3 U	2.2 U	2.4 U
Phenanthrene	100	480	mg/kg OC-dw	6.6	6.5	9.8	29	6.8	21	**1,000**	29	5.7	4.5	5.2
Total HPAH (calc'd)	960	5,300	mg/kg OC-dw	28	59	38	160	23	75	**1,000**	140	51	120 J	37
Total LPAH (calc'd)	370	780	mg/kg OC-dw	6.6	6.5	19	72	6.8	36	**1,900**	54	8.1	8.5	5.2
Bis(2-ethylhexyl)phthalate	47	78	mg/kg OC-dw	6.1	9.9	8.0	7.9	7.2	21	**78**	23	2.9	40	7.9
Butyl benzyl phthalate	4.9	64	mg/kg OC-dw	3.5 U	3.4 U	2.0 U	3.2 U	4.3 U	2.4 U	**5.2 U**	2.6 U	2.3 U	2.2 U	2.4 U
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg OC-dw	0.61 U	0.77 U	0.67	**160 J**	**0.82 U**	**0.91 U**	0.29 U	**0.86 J**	0.36 U	0.43 U	0.40 U
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC-dw	0.12 U	0.15 U	0.090 U	1.4 J	0.16 U	0.19 U	0.056 U	0.086 U	0.073 U	0.083 U	0.079 U
1,3-Dichlorobenzene	170		µg/kg dw	1.0 U	0.90 U	1.5 J	140	1.0 U	1.2 U	1.3 U	2.5 J	1.5 U	1.4 U	1.0 U
1,4-Dichlorobenzene	3.1	9	mg/kg OC-dw	0.12 U	0.15 U	2.9	**34**	0.16 U	0.19 U	0.38	**3.2**	0.11 J	0.083 U	0.079 U
2,4-Dimethylphenol	29	29	µg/kg dw	28 U	20 U	24 U	**30 U**	26 U	28 U	**120 U**	**43 U**	**38 U**	**49 U**	**30 U**
2-Methylphenol	63	63	µg/kg dw	28 U	20 U	24 U	30 U	26 U	28 U	**120 U**	43 U	38 U	49 U	30 U
Benzoic acid	650	650	µg/kg dw	280 U	200 U	240 U	300 U	260 U	280 U	**1,200 U**	430 U	380 U	490 U	300 U
Benzyl alcohol	57	73	µg/kg dw	28 UJ	20 UJ	24 UJ	30 UJ	26 UJ	28 UJ	**120 U**	43 UJ	38 UJ	49 UJ	30 UJ
Hexachlorobenzene	0.38	2.3	mg/kg OC-dw	0.36 U	0.17 U	**0.55 U**	**0.80 U**	0.23 U	**0.58 U**	**5.2 U**	**0.46 U**	**0.53 U**	0.18 U	**0.56 U**
Hexachlorobutadiene	3.9	6.2	mg/kg OC-dw	0.36 U	0.17 U	0.55 U	0.80 U	0.23 U	0.58 U	**5.2 U**	0.46 U	0.53 U	0.18 U	0.56 U
N-Nitrosodiphenylamine	11	11	mg/kg OC-dw	3.5 U	3.4 U	2.0 U	3.2 U	4.3 U	2.4 U	5.2 U	2.6 U	2.3 U	2.2 U	2.4 U
Pentachlorophenol	360	690	µg/kg dw	140 U	98 U	120 U	150 U	130 U	140 U	**610 U**	210 U	190 U	240 U	150 U
PCBs (total calc'd)	12	65	mg/kg OC-dw	**19**	**36**	**20**	**260**	**43**	**14**	**91**	**91**	**37**	**61**	**13**
DDTs (total-calc'd)	6.9	69	µg/kg dw	5.8 U	4.2 U	**13 U**	**15 U**	5.7 U	**77 U**	**38 U**	**37 U**	**18 U**	**69 U**	**14 U**
Aldrin	10	nv	µg/kg dw	2.9 U	0.99 U	6.7 U	7.5 U	1.4 U	6.9 U	7.4 U	7.8 U	8.8 U	4.0 U	7.0 U
Dieldrin	10	nv	µg/kg dw	5.8 U	**11 U**	**13 U**	**15 U**	**18 U**	**56 U**	**38 U**	**63 U**	**18 U**	**31 U**	**14 U**
gamma-BHC	10	nv	µg/kg dw	2.9 U	0.99 U	6.7 U	7.5 U	1.4 U	6.9 U	7.4 U	7.8 U	8.8 U	4.0 U	7.0 U
Total chlordane (calc'd)	10	nv	µg/kg dw	2.9 U	0.99 U	6.7 U	7.5 U	1.4 U	6.9 U	7.4 U	7.8 U	8.8 U	4.0 U	7.0 U
Heptachlor	10	nv	µg/kg dw	2.9 U	0.99 U	6.7 U	7.5 U	1.4 U	6.9 U	7.4 U	7.8 U	8.8 U	4.0 U	7.0 U

Chemical	SQS	CSL	Unit	EW-PDM-S12	EW-PDM-S13	EW-PDM-S14	EW-PDM-S15	EW-PDM-S16	EW-PDM-S17	EW-PDM-S18	EW-PDM-S19	EW-PDM-S20	EW-PDM-S21	EW-PDM-S22
Mercury	0.41	0.59	mg/kg dw	0.24 J	0.20 J	**0.44**	**0.43**	**0.47**	0.28	0.10	0.13	0.20	0.25	**0.85**
Zinc	410	960	mg/kg dw	79	55.8	85	93	147	74.0	67.2	104	97	77.3	87.2
Acenaphthene	16	57	mg/kg OC-dw	3.2 U	4.8 U	3.5 U	4.3	11 U	3.7	4.6	2.1	**21**	15	16
Fluoranthene	160	1,200	mg/kg OC-dw	18	19	22	31	58	21	24	15	44	50	57
Fluorene	23	79	mg/kg OC-dw	3.2 U	4.8 U	3.5 U	5.2	5.6 J	4.6	5.7	3.3	**26**	16	18
Phenanthrene	100	480	mg/kg OC-dw	13	8.4	11	19	24	15	19	9.9	74	56	59
Total HPAH (calc'd)	960	5,300	mg/kg OC-dw	76	62	85	100	230 J	65	71	60	130	130	160
Total LPAH (calc'd)	370	780	mg/kg OC-dw	19	8.4	15	38	38 J	30	38	22	250	120	140
Bis(2-ethylhexyl)phthalate	47	78	mg/kg OC-dw	11	8.1	11	27	**56**	15	13	7.0	3.7	13	13
Butyl benzyl phthalate	4.9	64	mg/kg OC-dw	3.2 U	4.8 U	3.5 U	3.3 U	**11 U**	2.9 U	3.1 U	2.0 U	1.5 U	3.2 U	2.9 U
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg OC-dw	0.50 U	**0.81 U**	0.34 U	0.42 U	0.43 U	0.48 U	0.78 U	0.52 U	0.74	**2.3**	0.39 J
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC-dw	0.10 U	0.16 U	0.067 U	0.086 U	0.085 U	0.093 U	0.16 U	0.11 U	0.11 U	0.10 U	0.045 U
1,3-Dichlorobenzene	170		µg/kg dw	1.1 U	1.0 U	1.3 U	1.4 U	1.5 U	1.0 U	1.1 U	1.1 J	2.5 J	7.1 J	9.4 J
1,4-Dichlorobenzene	3.1	9	mg/kg OC-dw	0.10 U	0.16 U	0.067 U	0.086 U	0.085 U	**3.9**	0.16 U	2.1	0.53	**3.1**	1.8
2,4-Dimethylphenol	29	29	µg/kg dw	**34 U**	**31 U**	**38 U**	**38 U**	**180 U**	**31 U**	**32 U**	20 U	20 U	**32 U**	**32 U**
2-Methylphenol	63	63	µg/kg dw	34 U	31 U	38 U	38 U	**180 U**	31 U	32 U	20 U	20 U	32 U	32 U
Benzoic acid	650	650	µg/kg dw	340 U	310 U	380 U	380 U	**1,800 U**	310 U	320 U	200 U	200 U	320 U	320 U
Benzyl alcohol	57	73	µg/kg dw	34 UJ	31 UJ	38 UJ	38 UJ	**180 UJ**	31 UJ	32 UJ	20 U	20 U	32 UJ	32 UJ
Hexachlorobenzene	0.38	2.3	mg/kg OC-dw	**0.73 U**	**0.47 U**	0.31 U	**0.46 U**	**0.54 U**	**0.69 U**	**0.73 U**	**2.0 U**	**1.5 U**	**3.0 U**	**0.67 U**
Hexachlorobutadiene	3.9	6.2	mg/kg OC-dw	0.73 U	0.47 U	0.31 U	0.46 U	0.54 U	0.69 U	0.73 U	2.0 U	1.5 U	3.0 U	0.67 U
N-Nitrosodiphenylamine	11	11	mg/kg OC-dw	3.2 U	4.8 U	3.5 U	3.3 U	11 U	2.9 U	3.1 U	2.0 U	1.5 U	3.2 U	2.9 U
Pentachlorophenol	360	690	µg/kg dw	170 U	160 U	190 U	190 U	**880 U**	150 U	160 U	100 U	100 U	160 U	160 U
PCBs (total calc'd)	12	65	mg/kg OC-dw	**17**	**42**	**16**	**18**	**28**	**18**	**28**	**33**	**15**	**54**	**180**
DDTs (total-calc'd)	6.9	69	µg/kg dw	**15 U**	**15 U**	**39 U**	**32 U**	**25 U**	**15 U**	**15 U**	**160 U**	**30 U**	**60 U**	**15 U**
Aldrin	10	nv	µg/kg dw	7.7 U	3.0 U	3.3 U	5.3 U	8.8 U	7.5 U	7.4 U	**15 U**	**15 U**	**30 U**	7.3 U
Dieldrin	10	nv	µg/kg dw	**15 U**	5.9 U	**41 U**	10 U	**18 U**	**15 U**	**95 U**	**120 U**	**140 U**	**920 U**	**74 U**
gamma-BHC	10	nv	µg/kg dw	7.7 U	3.0 U	3.3 U	5.3 U	8.8 U	7.5 U	7.4 U	**15 U**	**15 U**	**30 U**	7.3 U
alpha-Chlordane	10	nv	µg/kg dw	7.7 U	3.0 U	3.3 U	5.3 U	8.8 U	7.5 U	7.4 U	**15 U**	**15 U**	**30 U**	7.3 U
Heptachlor	10	nv	µg/kg dw	7.7 U	3.0 U	3.3 U	5.3 U	8.8 U	7.5 U	7.4 U	**15 U**	**15 U**	**30 U**	7.3 U

Chemical	SQS	CSL	Unit	EW-PDM-S23	EW-PDM-S24	EW-PDM-S25	EW-PDM-S26	EW-PDM-S27	EW-PDM-S28	EW-PDM-S29	EW-PDM-S30	EW-PDM-S31	EW-PDM-S32	EW-PDM-S33
Mercury	0.41	0.59	mg/kg dw	*0.12*	**10.9**	**0.64**	***0.45***	**0.82**	**0.56**	**0.59**	**0.52**	**0.73**	**0.51**	**0.58**
Zinc	410	960	mg/kg dw	102	186	152	*115*	281	340	260	147	250	177	134
Acenaphthene	16	57	mg/kg OC-dw	3.0 U	4.5	1.8 U	3.5	4.0	6.3 U	1.0 U	6.6 J	0.96 U	1.1 U	3.2
Fluoranthene	160	1,200	mg/kg OC-dw	16	27	11	19	22	11	1.9	58	2.8	4.6	13
Fluorene	23	79	mg/kg OC-dw	3.0 U	6.0	1.8	5.8	5.4	6.3 U	1.0 U	8.4 J	0.96 U	1.1 U	3.5
Phenanthrene	100	480	mg/kg OC-dw	9.4	21	8.2	22	19	8.4	1.1	29	1.4	2.6	8.1
Total HPAH (calc'd)	960	5,300	mg/kg OC-dw	55	110 J	46 J	88 J	110 J	46 J	3.9	190	7.4	23	66 J
Total LPAH (calc'd)	370	780	mg/kg OC-dw	13	43	15	43	39	8.4	1.1	59 J	1.4	3.9	19
Bis(2-ethylhexyl)phthalate	47	78	mg/kg OC-dw	14	43	13	**53**	**59**	30	1.3	41	1.5	4.7	29
Butyl benzyl phthalate	4.9	64	mg/kg OC-dw	3.0 U	1.9 U	1.8 U	1.5 U	1.8 U	**6.3 U**	1.0 U	**9.9 U**	0.96 U	1.1 U	2.1 U
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg OC-dw	**1.2 J**	**0.84 J**	0.36 J	0.48 U	0.33 U	0.40 U	0.55 J	0.37 U	0.34 U	**1.2 J**	0.40 U
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC-dw	0.19 U	0.17 J	0.21 J	0.24 J	0.087 J	0.078 U	0.37 J	0.076 U	0.066 U	0.082 U	0.079 U
1,3-Dichlorobenzene	170		µg/kg dw	7.1 J	4.6 J	5.6 J	2.2 J	1.5 U	1.4 U	3.0 J	1.4 U	1.3 U	1.5 U	1.4 U
1,4-Dichlorobenzene	3.1	9	mg/kg OC-dw	**5.3**	2.1 J	1.7 J	1.0 J	0.24 J	0.13 J	0.65 J	0.12 J	0.11 J	0.30 J	0.079 U
2,4-Dimethylphenol	29	29	µg/kg dw	19 U	**32 U**	**30 U**	**58 U**	**41 U**	**150 U**	20 U	**130 U**	19 U	20 U	**31 U**
2-Methylphenol	63	63	µg/kg dw	19 U	32 U	30 U	58 U	41 U	**150 U**	20 U	**130 U**	19 U	20 U	31 U
Benzoic acid	650	650	µg/kg dw	190 U	320 U	300 U	580 U	410 U	**1,500 U**	200 U	**1,300 U**	190 U	200 U	310 U
Benzyl alcohol	57	73	µg/kg dw	19 U	32 U	30 U	**58 U**	41 U	**150 U**	20 U	**130 UJ**	19 U	20 U	31 U
Hexachlorobenzene	0.38	2.3	mg/kg OC-dw	**3.0 U**	0.30 U	0.056 U	0.12 U	**0.45 U**	0.20 U	**1.0 U**	**0.47 U**	**0.96 U**	**1.1 U**	0.065 U
Hexachlorobutadiene	3.9	6.2	mg/kg OC-dw	3.0 U	0.30 U	0.13 U	0.12 U	0.45 U	0.20 U	1.0 U	0.47 U	0.96 U	1.1 U	0.065 U
N-Nitrosodiphenylamine	11	11	mg/kg OC-dw	3.0 U	1.9 U	1.8 U	1.5 U	3.7	6.3 U	1.0 U	9.9 U	0.96 U	1.1 U	2.1 U
Pentachlorophenol	360	690	µg/kg dw	96 U	160 U	150 U	290 U	210 U	**760 U**	98 U	**660 U**	97 U	100 U	150 U
PCBs (total calc'd)	12	65	mg/kg OC-dw	**860**	**36 J**	**48**	**22 J**	**48**	**24**	**17**	**31**	**32**	**30 J**	**16**
DDTs (total-calc'd)	6.9	69	µg/kg dw	**9.7 U**	**9.8 U**	4.3 U	**60 U**	**20 U**	**24 U**	**89 U**	**12 U**	**57 U**	**33 UJ**	2.8 U
Aldrin	10	nv	µg/kg dw	4.9 U	4.9 U	0.96 U	4.9 U	9.9 U	4.8 U	10 U	6.2 U	9.5 U	8.9 UJ	0.97 U
Dieldrin	10	nv	µg/kg dw	**550 U**	**58 U**	10 U	**94 U**	**64 U**	**22 U**	**53 U**	**38 U**	**91 U**	**18 UJ**	**17 U**
gamma-BHC	10	nv	µg/kg dw	4.9 U	4.9 U	0.96 U	4.9 U	9.9 U	4.8 U	10 U	6.2 U	9.5 U	8.9 UJ	0.97 U
alpha-Chlordane	10	nv	µg/kg dw	4.9 U	4.9 U	0.96 U	8.1 U	9.9 U	4.8 U	**37 U**	6.2 U	**55 U**	8.9 UJ	0.97 U
Heptachlor	10	nv	µg/kg dw	4.9 U	4.9 U	0.96 U	9.9 U	9.9 U	4.8 U	10 U	6.2 U	9.5 U	8.9 UJ	2.3 U

Chemical	SQS	CSL	Unit	EW-PDM-S34	EW-PDM-S35	EW-PDM-S36	EW-PDM-S37	EW-PDM-S38	EW-PDM-S39	EW-PDM-S40	EW-PDM-S41	EW-PDM-S42	EW-PDM-S43	EW-PDM-S44
Mercury	0.41	0.59	mg/kg dw	0.38	*0.31*	0.32	**0.47**	**0.54**	**0.45**	**0.45**	**0.94**	**0.57**	**1.93**	**1.09**
Zinc	410	960	mg/kg dw	174	127	283	*281*	150	248	390	309	*148*	237	173
Acenaphthene	16	57	mg/kg OC-dw	2.1 U	2.2 U	7.9 U	1.4 U	6.9 U	1.2 U	5.6	0.68 U	1.9 U	1.0 U	1.4 U
Fluoranthene	160	1,200	mg/kg OC-dw	18	15	19	2.6	4.7 J	3.5	34	3.1	17	5.0	5.1
Fluorene	23	79	mg/kg OC-dw	2.1 U	2.2 U	7.9 U	1.4 U	6.9 U	1.2 U	6.9	0.75	1.9 U	1.0 U	1.4 U
Phenanthrene	100	480	mg/kg OC-dw	6.5	9.8	10	1.4 U	6.9 U	1.3	13	2.2	5.6	2.2	1.7
Total HPAH (calc'd)	960	5,300	mg/kg OC-dw	93 J	70 J	85 J	8.8	9.9 J	11	140 J	11	81	28	21
Total LPAH (calc'd)	370	780	mg/kg OC-dw	10	13	10	1.4 U	6.9 U	1.3	35	3.7	9.1	3.4	1.7
Bis(2-ethylhexyl)phthalate	47	78	mg/kg OC-dw	39	12	39	1.4 U	3.8 J	5.2	**56**	5.6	16	1.0 U	5.9
Butyl benzyl phthalate	4.9	64	mg/kg OC-dw	2.1 U	2.2 U	**7.9 U**	1.4 U	**6.9 U**	1.2 U	1.4 U	0.68 U	1.9 U	1.0 U	1.4 U
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg OC-dw	0.38 J	0.52 U	**3.5**	0.47 U	0.43 U	0.39 U	**1.3 J**	0.21 U	0.36 U	0.34 U	0.55 U
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC-dw	0.078 U	0.11 U	0.11 J	0.096 U	0.085 U	0.075 U	0.082 U	0.043 U	0.072 U	0.070 U	0.11 U
1,3-Dichlorobenzene	170		µg/kg dw	1.2 U	1.9 U	8.4 J	1.4 U	1.4 U	1.2 U	3.4 J	1.4 U	1.5 U	1.4 U	1.5 U
1,4-Dichlorobenzene	3.1	9	mg/kg OC-dw	0.16 J	0.47 J	2.2	0.096 U	0.085 U	0.075 U	0.70 J	0.11 J	0.072 U	0.070 U	0.22 J
2,4-Dimethylphenol	29	29	µg/kg dw	**35 U**	**32 U**	**190 U**	20 U	**99 U**	20 U	**35 U**	22 U	**32 U**	20 U	20 U
2-Methylphenol	63	63	µg/kg dw	35 U	32 U	**190 U**	20 U	**99 U**	20 U	35 U	22 U	32 U	20 U	20 U
Benzoic acid	650	650	µg/kg dw	350 U	320 U	**1,900 U**	200 U	**990 U**	200 U	350 U	220 U	320 U	200 U	200 U
Benzyl alcohol	57	73	µg/kg dw	35 U	32 U	**190 U**	20 U	**99 U**	20 U	35 U	22 U	32 U	20 U	20 U
Hexachlorobenzene	0.38	2.3	mg/kg OC-dw	0.064 U	0.069 U	0.20 U	**1.4 U**	0.069 U	0.22 U	0.20 U	**0.68 U**	0.059 U	**1.0 U**	**1.4 U**
Hexachlorobutadiene	3.9	6.2	mg/kg OC-dw	0.064 U	0.069 U	0.20 U	1.4 U	0.069 U	0.22 U	0.20 U	0.68 U	0.059 U	1.0 U	1.4 U
N-Nitrosodiphenylamine	11	11	mg/kg OC-dw	2.1 U	2.2 U	7.9 U	1.4 U	6.9 U	1.2 U	1.4 U	0.68 U	1.9 U	1.0 U	1.4 U
Pentachlorophenol	360	690	µg/kg dw	170 U	160 U	**950 U**	98 U	**490 U**	98 U	170 U	110 U	160 U	98 U	98 U
PCBs (total calc'd)	12	65	mg/kg OC-dw	**20**	**29**	**53**	**12 J**	12	**32**	**19**	**27**	**16**	3.1	**41 J**
DDTs (total-calc'd)	6.9	69	µg/kg dw	2.0 U	6.1 U	**26 U**	**25 U**	5.5 U	**7.1 U**	**25 U**	**34 U**	2.0 U	**93 U**	**44 U**
Aldrin	10	nv	µg/kg dw	0.98 U	0.98 U	4.9 U	4.9 U	0.99 U	3.5 U	4.9 U	4.8 U	0.98 U	10 U	**18 U**
Dieldrin	10	nv	µg/kg dw	**16 U**	**15 U**	**56 U**	**22 U**	4.1 U	**50 U**	**48 U**	**42 U**	5.4 U	**62 U**	**37 U**
gamma-BHC	10	nv	µg/kg dw	0.98 U	0.98 U	4.9 U	4.9 U	0.99 U	3.5 U	4.9 U	4.8 U	0.98 U	10 U	**18 U**
alpha-Chlordane	10	nv	µg/kg dw	5.2 U	0.98 U	4.9 U	4.9 U	0.99 U	**28 U**	4.9 U	4.8 U	0.98 U	**43 U**	**18 U**
Heptachlor	10	nv	µg/kg dw	0.98 U	0.98 U	4.9 U	4.9 U	0.99 U	3.5 U	4.9 U	8.6 U	0.98 U	10 U	**18 U**

Chemical	SQS	CSL	Unit	EW-PDM-S45[a]	EW-PDM-S46[a]	EW-PDM-S47[a]	EW-PDM-S48	EW-PDM-S49[b]	EW-PDM-S50[b]
Mercury	0.41	0.59	mg/kg dw	**1.07 J**	**1.09 J**	**1.18 J**	na	**0.80 J**	**0.65 J**
Zinc	410	960	mg/kg dw	**435**	357	**444**	45.5	225	209
Acenaphthene	16	57	mg/kg OC-dw	14	3.9	6.5	2.6 U	1.6 U	8.2 U
Fluoranthene	160	1,200	mg/kg OC-dw	52	21	45	8.2	17	13
Fluorene	23	79	mg/kg OC-dw	13	4.7	8.1	2.6 U	1.7	8.2 U
Phenanthrene	100	480	mg/kg OC-dw	35	17	20	4.2	5.4	9.4
Total HPAH (calc'd)	960	5,300	mg/kg OC-dw	190 J	79 J	170 J	21	86 J	51 J
Total LPAH (calc'd)	370	780	mg/kg OC-dw	77	37	47	4.2	11	9.4
Bis(2-ethylhexyl)phthalate	47	78	mg/kg OC-dw	**61**	29	**85**	9.1	42	25
Butyl benzyl phthalate	4.9	64	mg/kg OC-dw	1.7 U	1.7 U	1.7 U	2.6 U	1.6 U	**8.2 U**
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg OC-dw	**1.7 U**	**1.7 U**	**1.7 U**	**2.6 U**	**1.6 U**	**8.2 U**
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC-dw	1.7 U	1.7 U	1.7 U	**2.6 U**	1.6 U	**8.2 U**
1,3-Dichlorobenzene	170		µg/kg dw	40 U	35 U	42 U	20 U	32 U	140 U
1,4-Dichlorobenzene	3.1	9	mg/kg OC-dw	**3.4**	1.7 U	**3.7**	2.6 U	1.6 U	**8.2 U**
2,4-Dimethylphenol	29	29	µg/kg dw	**40 U**	**35 U**	**42 U**	20 U	**32 U**	**140 U**
2-Methylphenol	63	63	µg/kg dw	40 U	35 U	42 U	20 U	32 U	**140 U**
Benzoic acid	650	650	µg/kg dw	400 U	350 U	420 U	200 U	320 U	**1,400 U**
Benzyl alcohol	57	73	µg/kg dw	40 U	35 U	42 U	20 UJ	32 U	**140 U**
Hexachlorobenzene	0.38	2.3	mg/kg OC-dw	0.21 U	0.049 U	0.20 U	0.12 U	0.048 U	0.29 U
Hexachlorobutadiene	3.9	6.2	mg/kg OC-dw	0.21 U	0.049 U	0.20 U	0.12 U	0.048 U	0.29 U
N-Nitrosodiphenylamine	11	11	mg/kg OC-dw	1.7 U	1.7 U	1.7 U	2.6 U	1.6 U	8.2 U
Pentachlorophenol	360	690	µg/kg dw	200 U	170 U	210 U	98 U	160 U	**720 U**
PCBs (total calc'd)	12	65	mg/kg OC-dw	**90 J**	**31 J**	**100**	8.4	**20**	**86**
DDTs (total-calc'd)	6.9	69	µg/kg dw	**30 U**	**19 U**	**20 U**	5.3 U	**12 U**	**36 U**
Aldrin	10	nv	µg/kg dw	4.9 U	0.98 U	4.9 U	0.96 U	0.99 U	4.9 U
Dieldrin	10	nv	µg/kg dw	**51 U**	**21 U**	**26 U**	1.9 U	**13 U**	**27 U**
gamma-BHC	10	nv	µg/kg dw	4.9 U	0.98 U	4.9 U	0.96 U	0.99 U	4.9 U
alpha-Chlordane	10	nv	µg/kg dw	4.9 U	2.8 U	4.9 U	0.96 U	1.5 U	4.9 U
Heptachlor	10	nv	µg/kg dw	9.9 U	0.98 U	4.9 U	0.96 U	2.6 U	4.9 U

Notes:

[a] Samples located on the mound, no pre-sand placement samples were collected

[b] EPA discretionary samples not reoccupied in the pre-sand placement sampling

[c] Sample is field duplicate collected with PDM-S50

[d] Sample is a field duplicate collected with PDM-S19
[e] Sample is a field duplicate collected with pre-sand placement sample at PDM-S39
nv – no value available for this chemical
Shaded cells indicate values obtained from the pre-sand placement sample that have replaced the PDM result
Bold indicates an SQS exceedance
Underline indicates a CSL exceedance
Italics indicate a value that is the mean of laboratory replicates

In the EE/CA, DDTs were identified as a potential COC for this area. DDT was detected in one post-dredge monitoring sample. DDTs and other organochlorine pesticides were reported as nondetected with elevated reporting limits due to likely analytical interference from PCB congeners. It is likely that the historical reports of detected DDT concentrations were due to PCB interference in the pesticide analysis rather than the presence of DDT in the sediment samples. See Section 5.8 for discussion of how these results met goals.

5.5 Results of Water Quality Monitoring

Water quality monitoring was conducted throughout the construction season during dredging and clean cover placement activities. Results of this monitoring are included as Appendix D to this report. The water quality monitoring was comprised of in-situ measurements of turbidity, pH, dissolved oxygen, and grab samples collected for chemical analysis. Exceedances of the water quality parameters were determined by comparing results obtained 100 meters away from the point of dredging or cover placement to ambient conditions, which consisted of water quality measurements obtained more than 400 meters upstream and downstream of construction activity. In addition, water quality was measured at 30 meters from the point of dredging or cover placement. In case of a water quality criteria violation, the water quality team took another sample at 100 meters from the point of dredging or cover placement 15 minutes after the first measurement. If an exceedance was still measured, the Port, the EPA, and the contractor were notified, and the contractor was directed to modify its operations to comply with the water quality standards. Another sample was taken 1 hour later to determine whether the modifications returned water quality conditions to compliance. If the last sample indicated that the contractor was still not meeting water quality criteria, EPA was consulted to make a determination whether to allow operations to continue or to temporarily shut down operations. In addition, whenever there was an exceedance, a water quality sampling event was scheduled for the next day.

According to the detailed sampling protocols presented in the project Water Quality Monitoring QAP (Appendix D of Anchor and Windward 2003a), water quality monitoring events were divided into two categories: intensive monitoring and moderate monitoring, as defined in the WQCs which were issued before the start of each dredging season (issued by the EPA in 2003 and 2005). Intensive monitoring occurred at the onset of new activities, such as the beginning of a construction season, change in nature of material being dredged,

and beginning of clean cover placement operations. Such monitoring also occurred when the contractor was near the abandoned sewer outfall, which had been identified as an area of highest concern due to elevated chemical concentrations as well as sediment characteristics such as high TOC values and relatively high amounts of fine grained sediment.

Water quality monitoring was conducted in accordance with the WQCs issued by the EPA in December 2003 (Season 1) and July 2004 (Season 2). During Season 1 (January through March 2004) and the first part of Season 2 (July through September 2004), water quality monitoring was only conducted downstream of dredging; the results of the hydroacoustic survey in September 2004 indicated that upstream sampling should be required on the flood tide, which is consistent with the intent of the WQC. Data reports were prepared following each season of dredging and are presented in Appendix C. The following summary discussions present only the data associated with exceedances of the water quality criteria for turbidity. Chemistry samples were taken weekly and daily during persistent turbidity exceedances. Throughout both seasons of dredging, turbidity was the only water quality parameter associated with dredging that also exceeded applicable project water quality criteria.

5.5.1 Season 1 (January Through March 2004)

The first season of dredging was conducted from January 2 to March 3, 2004. The dates, dredging locations, and tidal conditions associated with water quality exceedances in the first season of dredging are summarized in Table 6. Exceedances of the turbidity criteria were observed during both flood and ebb tides. Turbidity exceedances were also observed throughout the water column. Depths in the water column at which exceedances were observed ranged from 1 to 18.5 meters.

When an exceedance occurred, the contractor responded with a change in BMPs whenever possible. In most cases, the operational response was to slow the dredging operation down by increasing the dredge cycle time. The dredge cycle consisted of several phases: descent of open bucket, bucket closure to “bite” the sediment, ascent of full bucket, swing of full bucket to barge deck, opening of bucket to deposit sediment on barge, and return swing to begin cycle with descent through water column. As it was believed that the most disturbance to sediments occurred when they were impacted by

the descending open bucket and the suction from the ascending bucket, the cycle time was slowed at these stages as necessary to reduce exceedances. When a surface exceedance was observed, the contractor tried to snap open the dredge bucket over the barge in order to dislodge any external sediment clinging to the dredge bucket before re-entering the water. Frequently, the exceedances persisted despite the operational responses. There were also certain limitations to the operation of the dredge cable/bucket control equipment that limited possible operational responses. Snapping the dredge bucket open was stopped after Season 1 due to concerns over excessive wear and tear to the equipment. Clutch mechanisms restricted how slowly the bucket could be dropped or raised.

On February 20, 2004, an exceedance was measured in the surface water (less than 1 meter water depth). That exceedance was traced to a separation in the filter fabric fence on the barge. The filter fabric fence was repaired and no further exceedances were observed.

The one time, short-term exceedance of the chronic water quality criteria levels for PCBs (on March 1, 2004) was not an exceedance of the applicable water quality criteria; copper exceeded limits in the ambient background water.

Table 6
Summary of Season 1 Water Quality Monitoring Exceedances

Date	Location (DMMU)	Tide	Turbidity Exceedance Above Background (NTU) at 100 meters	Depth in Water Column (meters)	Persistence After Re-sampling?	Exceedance at 150 meters?	Chemistry?	Detected Analytes
2-Feb-2004	1C31; 1C32	ebb	19 to 24[a]	17.6	no	not sampled	yes	Copper[b]
4-Feb-2004	1C31; 1C32; 1C37; 1C38	flood	11 to 16	13	yes	not sampled	no	NA
9-Feb-2004	1C37; 1C38	ebb	11 to 20	15 to 17.5	yes	not sampled	no	NA
11-Feb-2004	1C38	ebb	11 to 19	1 to 12	yes	yes	yes	Copper[b]
12-Feb-2004	1C38; 1C32; 1C33	ebb	21 to 25	1	yes	yes	no	NA
			47 to 49	15.8	yes	yes	yes	Copper[b]
13-Feb-2004	1C32; 1C38; 1C33; 1C39	ebb	13 to 27	17 to 18.5	not sampled[c]	yes	no	NA
20-Feb-2004	1C31; 1C37	ebb	19 to 23	1	no	not sampled	yes	Copper[b]
25-Feb-2004	1C31; 1C32; 1C33	flood	19	1	no	not sampled	yes	Copper[b]
27-Feb-2004	1C38; 1C44; 1C39	ebb	12 to 34	1 to 17.7	yes	yes	yes	Copper[b]
1-Mar-2004	1C33; 1C39	flood	11 to 20	4.5 to 7	yes	no	no	NA
1-Mar-2004	1C33; 1C39	ebb	18 to 56	8.5 to 15	not sampled[c]	not sampled	yes	PCB and Copper[b]
2-Mar-2004	1C39	flood	30	16.8	not sampled[c]	no	no	NA
2-Mar-2004	1C39	ebb	12 to 22	6.9 to 8	not sampled[c]	yes	no	NA

Notes:
NTU Nephelometric Turbidity Unit
NA not applicable
[a] Turbidity exceedances also reported 100 meters upstream of dredge operation likely due to Terminal 18 dredge activity
[b] Copper concentrations similar to those measured at ambient locations and reflect ambient concentrations, PCB concentrations exceeded chronic applicable water quality criteria
[c] No re-sampling since no operational changes occurred

5.5.2 Season 2 (July 2004 Through March 2005)

The dates, dredging locations, and tidal conditions associated with water quality exceedances in Season 2 are summarized in Table 7. Exceedances of the turbidity criteria were observed during both flood and ebb tides. Turbidity exceedances were also observed throughout the water column. Depths in the water column at which exceedances were observed ranged from 0.5 to 18.2 meters.

Table 7
Summary of Season 2 Water Quality Monitoring Exceedances

Date	Location (DMMU)	Tide	Turbidity Exceedance Above Background (NTU) at 100 meters[a,b]	Depth in Water Column (meters)	Persistence After Re-sampling	Maximum Exceedance Distance (meters)	Chemistry Taken?	Chemical Exceedance[c]
26-July-2004	1C43; 1C44	slack	15 to 28	1.5 to 3.5	yes	200	yes	copper
29-July-2004	1C50; 1C49	flood	23	105. to 15.4	yes	200	yes	copper
30-July-2004	1C50; 1C49	flood	26	8.5 to 12.3	yes	125	no	NA
4-Aug-2004	1C44	flood	11	1 to 1.6	no	100	no	NA
9-Aug-2004	1C45	flood	24	10.5	yes	>400	yes	copper
10-Aug-2004	1C45; 1C51	flood	18.5 to 30	8.1 to 13.5	yes	200	no	NA
11-Aug-2004	1C51	flood	10 to 14	10.5 to 11.5	not sampled	not sampled	no	NA
20-Aug-2004	1C33; 1C39; 1C45	flood	10 to 12	17 to 18	yes	200	no	NA
23-Aug-2004	1C45	flood	12	15.4	no	not sampled	no	NA
5-Sept-2004	1C50	ebb	10 to 13	1 to 13.8	no	100	no	NA
17-Sept-2004	2C16; 2C17	ebb	13	1	no	100	no	NA
21-Sept-2004	2C18	ebb	10 to 40	1 to 17.1	yes	200	no	NA
22-Sept-2004	2C19	flood	10 to 35	8 to 17	no	100	no	NA
27-Sept-2004	2C15	flood	10 to 30	8 to 13.5	yes	250	yes	copper; PCB
28-Sept-2004	2C14	flood	25	1 to 11	yes	300	yes	copper
29-Sept-2004	2C13; 2C12	flood	32	10.5 to 15.4	yes	350	yes	copper
30-Sept-2004	2C15	flood	25 to 40	7 to 15.8	yes	250	yes	copper; PCB
4-Oct-2004	2C15; 2C14	ebb	20 to 30	2 to 4	yes	300	yes	copper; PCB
5-Oct-2004	2C13	ebb	13 to 15	1 to 11.5	not sampled	250	yes	copper
6-Oct-2004	2C13; 2C12	ebb	15 to 30	12.5 to 15.5	yes	150	yes	copper
12-Oct-2004	S25	ebb and flood	12 to 20	1 to 4.1	no	250	yes	copper
15-Oct-2004	S24; S38; S37	ebb and flood	20 to 40	1 to 14.6	yes	>400	yes	copper
18-Oct-2004	S38	ebb	10 to 20	1 to 17.1	yes	200	yes	copper
21-Oct-2004	S38; S24	ebb	20 to 40	1 to 17.2	yes	>400	no	NA

Date	Location (DMMU)	Tide	Turbidity Exceedance Above Background (NTU) at 100 meters[a,b]	Depth in Water Column (meters)	Persistence After Re-sampling	Maximum Exceedance Distance (meters)	Chemistry Taken?	Chemical Exceedance[c]
22-Oct-2004	S24	flood	55 to 65	1	no	150	yes	copper
2-Nov-2004	S35; S36	ebb	13 to 15	1	yes	250	yes	copper
4-Nov-2004	S36	ebb	10 to 20	1 to 12.8	no	200	no	NA
9-Nov-2004	S37	flood	15 to 20	14.7	yes	250	yes	copper; PCB
10-Nov-2004	S25; S24; S38	ebb	14	15	no	100	no	NA
7-Dec-2004	2C15	flood	10	17.7	no	100	no	NA
10-Dec-2004	2C14; 2C15	flood	13	17.1	no	100	yes	copper
20-Dec-2004	2C18	ebb	16	1	no	200	no	NA
4-Jan-2005	2C13	ebb	17 to 30	1 to 2	no	100	yes	copper
12-Jan-2005	S38	flood	12 to 25	5 to 6	yes	200	no	NA
13-Jan-2005	S24; S38	flood	16 to 37	9 to 15.9	no	100	yes	copper
21-Jan-2005	1C50; 1C49; 1C43; 1C44	ebb	25 to 30	10.8 to 12	yes	350	no	NA
25-Jan-2005	1C51; 1C45; S35; S23	flood	15 to 30	10 to 13	yes	250	no	NA
26-Jan-2005	S35; S36	flood	10 to 15	7.8	no	200	no	NA
14-Feb-2005	1C31; 1C32; 1C37; 1C38; 1C33	ebb	12 to 30	0.5 to 1	yes	300	no	NA
19-Feb-2005	1C44; 1C43; 1C45; 2C18; 2C17; S24	flood	11	17.5	no	100	no	NA
22-Feb-2005	2C17; 2C16; 2C15; S23; S35	ebb and flood	13 to 30	1 to 18.2	yes	200	yes	copper
23-Feb-2005	S23; S36; S37; 2C16; 2C15	ebb	13 to 30	1 to 16.8	yes	100	yes	copper
8-Mar-2005	1C43; 1C37; 1C32; 2C17; 2C16; 2C15	flood	13 to 20	5 to 7.5	no	200	no	NA

Notes:

NTU Nephelometric Turbidity Unit

[a] 100 meter exceedance boundary extended by EPA to 200 meters after October 12, 2004, when dredging was conducted outside the area of highest concern

[b] Following the hydroacoustic survey September 21 to 23, 2004, water quality measurements were made upstream of the dredge activity on the flood tide in addition to the downstream measurements

[c] copper concentrations are similar to those measured at ambient locations and reflect ambient concentrations, PCB concentrations exceeded chronic applicable water quality criteria

NA not applicable

5.5.3 Hydroacoustic Survey

In addition to the water quality monitoring events described above, two hydroacoustic surveys were conducted. The first hydroacoustic survey was completed on January 28, January 30, and February 2, 2004. The second took place from September 21 to 23, 2004. The hydroacoustic survey in January and February was not informative because of the absence of a turbidity plume. However, hydroacoustic monitoring conducted in September was more informative. Hydroacoustic monitoring used sound waves underwater, similar to sonar, to detect particle density in the water column (i.e., a turbidity plume). These hydroacoustic monitoring events were scheduled to occur when the contractor was present in an area of the site where turbidity exceedances occurred repeatedly, despite the contractor's efforts. The objectives of this event were to get a better representation of the material behavior, of the relationship between rate of dredging and generation of a turbidity plume, and the relationship between tidal cycles and plume length and plume location in the water column.

The contractor was directed to follow the following methods during the September 3-day monitoring event:

- September 21: Operate normally
- September 22: Slow down bucket near bottom during descent phase
- September 23: Dredge at high rate

There are many variables that can affect turbidity plume creation and persistence. This survey was not designed to discriminate between these variables. However, within the constraints of the survey, the contractor's change in operation did not seem to have a measurable effect on the generation of a turbidity plume. The variation in tidal cycle during the hours of dredge operation was poor and we were unable to sample a strong ebb tide. The effect of the flood tide on the turbidity plume was observed and substantial turbidity was observed upstream of the dredge operation during the flood tide.

5.6 Results of Construction Oversight Activities

Construction oversight activities were used to keep all parties informed of project progress and contractor compliance. The Port was able to use the oversight activities to meet clean-

up objectives, help administer the contract, protect water quality, and maintain normal navigation and commerce within the EWW. Field inspection activities used in the oversight are provided in Section 6.

5.7 Contingency Dredging and Placing Clean Cover

As discussed in Sections 3.8 and 5.3, contingency dredging was performed in areas where post-dredge monitoring sampling results indicated that the new dredge surface still had contaminants that exceeded SQOs. The contract depth for contingency dredging was -53 feet MLLW, which provided as much as 2 feet of additional sediment removal from the -51 feet MLLW design grade. When the contingency dredging was completed, these same areas were covered with clean sand to provide a clean substrate in the project area for benthic organisms to reoccupy.

The cover sand was obtained from Glacier Northwest in Dupont, Washington. A source sample was tested by the Port for metals, organic compounds, PCBs, and pesticides to ensure the material was clean. Grain size and other parameters were also tested to ensure contract compliance (Appendix E).

The sand was distributed just above the water surface with a clamshell bucket. To distribute sand, the operator opened the clamshell bucket a sufficient amount to allow the dry sand to drop, while simultaneously swinging the bucket at a fixed rate to distribute a uniform depth of sand. This procedure was established on a dry barge top before placement in the water, in order to measure the depth of sand at a given bucket opening and swing speed. In-water uniform placement coverage was then monitored by two methods. First, the contractor used a distribution grid of known area and a fixed volume of sand to determine when the desired depth of sand placement had been achieved (as averaged over the area). Second, hydrographic surveys were used to take post-sand placement soundings. The contract requirement was a minimum of 6 inches of sand cover to a minimum elevation of -52.5 feet MLLW with an allowable tolerance to -52 feet MLLW. The contractor was later requested to achieve an average of 10 inches of sand cover. An average layer of approximately 10 inches of sand was achieved as measured by both hydrographic survey and volumetric averages of the distribution area (See Appendix B). In areas where loss of

control resulted in over dredging, the contractor was required to place the desired sand layer thickness but not to backfill to the minimum elevation (-52.5 feet MLLW).

Some turbidity exceedances were recorded during contingency dredging, and one exceedance was recorded during placement of the sand cover (Table 7).

5.8 Achievement of Removal Action Objectives

The specific cleanup standard for the Phase 1 Removal Action area presented in the EE/CA (Section 4.3) was:

- The chemical concentrations in the newly exposed surface sediments will be less than the SQS or SL as appropriate for all chemicals. (The DMMP SL will be used where there is no SQS value.)

This objective was not met with dredging alone. None of the management units met the SQS after the design dredge depth was reached (-51 feet MLLW) or after the contingency dredging (-53 feet MLLW). Approximately 13.5 acres of the 20-acre dredge area (67.5 percent) were covered with a sand layer, which is anticipated to result in a final sediment surface with no SQS exceedances. Further monitoring will be conducted to confirm the extent of the sand layer as well as chemical concentrations of the substrate. Eight post-dredge monitoring areas (Areas 1, 2, 3, 5, 11, 12, 13, and 17) were not selected for contingency dredging and sand layer placement. The primary chemical that exceeded the SQS in these areas was PCBs. In addition, 1,4-Dichlorobenzene exceeded the SQS at post-dredge monitoring location 17. Four of the locations with SQS exceedances (locations 1, 2, 5, and 13) had TOC values less than 1 percent TOC. It is expected that biological activity and sediment deposition will result in higher TOC values in these areas over time. This hypothesis will be tested in future recontamination monitoring (see Section 7).

6 FIELD INSPECTION AND CERTIFICATION

The Port had at least one inspector observing Manson's daily operations. The inspector prepared a daily report of the contractor's operations and other site observations, which were summarized into a weekly report to Port management. Before construction operations began, a detailed communication plan was established between the Port inspectors, the water quality monitoring crew, the Port project managers, and EPA representatives (Figure 17). The Port's inspectors observed whether Manson and TAU implemented the BMPs set forth in their work plans and in the contract, and whether the contractor was adhering to other pertinent terms of the contract during construction operations. The Port's inspectors also coordinated water quality efforts and reported any exceedances observed by the water quality monitoring crew to Manson, the Port project manager, and the EPA for appropriate actions.

The inspection and water quality monitoring teams did not notice any major deficiencies during construction operations, with the exception of the water quality exceedances discussed in Section 5. When Manson's or TAU's equipment or procedures varied from what was described in their work plans or in the contract, it was brought to their attention and they took appropriate action to correct any variances.

Both contractors held regular health and safety meetings, and no major accident occurred during construction activities. All remedial action activities were conducted according to the EPA-approved Contractor Health and Safety Plan.

Inspection observations, monitoring results, dredging operations, survey results, schedule, and other issues were discussed at weekly project meetings. The EPA and their oversight contractor regularly participated in the meetings and in the review of all project documentation.

The Port and the Port's project engineer have determined that the removal action has been constructed in general accordance with the design documents.

7 OPERATIONS AND MAINTENANCE

No requirements for operations and maintenance (O&M) were established for this project. The sand layer is not an engineered cap and has not been evaluated for long term performance.

Although the project is not an O&M program, it is important to note that future monitoring and a final remedy for the entire EWW are being planned. The thickness of the sand layer and the surface sediment chemistry will be monitored as part of the recontamination monitoring plan. The design of the recontamination monitoring plan is presented in the QAPP (Windward 2005). Further sediment sampling will also be conducted as part of the site-wide RI/FS, which will result in the selection of a final remedy for the removal area as well as the rest of the EWW.

8 SUMMARY OF PROJECT COSTS

The estimated cost (Engineer's Estimate) to complete the Phase 1 Removal Action was $15,044,000, assuming 8,000 cy of contingency dredging and 4,000 cy of contingency clean cover placement for bidding purposes.

The contractor's bid price, based on the estimated volumes provided, was $13,486,000.

The final construction cost, including the additional contingency dredging and clean cover placement, change orders, and sales tax was $15,786,900 (Table 8), approximately 5 percent above the engineer's estimate.

Table 8
Final Construction Costs*

Item	Quantity	Unit Price	Cost
Mobilization and Demobilization	1 lump sum	$1,310,000	$1,310,000
Dredging and Disposal of Suitable Sediments	67,330 cy	$6/cy	$ 403,980
Dredging and Disposal of Unsuitable Sediments	179,954 cy	$55/cy	$9,897,470
Post-dredge stand-by time	1.5 days	$8,000/day	$ 12,000
Contingency Dredging and Disposal	26,038 cy	$70/cy	$1,822,660
Contingency Sand and Gravel Cover	19,131 cy	$50/cy	$ 956,550
Base contract total			$14,402,660
Change orders**			$ 107,358
Sales tax			$ 1,276,882
Construction total			$15,786,900

Notes:
* At the time of this report preparation.
** Does not include Change Order #2 (T-46), which was completed via this contract, but not as a part of the EWW Phase 1 Removal Action.

Table 9 presents a summary of project quantities (bid versus actual) to relate where the actual items varied from those estimated. Although there were contract savings due to underruns in unsuitable dredging and stand-by days, suitable dredging and contingency items exceeded the plan quantities. The large overruns in contingency dredging and sand cover were directly tied to the Port's commitment to the EPA to work together to achieve environmental goals. Taking planned suitable, unsuitable, and contingency dredge quantities together, the actual total

dredge quantity of 273,322 cy was only slightly more than 5,000 cy above the plan total of 268,000. There is a difference of less than 2 percent.

Table 10 provides a total cost to perform the entire project, including analysis, construction, and monitoring.

Table 9
Summary of Project Quantities

Item	Bid	Actual	Difference
Suitable Dredging	60,000 cy	67,330 cy	7,330 cy
Unsuitable	200,000 cy	179,954 cy	<20,046 cy>
Standby Days	7	1.5	<5.5>
Contingency Dredging	8,000 cy	26, 038 cy	18,038 cy
Contingency Sand and Gravel Cover Material	4,000 cy	19,131 cy	15,131 cy

Table 10
Total Project Costs

Removal Action Analysis and Design	$ 340,000
Construction Oversight and Monitoring	$ 1,230,000
Port Internal Oversight and Management	$ 280,000
Total Construction Cost	$15,786,900
	$17,636,900

9 OBSERVATIONS AND LESSONS LEARNED

9.1 Water Quality Related to Mechanical Dredging Activities

As described in Section 5, water quality exceedances were measured on multiple occasions during both dredging seasons. In past dredging projects, water quality exceedances have often been assumed to result from the contractor's dredging operations (such as cycle time or dredging speed), or the nature of the dredging equipment used by the contractor (such as open bucket or closed bucket). An attempt was made during this project to correlate these contractor-related factors with the measured water quality exceedances.

As previously described in Section 5.5.3, a 3-day hydroacoustic monitoring event (September 21 to 23, 2004) was conducted in order to observe the behavior of the turbidity plume under a range of tidal conditions and to determine if certain changes in dredging operations (e.g., decreasing and increasing the speed of the dredging operations) resulted in changes in the observed turbidity. The hydroacoustic data collected indicates that varying these BMPs had little effect on the magnitude and extent of the turbidity plume generated during dredging. However, the results of this study are not conclusive, because of the difficulty in scheduling the survey to coincide with optimal tide cycles and dredging of the most silty (and contaminated) material. The hydroacoustic data did clearly document plume movement upstream on the flood tide.

At the start of the second season of dredging, an attempt was made to use the existing sediment data to predict areas where turbidity exceedances could be considered to be more likely to occur. Contour maps of the sediment percent fines, TOC, and PCB concentrations were overlaid and an "area of highest concern" was defined as the area with high percent fines, high TOC, and elevated PCB concentrations. All of the Season 1 turbidity exceedances occurred within this area. However, in Season 2, exceedances were seen in other areas outside of the "area of highest concern" as well as within it.

The physical characteristics of the dredged material appeared to be the determining factor in the occurrence and intensity of the observed turbidity exceedances; in several areas, the material was consistently fine-grained with high organic carbon content. Highly organic and flocculent material was observed in the water column when dredging occurred in these areas, and turbidity plumes were observed at distances up to 300 and 400 meters from the

dredging operation. Modifications to dredging operations were not observed to demonstrably affect the extent of the turbidity plume when this fine-grained material was encountered. However, the application of dredging BMPs was critical to minimizing overall turbidity at the site.

9.2 Lessons Learned

9.2.1 Communication and Oversight

Construction operations during the EWW Phase 1 Removal Action were completed within two dredging seasons, without problems that could not be collaboratively addressed and solved. This was due in large part to effective communication between the Port, the contractors, and the EPA. Weekly project meetings, attended by the EPA, the Port, and the contractors, facilitated timely and effective communication and all parties worked to ensure that all dredged material was handled properly and that the project was completed on time.

Independent oversight of the construction activities was provided by Anchor Environmental, L.L.C. (Anchor). Construction oversight activities included site visits and review of contractor operations, review of positioning data and bathymetric surveys, and coordination with the Windward Environmental, LLC (Windward) water quality team. As a result, issues associated with the performance of the dredge contractor were quickly identified and any problems were quickly remedied.

9.2.2 Environmental Monitoring

The incorporation of the post-dredge monitoring and contingency dredging plan in the project design documents was instrumental to the success of the project. The fact that a plan was in place to quickly and efficiently address the results of the post-dredge monitoring sampling resulted in the placement of clean sand material on the waterway bottom and reduced the potential for biological exposure to sediment contaminants.

Turbidity monitoring was the standard water quality monitoring tool. Direct communication between the monitoring crew and the Port's resident engineer was critical in initiating any operational change found necessary.

Hydroacoustic monitoring was planned to track operational impacts of dredging the worst material (i.e., the most likely to cause tubidity) as a once per season experiment; however, the following factors made it difficult to time the hydroacoustic monitoring to coincide with the most visually impacted plume:

- Limitations in the availability of hydroacoustic monitoring equipment
- Unanticipated changes in contractors schedules
- Heterogeneity of sediment grain size within the project area
- Inherent differences in strong acoustic signatures and strong visual signatures of dredged material (the variability of sediment characteristics is such that that a strong visual plume does not necessarily coincide with a higher acoustic reading)
- The relatively narrow range of speed controls on some dredge derrick barges that made it difficult to document changes resulting from varying the BMPs (dredging speed variation did not necessarily result in a difference in the monitoring results)

The effect of the dredging on the areas surrounding the project area was not evaluated as part of the post-dredge monitoring sampling, due to a lack of baseline data to compare with the results. For projects where this evaluation is anticipated, a robust baseline data set should be collected in surrounding areas prior to dredging.

The levels of sediment chemistry were generally reduced by the 1 foot contingency dredging. It is not known if this was due to the removal of in-place sediment chemistry or the removal of residuals.

Tidal influence had greater impacts in the EWW than originally anticipated. It is important to pay attention to channel flow direction when monitoring; monitoring locations upstream and downstream of the dredge area may be reversed on a strong flood tide.

9.2.3 Contractor Operations

The contractor spent a great deal of time and effort lining the sediment barge to ensure that any release of sediment from the barge was minimized. This effort was very successful; the effluent from the barge was clear and water quality monitoring found

only one instance where turbidity was observed due to leakage from the barge. The turbidity resulted from a break in the liner material, which was quickly repaired.

From an observational point of view, the BMPs used on the project seemed to have more effect on the "standard" type of sediments found throughout the project area. The visually "worst" sediments appeared to have a higher percentage of very fine, highly organic, less dense material. Once dredging commenced in these areas, a large plume was soon observed that did not readily settle in the water column. BMPs did not seem to make much difference on the visual impact of turbid water, containing this material, moving "downstream". However, the BMPs in place during these periods probably had an effect on the "nearfield fallout" around the dredging operation.

The one-time loss of dredge control in the first season occurred due to a combination of factors, including operator inexperience and lack of survey data. Manson was utilizing a new operator and retained a local survey subcontractor to provide daily progress surveys. The new operator was not sufficiently experienced with the dredge control software (WINOPS) and the software was not updated with daily survey information. The subcontracting surveyor was not keeping up with progress on a daily basis and, after missing several scheduled surveys, was subsequently released by Manson. During the missed survey events and before Manson replaced the subcontractor with their own surveyor, the dredge operator overdredged several feet below design grades and extended the Season 1 dredge boundary into the Season 2 area. Additional work was required to minimize the exposure of contaminated slopes during the seasonal shutdown, requiring an extension of time for Season 1 dredging. Manson prevented this problem in Season 2 by:

- Utilizing a more experienced dredge operator
- Providing their own full-time project surveyor
- Using WINOPS to plot bucket locations on a daily basis for survey progress review by the Port and EPA

Frequent and careful reviews of dredging progress are recommended, particularly at the start of a project or when dredge operators or surveyors are changed. Plots of WINOPS

location information and dredge progress surveys are valuable tools for assessing compliance with specifications.

The contractor continued to underachieve production rates throughout the project, which resulted in the need to request extensions to the work window. The contractor's reasons for the lack of predicted progress included:

- The claim that material was more dense than anticipated near the design grades, and therefore more difficult to dredge
- Tribal fishing activity slowed dredging progress
- The TAU offload site could not store or process an additional volume of material

The Port observed that the equipment the contractor made available during the majority of the contract did not have the production capabilities of the equipment utilized near the end of the contract.

The construction contract for this project was prepared as a competitive bid contract for qualified contractors. This method is established to allow the contractors, as professional dredgers, to meet the specification requirements using the techniques and equipment of their choice. In this type of a competitive bid contract, control over performance is dependent upon the contractor. Levels of performance are specified in the contract and the contractor is expected to meet performance in order to receive compensation. The decisions as to whether or not the contract specifications are met are the responsibility of the contracting entity. The key to good performance is to write clear, detailed specifications; to have tight monitoring of the performance of the contractor; and to establish clear lines of communication between the contractor oversight, the contracting entity, and the contractor to ensure that contractor performance is continually met as specified.

In future contracts, a contracting method that offers incentives for meeting or exceeding performance goals and penalties for failing to meet the performance specifications could be used as a method to complete contracts sooner and otherwise improve contractor performance (e.g., this method may provide more economic incentive for contractors to utilize high production equipment on relatively low volume dredging projects).

A few times during the project, there were concerns regarding the ability to continue to dredge unsuitable material due to restrictions in the capability of the transfer facility to offload, store, and transport material. It would be desirable to have a secondary offload site as an option if the primary facility is restricted; however, various development and permitting considerations make it uncommon for multiple offloading sites to be available simultaneously. These site considerations include: property lease for a large acreage waterfront site; facility development for material transfer, storage, dewatering, and water treatment; transportation contracting and railroad spur construction; attainment of permits or substantive permit requirements; and other factors related to health and safety, security, and environmental control issues. For many projects, it may be unlikely that a secondary site would be practical and economically feasible. It would also be difficult for a contractor to guarantee that a secondary facility would remain as an available option throughout the project. Future removal actions could either identify more than one offloading/transfer facility option, if feasible, or could ensure that the single transfer facility will have adequate offloading capacity throughout the life of the project, or else be subject to consequences related to a breach of contract.

It was agreed, between the EPA and the Port, that the removal action would cover two seasons. Reasons to allow two seasons included:

- Careful environmental dredging was preferred to production dredging with large and/or multiple open buckets
- The ability to leave a suitable surface between seasons was demonstrated
- It would be very difficult to remove all material in one ESA-constrained dredge season with the expected amount of ship traffic, tribal fishing, limitations in material handling, and a multitude of unknown factors

In addition to the reasons outlined above, it was the desire of all parties to start the contaminated sediment removal as soon as possible and to give the contractor a reasonable amount of time to complete the dredging. This allowed a degree of certainty that the dredging could be completed before the end of the second season, including the relatively uncertain volume of contingency dredging and contingency cover. Consequently, during the time allowed for the ESA closure, the contractor was able to correct some problems with operational control that were discovered in the first season.

The second season started with these operational changes in place, thereby allowing "lessons learned" to be implemented over the course of the project.

10 OPERABLE UNIT CONTACT LIST

Table 11 is a list of the major design and remediation contractors, EPA oversight contractors, the respective regional project manager and project managers for the EPA, and the primary responsible parties, as applicable.

Table 11
East Waterway Phase 1 Removal Action Project Contact List

Role	Company	Contact Name	Address	Phone
Owner	Port of Seattle	Doug Hotchkiss Port Environmental Michael McLaughlin Port Project Management Jerry Dowd, P.E. Resident Engineer	P.O. Box 1209 Seattle, Washington 98111	(206) 728-3192 (206) 728-3453 (206) 728-3178
Regulatory	EPA	Ravi Sanga	US EPA Region 10 Office of Environmental Clean-up 1200 6th Ave Seattle, Washington 98101	(206) 553-4092
EPA Oversight Contractor	URS	Kara Steward	1501 4th Ave, Ste 1400 Seattle, Washington 98101	(206) 438-2700
EPA Oversight Contractor	Integral Consulting, Inc.	David Schuchardt	7900 SE 28th Street, Suite 300 Mercer Island, Washington 98040	(206) 230-9600 ext. 27
EE/CA; Engineering and Design; Construction Management	Anchor Environmental	Tom Wang, P.E.	1423 3rd Avenue, Suite 300 Seattle, Washington 98101	(206) 287-9130
RI; EE/CA; Water Quality Monitoring	Windward Environmental	Susan McGroddy	200 West Mercer Street, Suite 401 Seattle, Washington 98119	(206) 577-1292
Dredging Contractor	Manson Construction	Gene Quinn	P.O. Box 24067 Seattle, Washington 98124	(206) 764-8558
Disposal Contractor	TAU L.L.C.	Geoffrey Starin (Regional Disposal Co.)	1011 SW Klickitat Way, Suite C109 Seattle, Washington 98134	(206) 292-2929

11 REFERENCES

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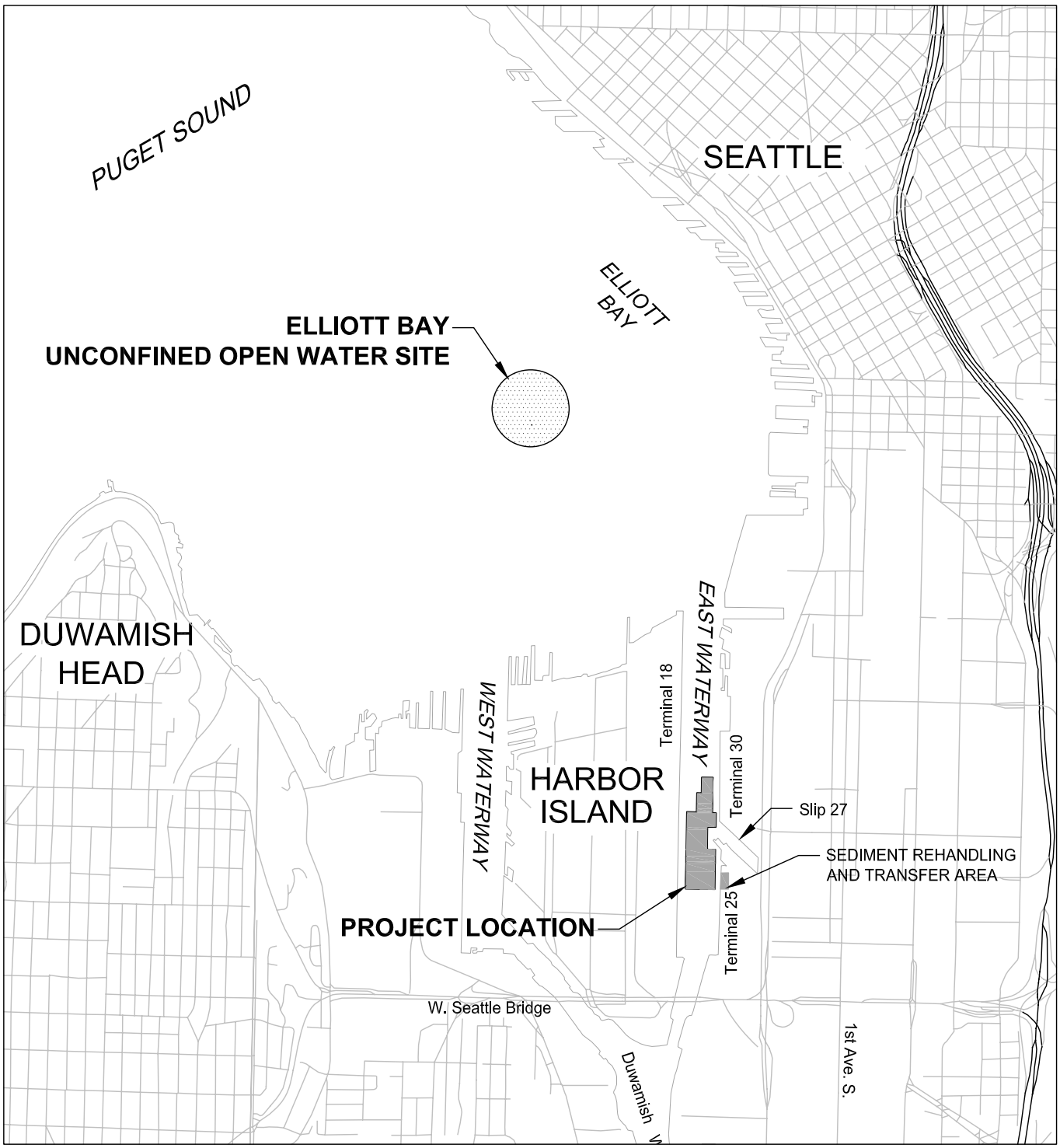
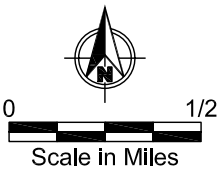
Windward. 2003b. East Waterway, Harbor Island Superfund Site, Nature and Extent of Sediment Contamination. Recency Data Report. For Submittal to U.S. EPA Region 10 Dredge Material Management Program, May 9, 2003. Windward Environmental, LLC, Seattle, WA.

FIGURES

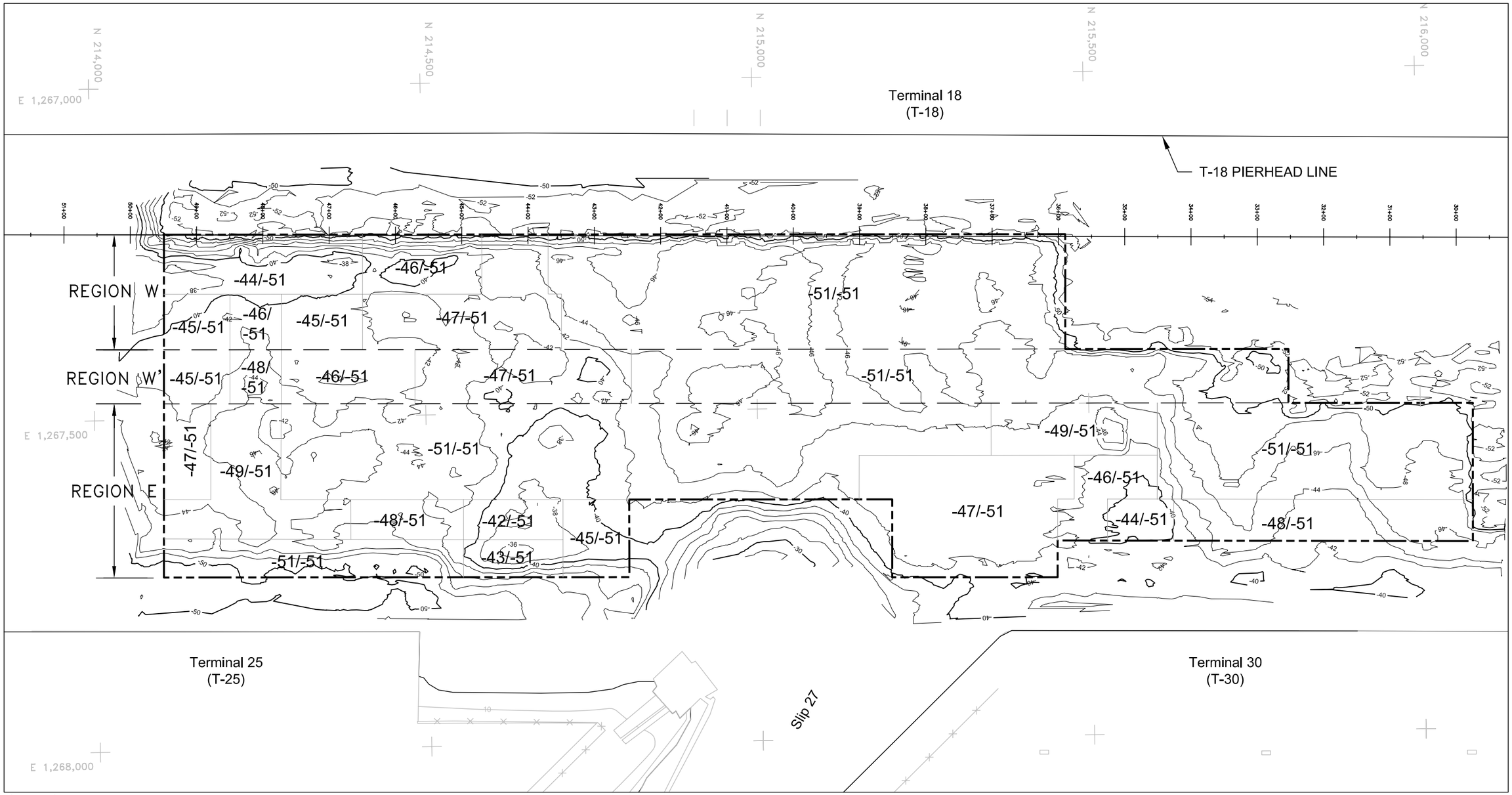




Jun 03, 2005 8:52am cdavidson K:\Jobs\030137-EWW-Windward\03013701\03013701-59.dwg FIG 1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Project Location
East Waterway Completion Report



Legend:

-50 Pre-Dredge Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

-46/-51 Unsuitable/Suitable Required Dredge Elevation in Feet (MLLW)

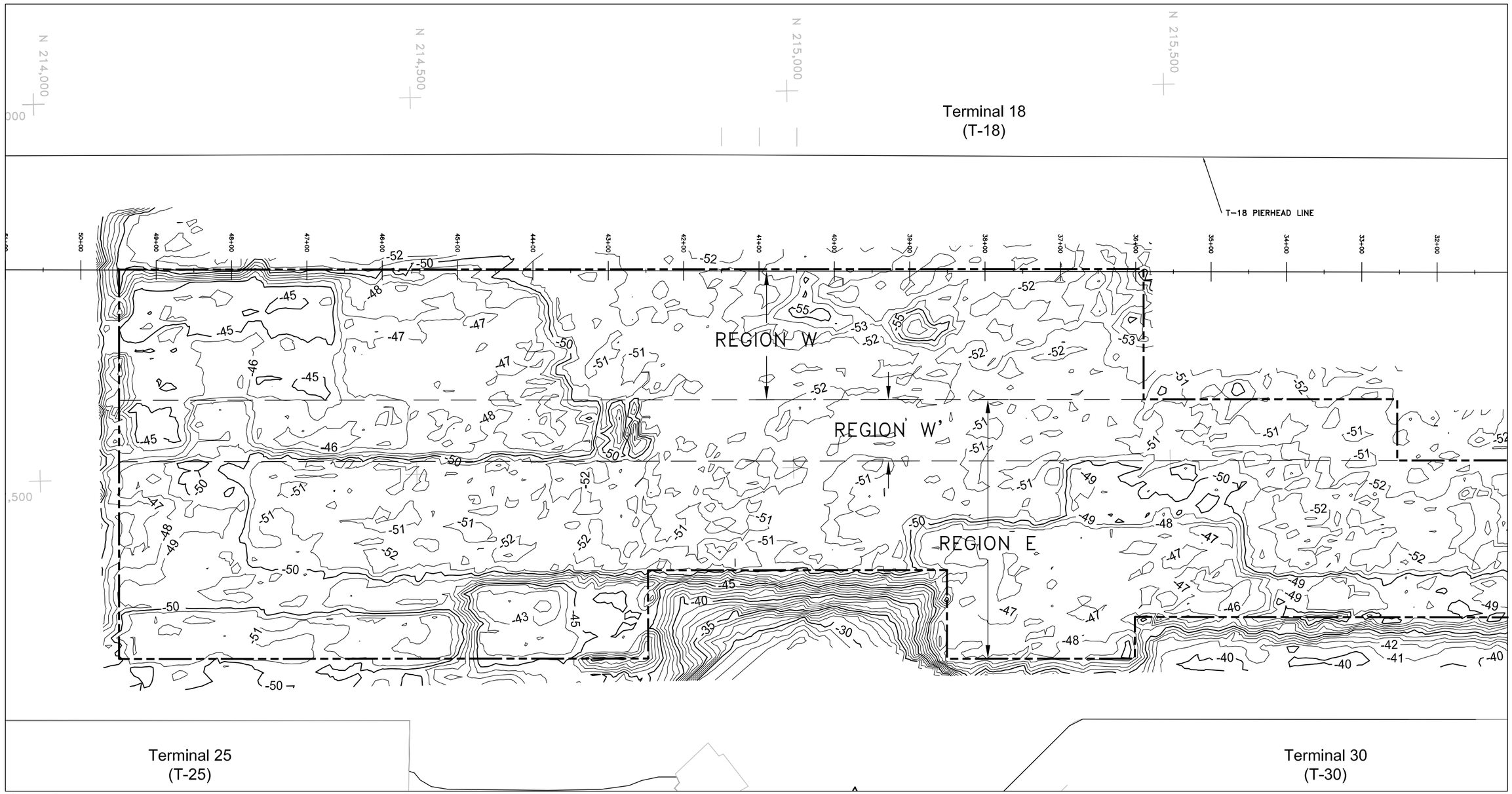
Source: Bathymetry provided by Blue Water Engineering dated January 5, 2004

0 150
Scale in Feet

Jun 03, 2005 9:41am cdavidson K:\Jobs\030137-EWW-Windward\030137011\030137011-64.dwg FIG 2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Pre-Dredge Bathymetry and Dredge Plan
East Waterway Completion Report



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

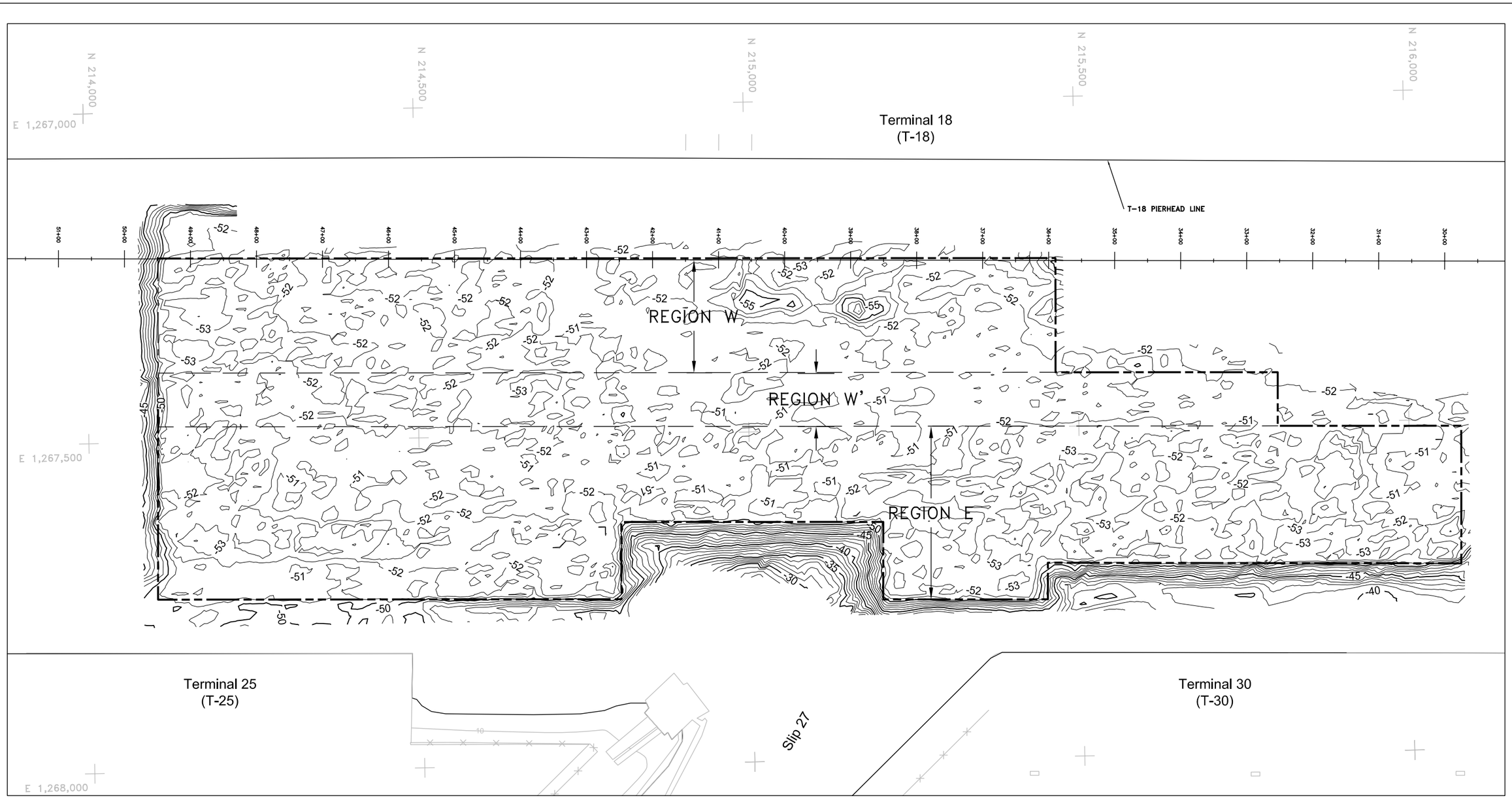
Source: Post unsuitable bathymetric survey provided by Blue Water Engineering dated January 24, 2005

0 150
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
Post Unsuitable Dredge Bathymetry
East Waterway Completion Report

Jun 03, 2005 9:11am cdavidson K:\Jobs\030137-EWW-Windward\03013701\03013701-60.dwg FIG 3



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

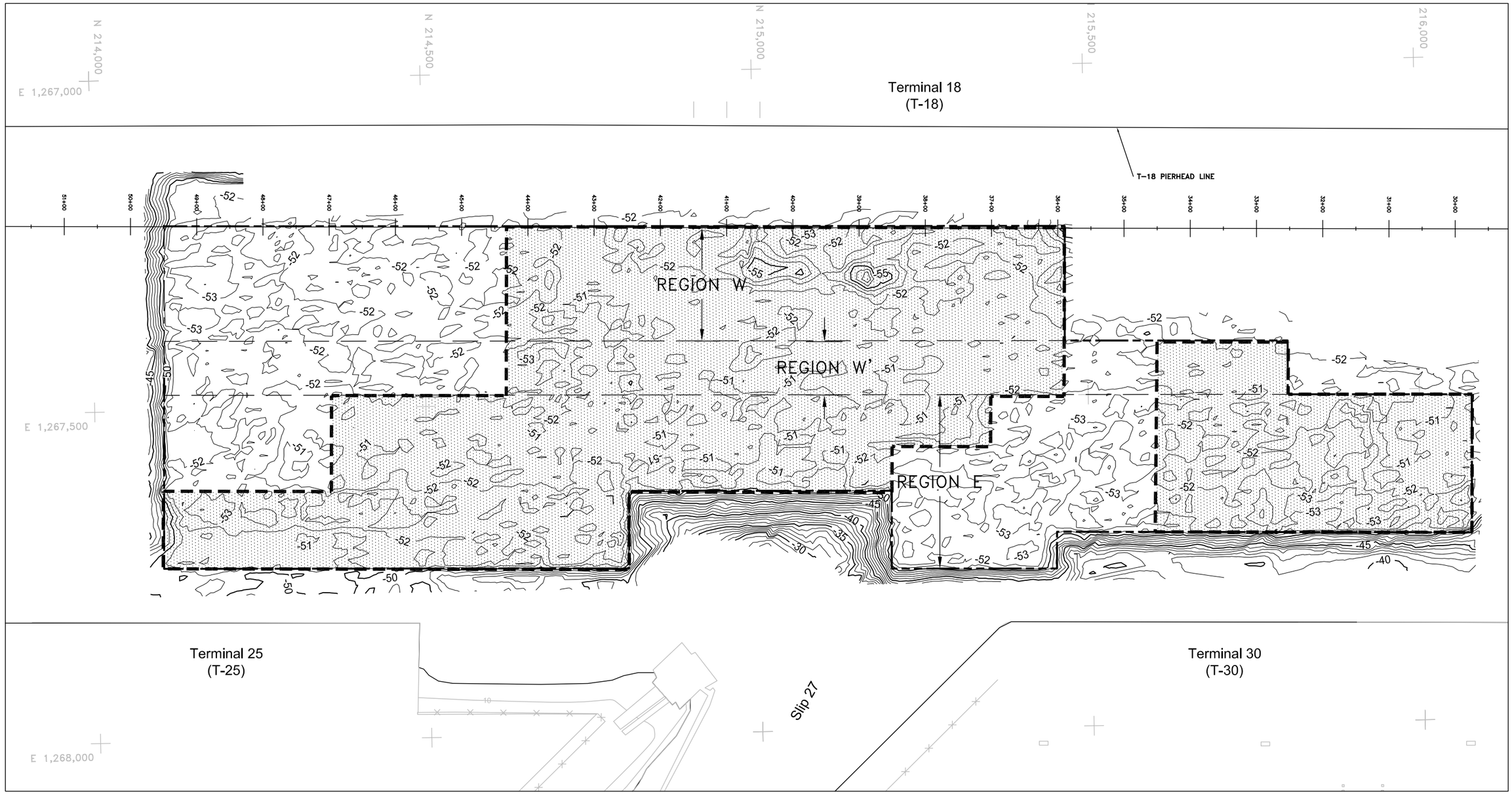
Source: Post suitable bathymetric survey provided by Blue Water Engineering dated February 2, 2005

0 150
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Post Suitable Dredge Bathymetry
East Waterway Completion Report

Aug 19, 2005 4:32pm dholmer K:\Jobs\030137-EWW-Windward\03013701\03013701-61.dwg FIG 4



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

Contingency Area to be Dredged to -53' and Covered with Clean Sand up to an Approximate 10 inch Depth

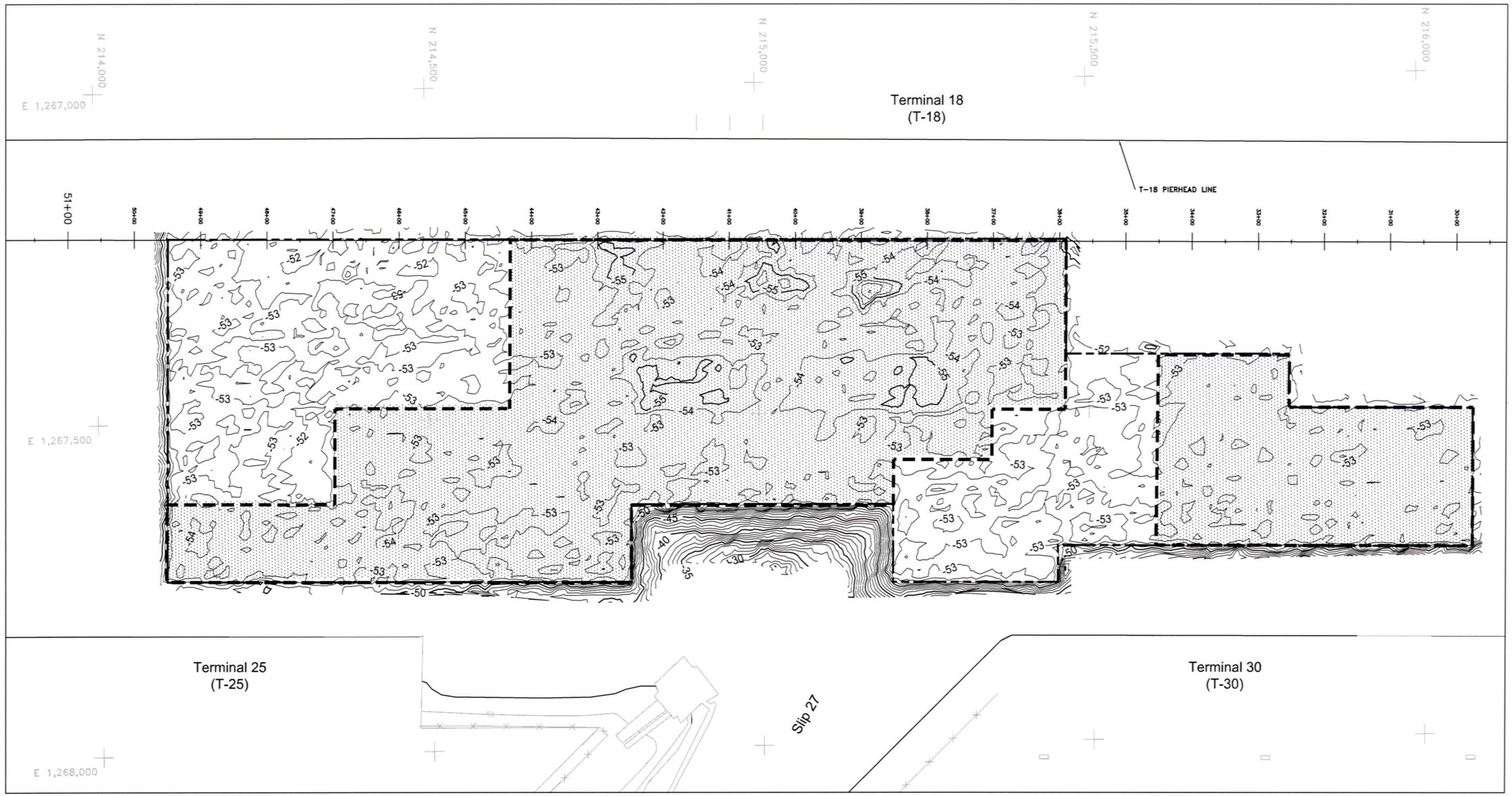
Source: Post suitable bathymetric survey provided by Blue Water Engineering dated February 2, 2005

0 150
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5
Contingency Dredge Areas
East Waterway Completion Report

Aug 19, 2005 4:32pm dholmer K:\Jobs\030137-EWW-Windward\03013701\03013701-61.dwg FIG 5



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

Contingency Dredging Area Boundary

Source: Post contingency dredging bathymetric survey provided by Blue Water Engineering dated February 28, 2005

JOHN P. LAPLANTE
STATE OF WASHINGTON
38792
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 03/26/07
9-29-05

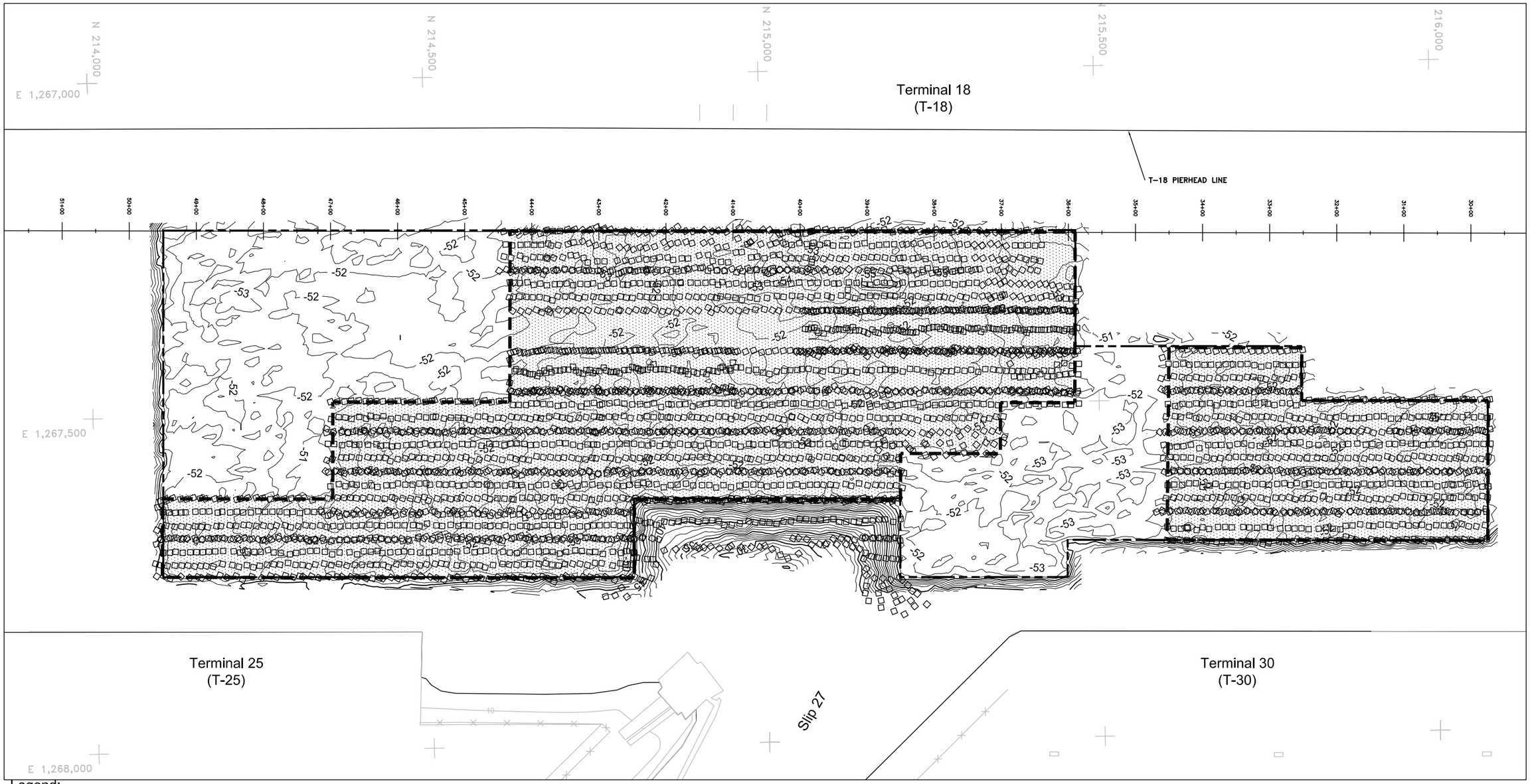
Note: These Record Documents have been prepared based on information provided by others. The Design Professional has not verified the accuracy and/or completeness of the information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

0 150
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 6
Post Contingency Dredge Bathymetry
East Waterway Completion Report

Jun 29, 2005 8:56am cdavidson K:\Jobs\030137-EWW-Windward\03013701\03013701-62.dwg FIG 6



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

Clean Sand Cover Boundary

Bucket Locations

Source: Post cover bathymetric survey provided by Blue Water Engineering dated March 17, 2005

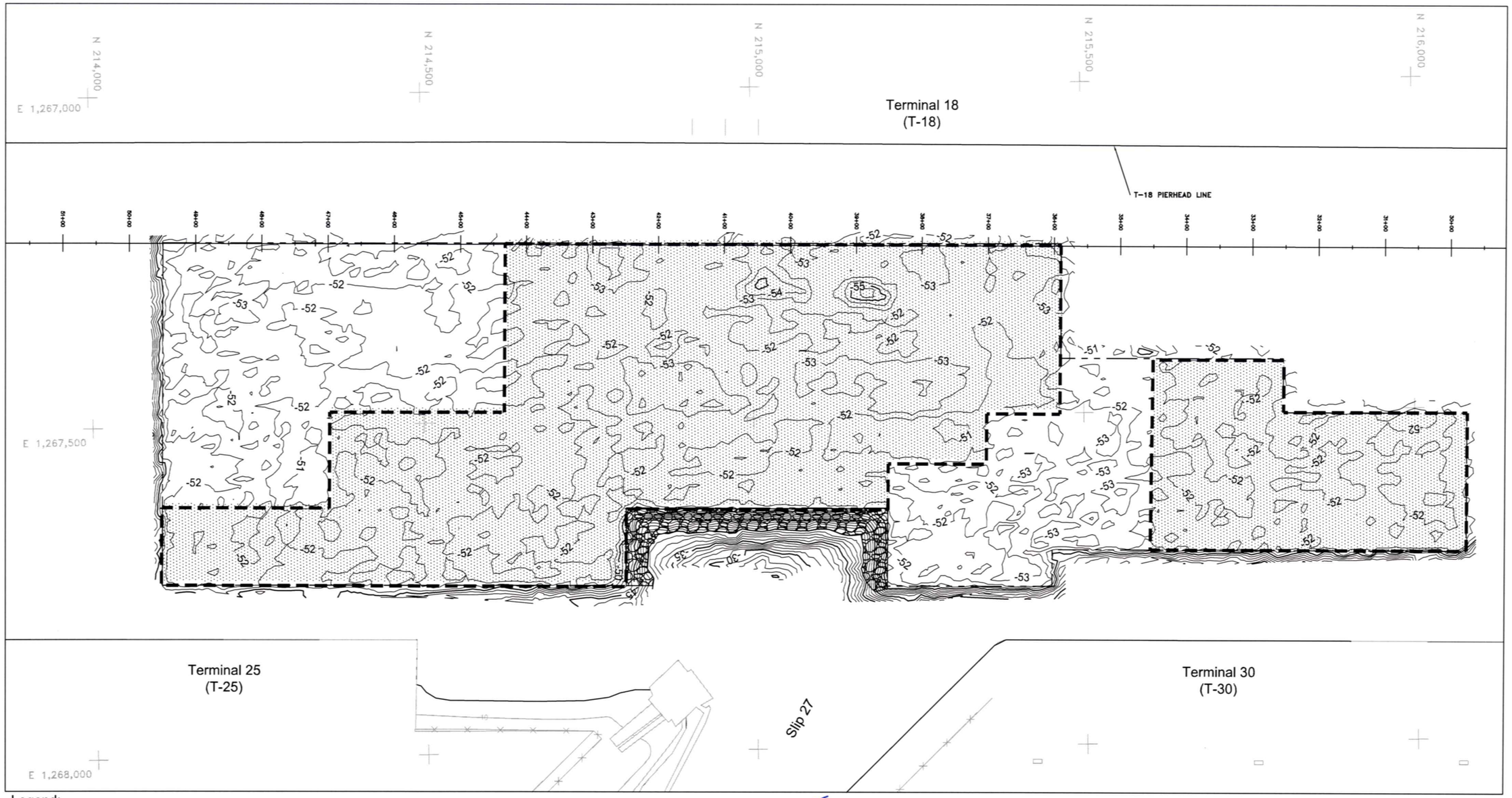
Note: These Record Documents have been prepared based on information provided by others. The Design Professional has not verified the accuracy and/or completeness of the information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

0 150
Scale in Feet

Aug 23, 2005 11:28am cdavidson K:\Jobs\030137-EWW-Windward\03013701\03013701-66.dwg FIG 7

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 7
Post Sand Cover Bathymetry and Bucket Locations
East Waterway Completion Report



Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

Sand Layer Boundary

Clean Gravel Layer

Source: Post sand cover bathymetric survey provided by Blue Water Engineering dated March 17, 2005

JOHN P. LAPLANTE
STATE OF WASHINGTON
38792
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 03/26/07
9-29-05

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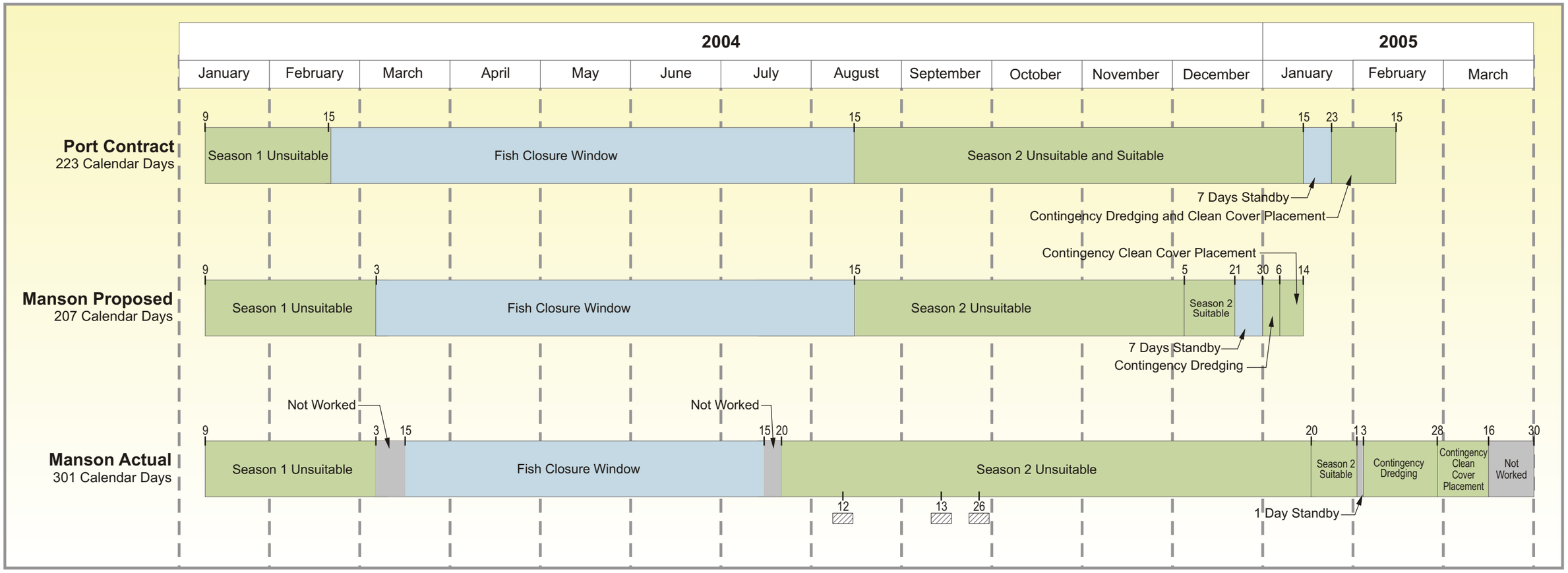
0 150
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 8
Post Sand Cover Bathymetry
East Waterway Completion Report

Aug 23, 2005 11:29am cdavidson K:\Jobs\030137-EWW-Windward\030137\01\030137\01-63.dwg FIG 8



Not to Scale

Legend

Fish Nets Closure

8/23/05 cvd K:\Jobs\030137\030137-01\FIG 9.cdr

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 9
Project Timeline
East Waterway Completion Report

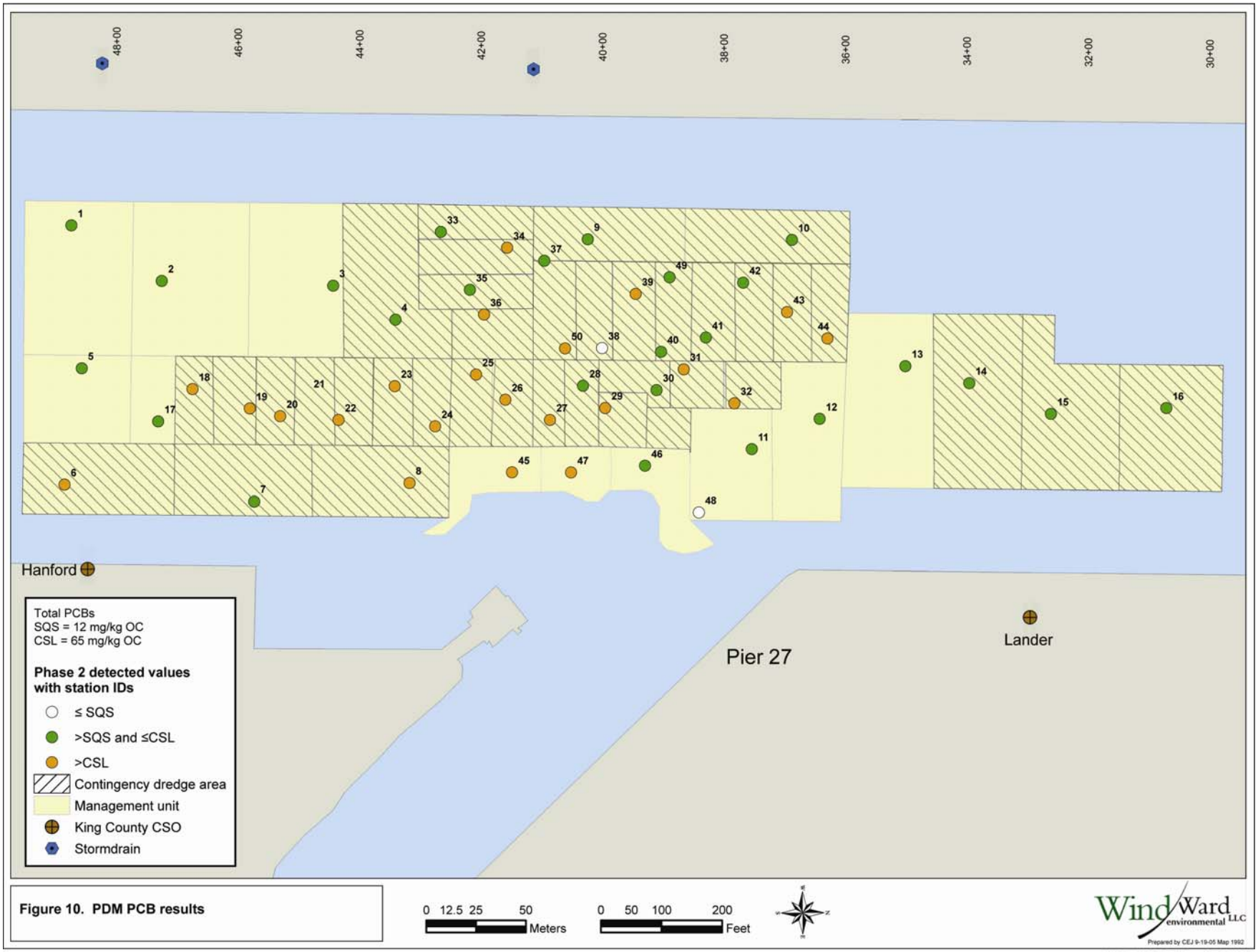


Figure 10. PDM PCB results

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 10
Post-Dredge Monitoring Total PCB Exceedances of SMS Criteria
East Waterway Completion Report

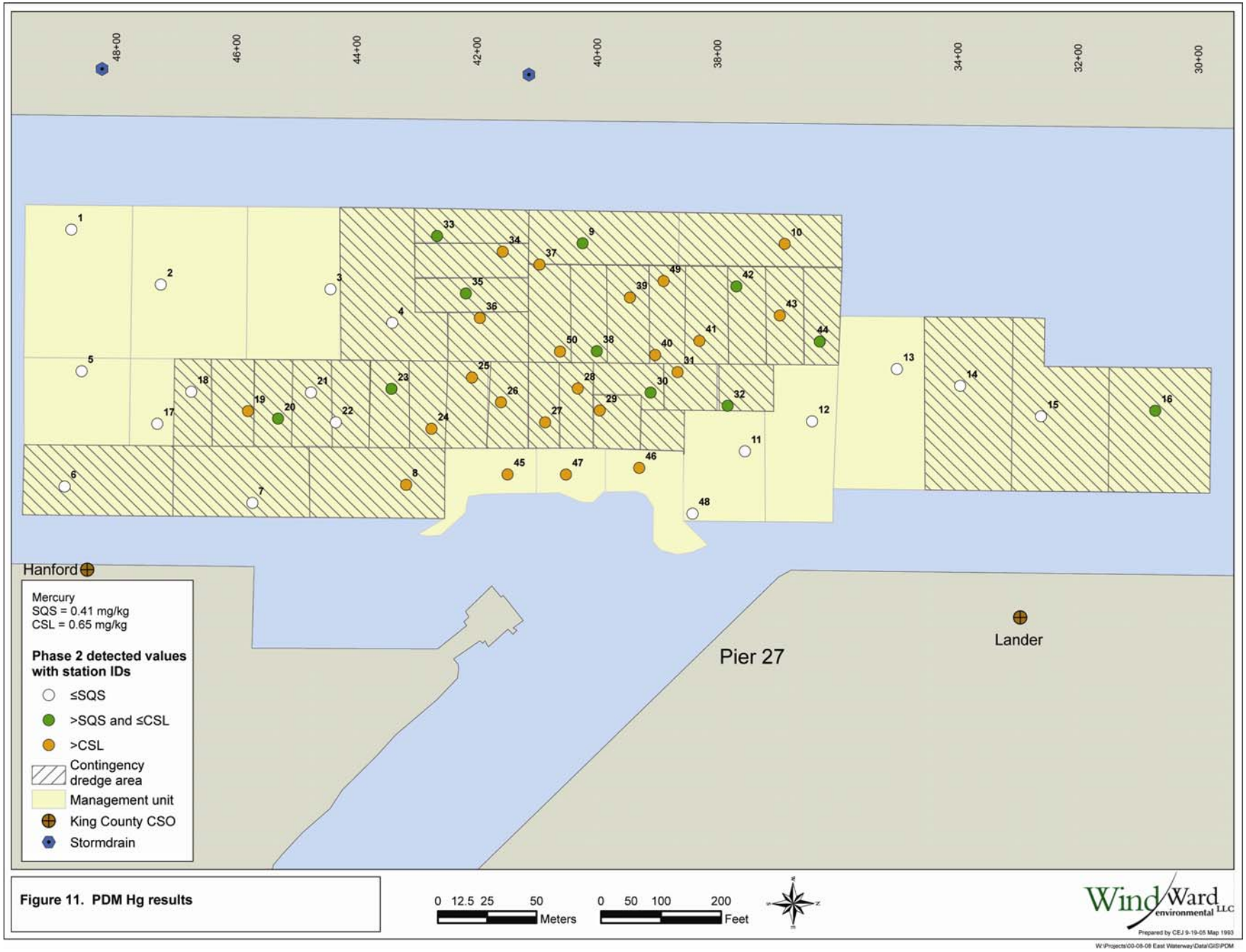


Figure 11. PDM Hg results

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 11
Post-Dredge Monitoring Mercury Exceedances of SMS Criteria
East Waterway Completion Report

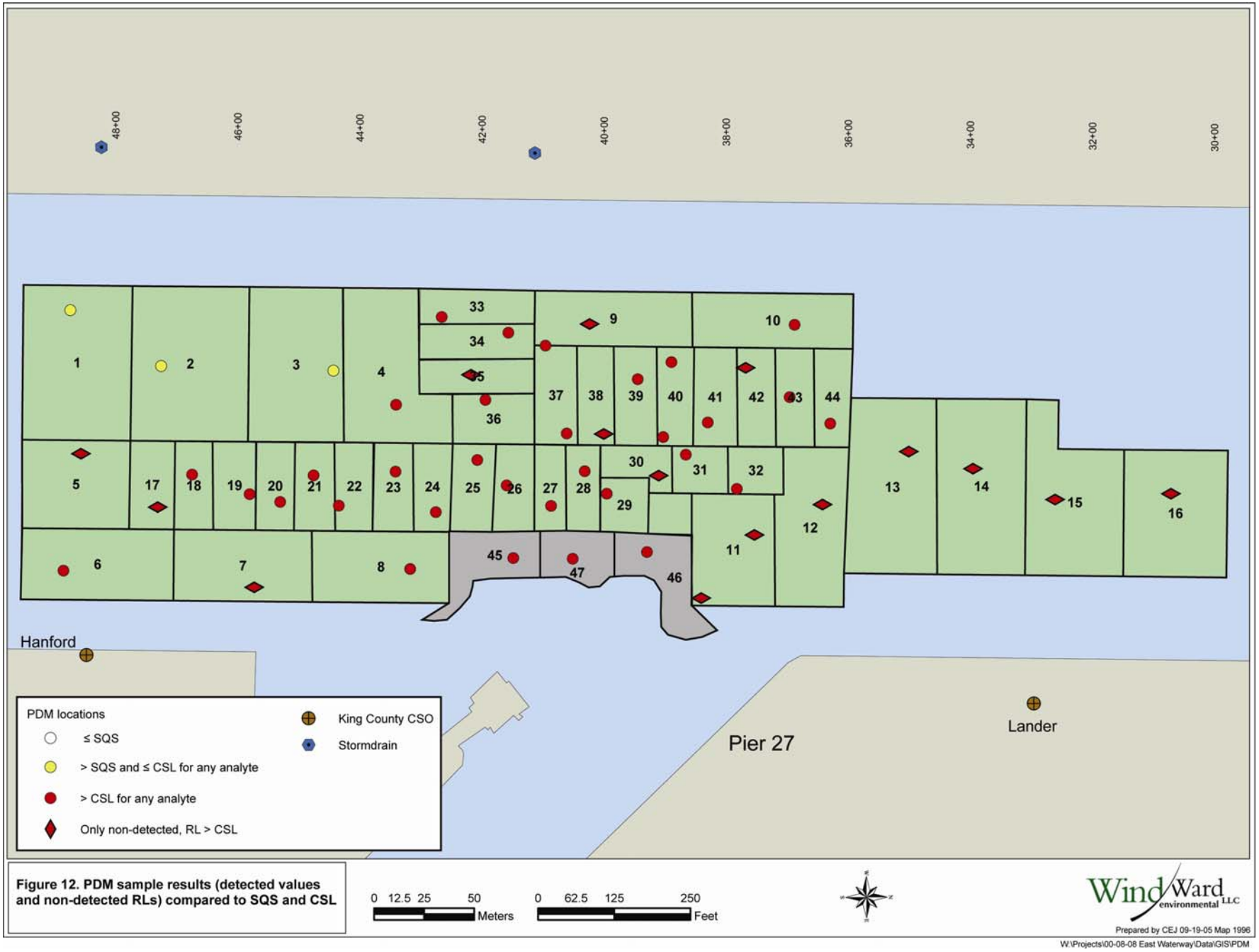


Figure 12. PDM sample results (detected values and non-detected RLs) compared to SQS and CSL

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 12

Post-Dredge Monitoring Sample Results (Detected Values and Non-Detected RLs Compared to SQS and CSL

East Waterway Completion Report

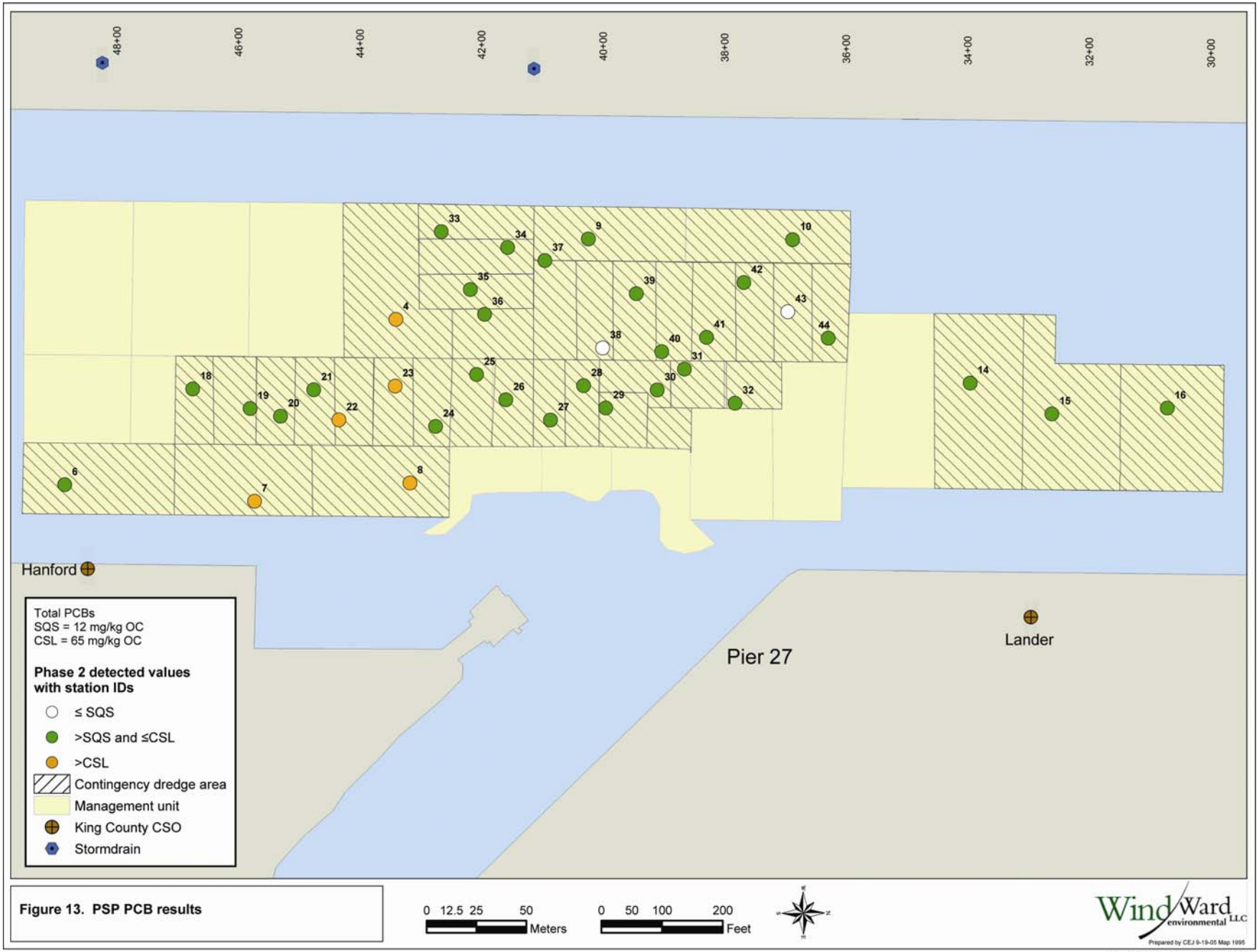


Figure 13. PSP PCB results

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 13
Pre-Sand Placement Sampling Total PCB Exceedances of SMS Criteria
East Waterway Completion Report

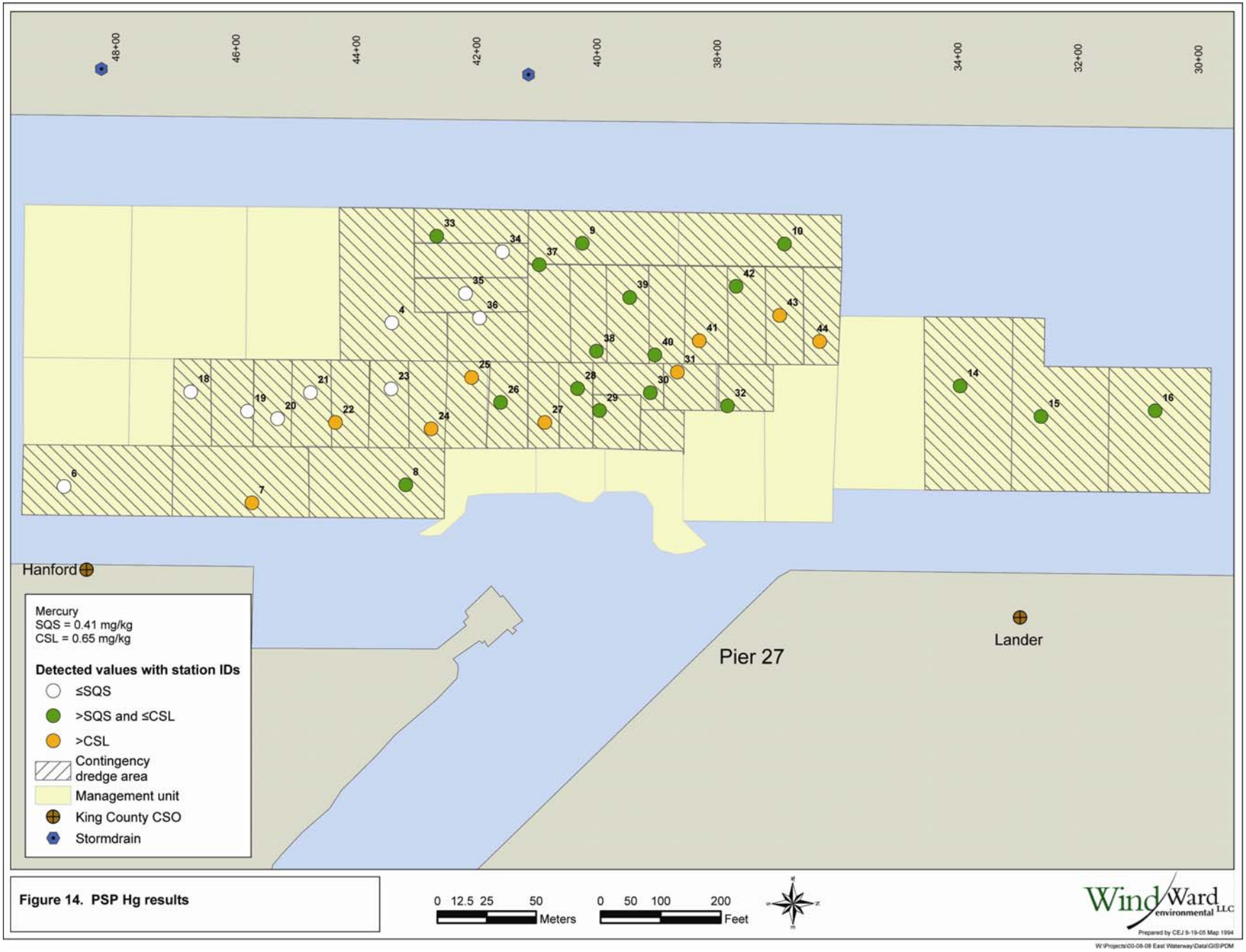


Figure 14. PSP Hg results

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 14
Pre-Sand Placement Sampling Mercury Exceedances of SMS Criteria
East Waterway Completion Report

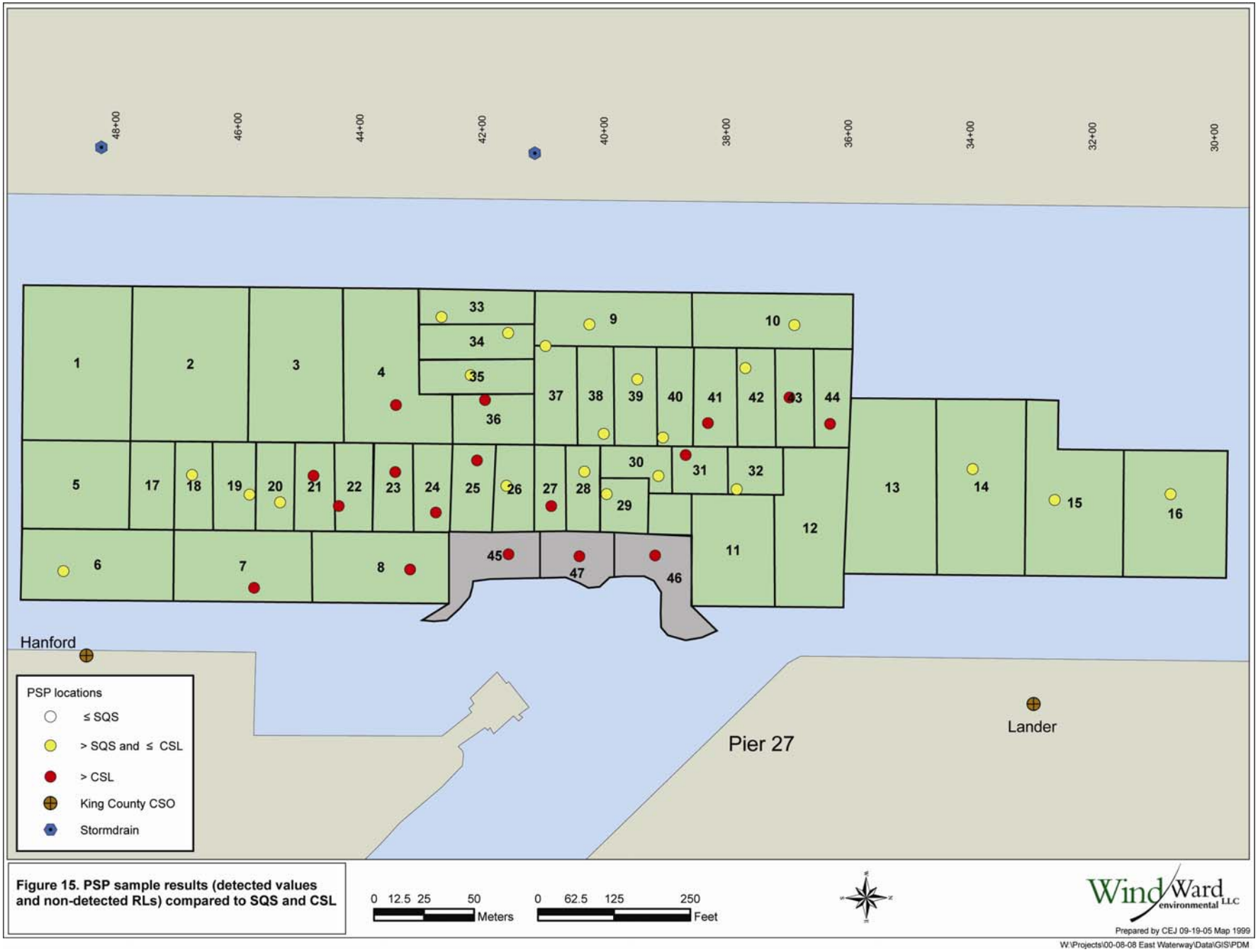


Figure 15. PSP sample results (detected values and non-detected RLs) compared to SQS and CSL

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 15
PSP Sample Results (Detected Values and Non-Detected RLs) Compared to SQS and CSL
East Waterway Completion Report

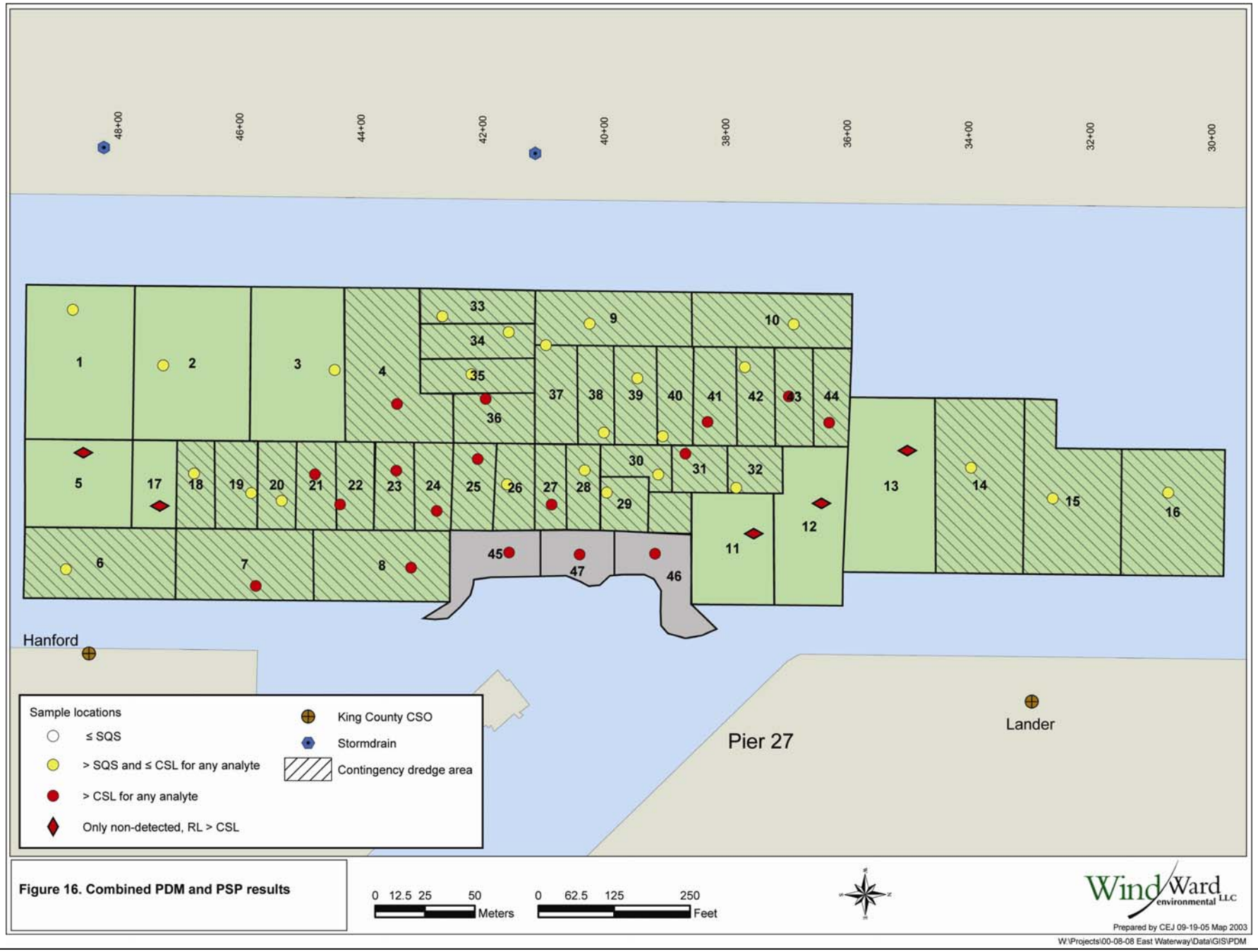
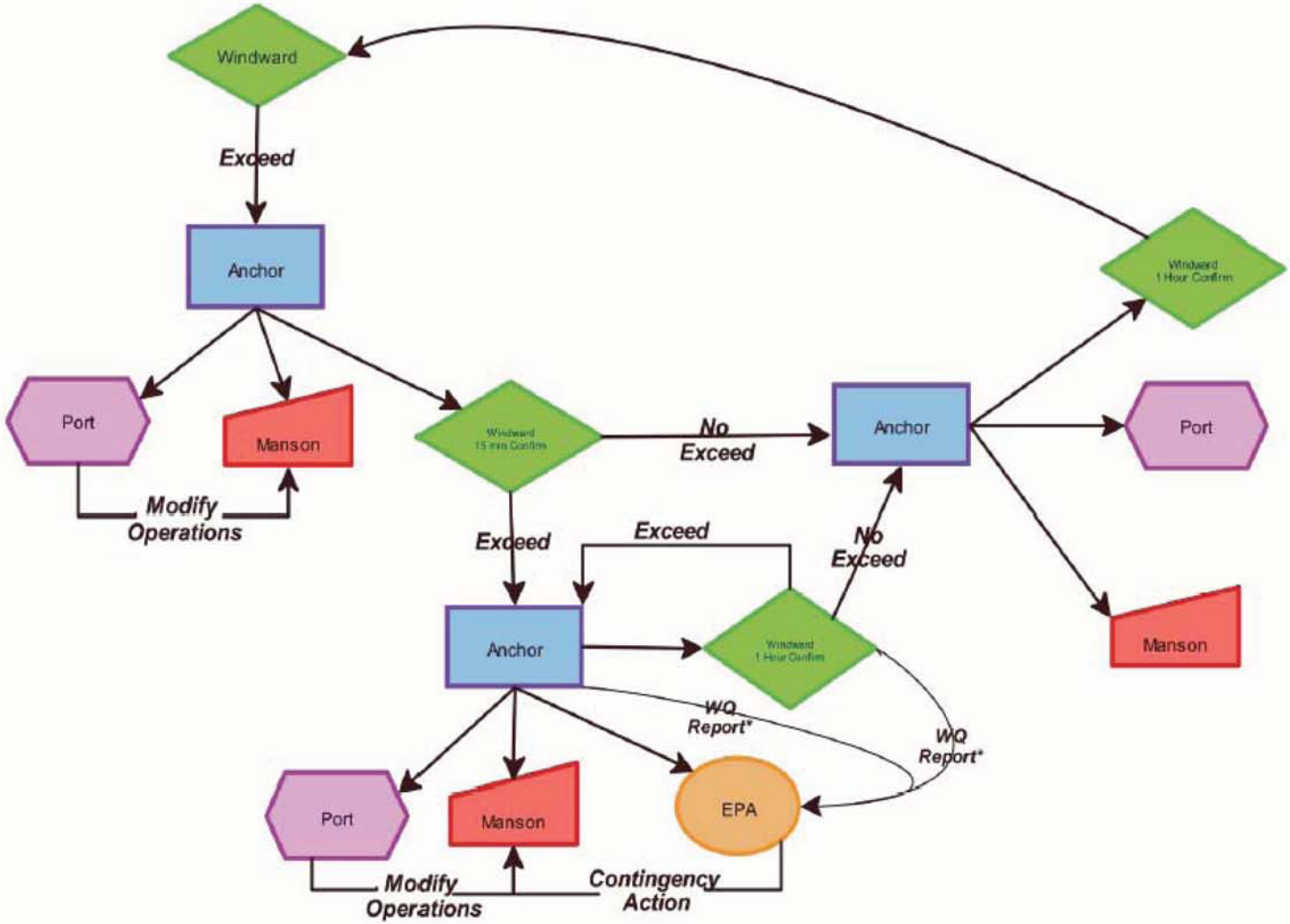


Figure 16. Combined PDM and PSP results

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 16
Combined Post-Dredge Monitoring and PSP Results
East Waterway Completion Report



Contacts:

EPA: Erika Hoffman (prim.), Kevin Rochlin
Port: Jerry Dowd
Windward: Joanna Florer, Susan McGroddy
Anchor: Greg Guannel, Ed Berschinsky
Manson: Gene Quinn

* WQ Report gives details about exceedance measurement and about contractor's response actions

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 17
Water Quality Monitoring Communication and Feedback Loop
East Waterway Completion Report

APPENDIX A
PROJECT PHOTOGRAPHS

Mason dredge in operation using 10 cy cable arm bucket

Transferring unsuitable material for upland transport and disposal. Loader on barge deck is consolidating material for bucket pick-up. Note dribble protection between barges and apron on shoreside.

Unsuitable material in Terminal 25 containment area being rehandled for loading to rail cars

Note how material can cling to external surfaces of cable arm bucket

Loader and backhoe in use at TAU facility placing material into lined rail car containers

Loading unsuitable material into lined rail car containers

APPENDIX B
SAND COVER PLACEMENT INFORMATION

Legend:

-50 Bathymetry (1 Foot Contour Interval, MLLW)

Phase I Removal Action Boundary

Clean Sand Cover Boundary

Color	Range Beg.	Range End
	0.00	0.50
	0.50	1.00
	1.00	1.50
	1.50	2.00

Source:
Post contingency and post cover bathymetric surveys provided by Manson dated March 11 and 25, 2005 respectively.

Note: These Record Documents have been prepared based on information provided by others. The Design Professional has not verified the accuracy and/or completeness of the information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

0 150
Scale in Feet

Aug 23, 2005 11:38am cdavidson K:\Jobs\030137-EWW-Windward\03013701\03013701-67.dwg FIG B-1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure B-1
Post Sand Cover Isopach
East Waterway Completion Report

Manson Construction Co.

East Waterway Operable Unit: Sand Cover Material

Updated on 3/16/2005

Date	Load #	Convertion Factor	Weather	Time In	Time Out	PB	PS	SS	SB	Total	Average	Low	Low Chart	High	High Chart	Tons	Net Tons	Cubic Yards Conversion factor 1.427	Headway	Cut Width	Area	Capping Thickness Inches	Barge	Cubic Yards Based on varying convertion factor	Load Total in Tons
3/1/05	1	1.427	Rain	12:00 PM		6.30	5.60	5.70	6.20	23.80	5.950	5.9	5605.17	6.0	5547.46	5576.32									
3/1/05	1	1.427	Rain		8:00 PM	7.60	6.10	7.60	9.00	30.30	7.575	7.5	4690.58	7.6	4633.81	4648.00	**928.31**	**650.53**	500	60	30000	7.03	Manson 73	650.53	
3/2/05	1	1.427	Clear	4:00am		7.50	6.50	7.50	9.20	30.70	7.675	7.6	4633.81	7.7	4577.11	4591.29							Manson 73		
3/2/05	1	1.427	Clear		8:00pm	11.60	14.45	10.80	13.55	50.40	12.610	12.6	1890.32	12.7	1837.54	1890.32	**2700.97**	**1892.76**	745.00	60.00	44700	13.72	Manson 73	1892.76	
3/3/05	1	1.427	Clear	4:00 AM		12.10	14.10	10.90	14.60	51.70	12.925	12.9	1732.31	13.0	1679.88	1719.20							Manson 73		
3/3/05	1	1.427	Clear		7:00 AM	13.60	13.00	13.60	13.10	53.30	13.325	13.3	1523.36	13.4	1471.63	1510.43	**208.78**	**146.30**					Manson 73	146.30	3838.05
3/3/05	2	1.323	Clear	7:00 AM		4.60	3.40	5.50	4.30	17.80	4.450	4.4	5874.39	4.5	5818.44	5846.42							Manson 74		
3/3/05	2	1.323	Clear		8:00 PM	11.00	9.40	9.00	7.40	36.80	9.201	9.2	3285.37	9.3	3233.75	3284.85	**2561.56**	**1795.07**	815.00	60.00	48900	12.86	Manson 74	1936.18	
3/4/05	2	1.323	Clear	7:00 AM		11.00	9.20	9.40	7.40	37.00	9.250	9.2	3285.37	9.3	3233.75	3259.56							Manson 74		
3/4/05	2	1.323	Clear		8:00 PM	12.70	12.10	12.60	11.60	49.00	12.201	12.2	1772.16	12.3	1723.42	1771.67	**1487.89**	**1042.67**	670.00	60.00	40200	8.40	Manson 74	1124.63	4049.45
3/7/05	3	1.387	Clear	7:00 AM		5.50	5.60	6.10	6.30	23.50	5.875	5.8	5662.94	5.9	5605.17	5619.61							Manson 73		
3/7/05	3	1.387	Clear		8:00 PM	8.80	11.80	13.00	10.10	43.70	10.925	10.9	2802.58	11.0	2748.22	2788.99	**2830.62**	**1983.62**	1000.00	60.00	60000	10.71	Manson 73	2040.82	
3/8/05	3	1.387	Clear	7:00 AM		7.70	11.60	10.00	13.00	42.30	10.575	10.5	3019.27	10.6	2964.98	2978.55							Manson 73		
3/8/05	3	1.387	Clear		12:00 PM	12.90	12.70	13.20	13.10	51.90	12.975	12.9	1732.31	13.0	1679.88	1692.99	**1285.57**	**900.89**	485.00	60.00	29100	10.03	Manson 73	926.87	4116.19
3/8/05	4	1.388	Clear	12:00 PM		5.00	5.00	3.70	3.70	17.40	4.350	4.3	5930.34	4.4	5874.39	5902.37							Manson 74		
3/8/05	4	1.388	Clear		8:00 PM	3.60	5.10	9.70	11.20	29.60	7.401	7.4	4233.56	7.5	4180.27	4233.03	**1669.34**	**1169.82**	570.00	60.00	34200	11.08	Manson 74	1202.69	
3/9/05	4	1.388	Clear	7:00 AM		3.60	5.10	9.70	11.20	29.60	7.401	7.4	4233.56	7.5	4180.27	4233.03							Manson 74		
3/9/05	4	1.388	Clear		8:00pm	12.20	12.45	12.80	12.15	49.60	12.401	12.4	1674.69	12.5	1625.95	1674.2	**2558.82**	**1793.15**	1130.00	60.00	67800	8.57	Manson 74	1843.53	4228.16
3/10/05	5	1.368	Clear	4:00 AM		6.30	5.80	5.40	4.80	22.30	5.575	5.5	5836.62	5.6	5778.66	5793.15							Manson 73		
3/10/05	5	1.368	Clear		12:00 PM	10.90	9.40	7.80	6.30	34.40	8.601	8.6	4069.91	8.7	4013.9	4069.35	**1723.80**	**1207.99**					Manson 73	1260.09	
3/10/05	6	1.416	Clear	12:00 AM		10.40	7.60	10.00	8.00	36.00	9.010	9.0	664.9	641.2	626.2	664.899							Manson 50		
3/10/05	6	1.416	Clear		7:00 PM	7.30	5.40	6.00	4.10	22.80	5.701	5.7	1453.3	5.8	1427.8	1453.05	**788.15**	**552.31**	1200.00	60.00	72000	7.92	Manson 50	556.60	
3/11/05	6	1.416	Clear	4:00 AM		7.30	5.40	6.00	4.10	22.80	5.701	5.7	1453.3	5.8	1427.8	1453.05							Manson 50		
3/11/05	6	1.416	Clear		12:00 PM	2.20	2.20	2.20	2.40	9.00	2.250	2.2	2390.2	2.3	2362.3	2376.25	**923.21**	**646.96**					Manson 50	651.98	1711.35
3/11/05	5	1.368	Clear	12:00 PM		11.80	11.50	8.40	8.30	40.00	10.001	10.0	3292.88	10.1	3237.96	3292.33							Manson 73		
3/11/05	5	1.368	Clear		6:00 PM	14.30	14.80	7.80	8.50	45.40	11.350	11.3	2585.41	11.4	2531.35	2558.38	**733.95**	**514.33**	900.00	60.00	54000	6.96	Manson 73	536.51	
3/14/05	5	1.368	Clear	12:00 PM		14.30	14.80	7.80	8.50	45.40	11.350	11.3	2585.41	11.4	2531.35	2558.38							Manson 73		
3/14/05	5	1.368	Clear		3:00 PM	13.80	13.50	13.60	13.20	54.10	13.525	13.5	1420.16	13.6	1368.94	1407.36	**1151.03**	**806.60**					Manson 73	841.39	3608.78
3/14/05	7	1.4	Clear	3:00 PM		3.55	3.90	3.00	3.35	13.80	3.450	3.4	6437.74	3.5	6381.14	6409.44							Manson 74		
3/14/05	7	1.4	Clear		7:00 PM	4.90	4.90	5.10	5.10	20.00	5.010	5.0	5538.71	5.1	5483.63	5533.20	**876.24**	**614.04**	610.00	60.00	36600	12.58	Manson 74	625.88	
3/15/05	7	1.4	Clear	4:00 AM		5.10	5.30	5.20	5.10	20.70	5.175	5.1	5483.63	5.2	5428.54	5442.31							Manson 74		
3/15/05	7	1.4	Clear		7:00 PM	11.60	9.90	11.90	10.20	43.60	10.900	10.9	2417.98	11.0	2367.48	2417.93	**3024.38**	**2119.40**	1020.00	60.00	61200	11.22	Manson 74	2160.27	
	Avarage	1.387														**Total**	**25452.6**	**17836.4**			Avarage	10.090		**18397.05**	

APPENDIX C
PDM DATA REPORT
(BOUND UNDER SEPARATE COVER)

APPENDIX D
WINDWARD SEASON 1 AND SEASON 2
WATER QUALITY MONITORING REPORTS (CD)

APPENDIX E
COVER MATERIAL CHEMISTRY
AND GRAIN SIZE

Table E-1
Summary of Cover Material Organic Carbon Normalized Data

Location ID Sample ID Sample Date	SMS (mg/kg-OC) SQS	SMS (mg/kg-OC) CSL	Cap01 LD-EW-CAP01-121704 12/17/2004		Cap02 LD-EW-CAP02-121704 12/17/2004		Cap03 LD-EW-CAP03-121704 12/17/2004	
Conventionals (%)								
Total Organic Carbon	--	--	**0.01**		**0.0253**		0.01	U
SVOCs								
LPAH								
Total LPAH	370	780	69	U	27.3	U	69	U
Naphthalene	99	170	69	U	27.3	U	69	U
Acenaphthylene	66	66	69	U	27.3	U	69	U
Acenaphthene	16	57	69	U	27.3	U	69	U
Fluorene	23	79	69	U	27.3	U	69	U
Phenanthrene	100	480	69	U	27.3	U	69	U
Anthracene	220	1200	69	U	27.3	U	69	U
2-Methylnaphthalene	38	64	69	U	27.3	U	69	U
HPAH								
Total HPAH	960	5300	69	U	27.3	U	69	U
Fluoranthene	160	1200	69	U	27.3	U	69	U
Pyrene	1000	1400	69	U	27.3	U	69	U
Benzo(a)anthracene	110	270	69	U	27.3	U	69	U
Chrysene	110	460	69	U	27.3	U	69	U
Total benzofluoranthenes (U=0)	230	450	69	U	27.3	U	69	U
Benzo(a)pyrene	99	210	69	U	27.3	U	69	U
Indeno(1,2,3-cd)pyrene	34	88	69	U	27.3	U	69	U
Dibenzo(a,h)anthracene	12	33	69	U	27.3	U	69	U
Benzo(g,h,i)perylene	31	78	69	U	27.3	U	69	U
Chlorinated Hydrocarbons								
1,4-Dichlorobenzene	3.1	9	10	U	4.0	U	10	U
1,2-Dichlorobenzene	2.3	2.3	10	U	4.0	U	10	U
1,2,4-Trichlorobenzene^	0.81	1.8	10	U	4.0	U	10	U
Hexachlorobenzene^	0.38	2.3	340	U	138.3	U	340	U
Phthalates								
Dimethylphthalate	53	53	690	U	272.7	U	680	U
Diethylphthalate	61	110	690	U	272.7	U	680	U
Di-n-butylphthalate	220	1700	340	U	138.3	U	340	U
bis(2-Ethylhexyl)phthalate	47	78	1700	U	671.9	U	**6200**	
Di-n-octylphthalate	58	4500	340	U	138.3	U	340	U
Butylbenzylphthalate	4.9	64	690	U	272.7	U	680	U
Phenols								
Phenol	420	1200	340	U	138.3	U	340	U
2-Methylphenol	63	63	340	U	138.3	U	340	U
4-Methylphenol	670	670	340	U	138.3	U	340	U
2,4-Dimethylphenol^	29	29	340	U	138.3	U	340	U
Pentachlorophenol	360	690	3400	U	1383.4	U	3400	U
Miscellaneous								
Dibenzofuran	15	58	340	U	138.3	U	340	U
Hexachlorobutadiene	3.9	6.2	52	U	20.6	U	51	U
n-Nitrosodiphenylamine	11	11	340	U	138.3	U	340	U
PCBs (mg/kg-OC)								
Total PCBs (U=0)	12	65	520	U	205.5	U	510	U

Notes:
U The analyte was not detected in sample.
J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.