UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL CLEANUP

October 19, 2012

Captain Pete M. Dawson
Naval Base Kitsap
120 South Dewey Street
Bremerton, Washington 98314-5020

Dear Captain Dawson:

The U.S. Environmental Protection Agency Region 10 has reviewed the Third Five Year Review report for the Bremerton Naval Complex (BNC) Superfund site in Bremerton, Washington. The EPA reviewed this report for technical adequacy, accuracy, and consistency with EPA guidance.

The report states that an overall protectiveness determination of the remedies for the BNC site cannot be made at this time and will be deferred until further information is obtained for OU A, OU B Terrestrial and OU B Marine. The EPA concurs with the findings in the report and the need to defer the overall protectiveness determination for the site. The EPA also concurs with the certification of protectiveness for the remedies implemented at OU NSC and OU D.

Following the collection and evaluation of the necessary additional information, the project team agrees that the protectiveness determinations will be made for the site as a whole and the individual OUs no later than December 31, 2015.

The EPA appreciates the Navy's efforts to complete this Five Year Review in collaboration with the EPA, Ecology and the Suquamish Tribe, and looks forward to continuing this good working relationship as we move forward with implementing the report's recommendations and follow-up actions.

Sincerely,

Cami Grandinetti

Cami Grandinetti
Remedial Program Manager
Office of Environmental Cleanup

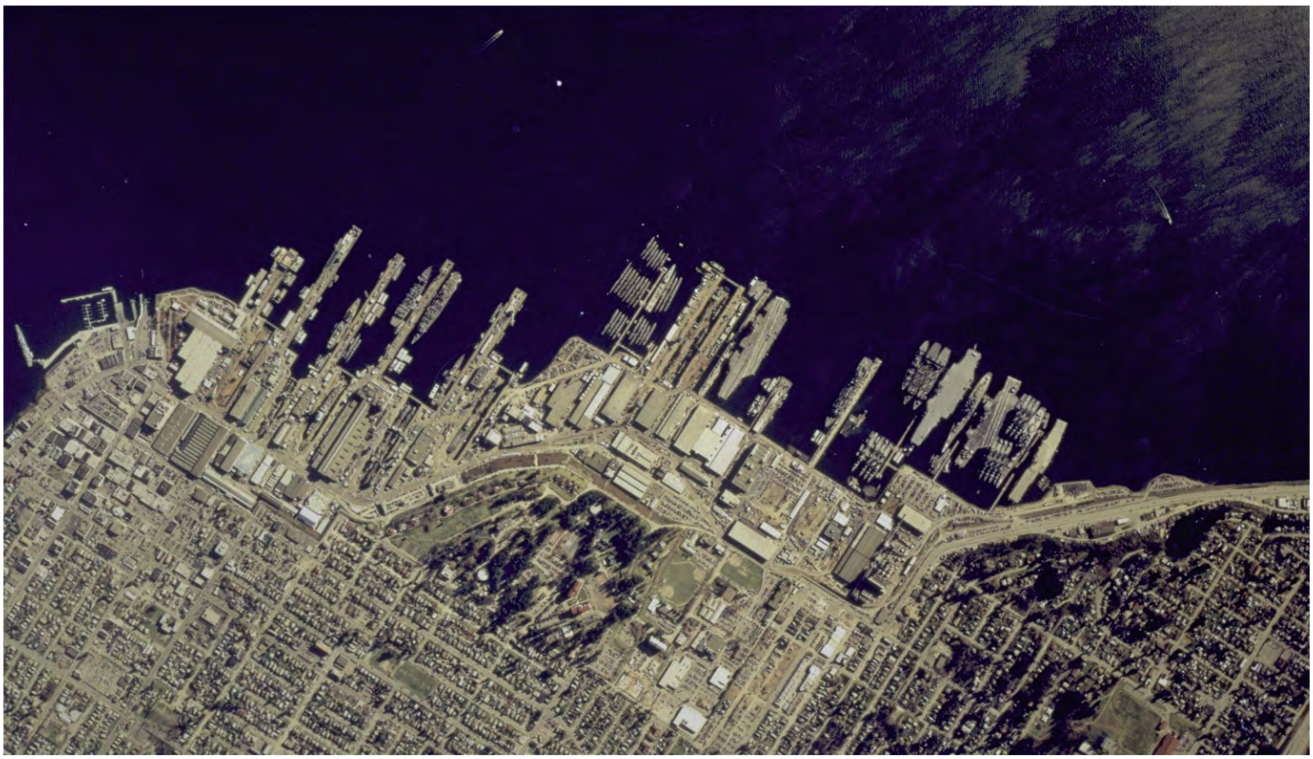
FINAL
October 2012

Third Five-Year Review

Bremerton Naval Complex

Bremerton, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315



EXECUTIVE SUMMARY

As lead agency for environmental cleanup of the Bremerton naval complex (BNC), Bremerton, Washington, the U.S. Navy (Navy) has completed this third 5-year review of the remedial actions at Operable Unit A (OU A), OU Naval Supply Center (NSC), OU B Terrestrial, OU B Marine, and OU D conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300). The purpose of this 5-year review is to ensure that the remedial actions selected in the Records of Decision (RODs) at BNC remain protective of human health and the environment. This review is required because contaminants have been left in place at BNC above levels that allow for unlimited use and unrestricted exposure.

This third 5-year review was prepared in accordance with *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Statutory Five-Year Reviews* (U.S. Navy 2004a) and the U.S. Environmental Protection Agency's (EPA's) *Comprehensive Five-Year Review Guidance* (USEPA 2001). This review is considered a statutory, rather than a policy review. The triggering action for this review was the execution by the Navy of the second 5-year review on October 28, 2007. In accordance with Navy guidance, this review covers the entire BNC, including both CERCLA and non-CERCLA sites. This review evaluates data collected at the site between October 2006 and October 2011.

There are a total of six OUs at BNC. This report covers the remedies selected in the signed RODs for OU A, OU NSC, OU B Marine, OU B Terrestrial, and OU D. OU C is a petroleum-contaminated site. CERCLA does not address petroleum as a contaminant. Petroleum releases are addressed, in Washington State, under Subchapter IX of the Resource Conservation and Recovery Act and the state Model Toxics Control Act (MTCA). A cleanup action plan under MTCA was executed for OU C during this 5-year review period, and this 5-year review includes an assessment of the OU C remedy protectiveness to address the parallel MTCA review requirements.

Since the second 5-year review in October 2006, the Navy has completed or made significant progress on all of the actions recommended by the MTCA review. The BNC reached the CERCLA milestone of "construction complete" for the remedies at all OUs during this 5-year review period.

This 5-year review concludes that the remedies are functioning as intended at OU NSC, OU B Marine, and OU C. The recent groundwater monitoring data for OU A are generally consistent with earlier data, suggesting no significant change in the low risks associated with site

groundwater. However, since a section of riprap was removed at Charleston Beach, bank erosion has been observed, releasing potentially contaminated material to the marine environment and possibly jeopardizing future site protectiveness. The continuing work to develop a permanent solution for ongoing erosion at Charleston Beach will ensure future functionality of the OU A remedy.

At OU B Terrestrial, there is evidence that mercury is being released via storm drain and groundwater discharges from this OU into Sinclair Inlet in quantities that may represent one of the more significant loadings of this element to the inlet. With the exception of the issue of mercury, the comparatively low-risk conditions continue that were present at OU B Terrestrial at the time the ROD was executed. The Navy is engaged in an extensive effort to better understand and address the migration of mercury into Sinclair Inlet.

The OU C cleanup action plan was completed during this 5-year review period, and the institutional control (IC) and groundwater monitoring are functioning as intended by the cleanup action Plan.

Despite the Navy's efforts of the last 5 years to improve the paving maintenance program, the BNC-wide excavation inspection process is not fully functional. The Navy continues to work toward a consistent BNC-wide process for regular maintenance of paving and storm drains. The Navy has contacted the City of Bremerton several times regarding remedy alterations and ICs at OU D, but the deed restrictions and IC inspections at OU D have still not functioned to ensure the integrity of the low-permeability cap, to document the continued prohibition on the use of groundwater, or to document the land use.

No applicable or relevant and appropriate requirement change has affected the remedy for OU A, OU NSC, OU C, or OU D since the last 5-year review. For OU B Marine, studies have been initiated to address the data gaps that need to be filled before the protectiveness of the remedy can be assessed with respect to mercury in sediment and aquatic biota.

Concentrations of chemicals in groundwater remain above the remediation goals (RGs) at some monitoring locations in OU A, OU NSC, and OU B Terrestrial, resulting in the need for continued ICs to prevent exposure and the need for ongoing monitoring. Although some of the RGs might be lower if calculated today, the remedy components continue to protect against exposures, just as they did at the time the RODs were signed. ICs preventing exposure and ongoing monitoring will need to continue until concentrations of chemicals of concern (COCs) in groundwater and surface water are below the RGs.

An overall protectiveness determination of the remedies for the BNC site cannot be made at this time and will be deferred until further information for three OUs is obtained, as described below. Following collection and evaluation of the necessary additional information, protectiveness

determinations will be made for the site as a whole and the individual OUs no later than December 31, 2015.

A protectiveness determination of the remedies for OU A, OU B Marine, and OU B Terrestrial cannot be made until further information is obtained. The protectiveness of the OU B Marine remedy has come into question based on evidence of releases through the groundwater and a primary storm drain line in the western portion of OU B Terrestrial and the potential release of fill materials from Charleston Beach at OU A. OU B Marine and OU B Terrestrial are inextricably linked. The future protectiveness of the OU B Marine remedy will depend on the accurate assessment of potential ongoing sources to the marine environment from OU B Terrestrial and implementing successful source control measures at OU B Terrestrial. Information needed to assess the protectiveness of the remedies for OU B Marine, OU B Terrestrial, and OU A will be developed through ongoing Navy investigations. These investigations include studies of terrestrial sources, mercury movement through the marine food web, and the nature of intertidal sediments at Charleston Beach. In addition, elevated polychlorinated biphenyl and mercury levels have been reported in some sediment samples collected during pre- and post-construction sampling for in-water construction projects at BNC. The implications of these findings for the remedy are still being evaluated. The results of these investigations are presently projected to be available by approximately 2015, at which time the protectiveness of the remedies for OU A, OU B Marine, and OU B Terrestrial will be reevaluated. In the interim, the pathways for human exposure are being controlled.

The cleanup action at OU C, selected under the state MTCA regulation, remains protective of human health and the environment.

The remedies implemented at OU NSC and OU D currently protect human health and the environment. Exposure pathways and infiltration pathways that could increase contaminant migration and result in unacceptable risks are being controlled and monitored. The conditions and COC concentrations found today in groundwater are similar to those at the time the RODs were executed. Conditions at the time of ROD execution were found not to pose unacceptable risks to human health and the environment as long as exposures and contaminant migration were controlled. In order for the remedies to be considered protective for the long term, the recommendations and follow-up actions listed in Table 8-1 need to be addressed in a timely manner. Future protectiveness will continue to be assessed during and after implementation of these actions based on monitoring of COC concentrations, trend analyses, and completion of follow-up actions.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Puget Sound Naval Shipyard Complex		
EPA ID: WA2170023418		
Region: 10	**State:** WA	**City/County:** Kitsap
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Navy		
Author name (Federal or State Project Manager): Michael Carsley		
Author affiliation: Naval Facilities Engineering Command Northwest, Navy		
Review period: 9/11 – 6/12		
Date of site inspection: Annual		
Type of review: Statutory		
Review number: 3		
Triggering action date: 10/28/2007		
Due date *(five years after triggering action date):* 10/28/2012		
Issues/Recommendations		
OU(s) Without Issues/Recommendations Identified in the Five-Year Review:		
OU Naval Supply Center, OU C		
Issues and Recommendations Identified in the Five-Year Review:		
OU(s): General	**Issue Category:** Operations and Maintenance	
	Issue: A more responsive program is needed to address and document pavement and storm drain repair and maintenance work identified during annual inspections.	
	Recommendation: Develop and implement a reliable BNC-wide program for executing repair work for pavement and storm drains in a timely manner after maintenance requirements are identified. Clearly document completed repairs and catch basin cleaning.	

Five-Year Review Summary Form (Continued)

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	Yes	Navy	EPA, Ecology	December 2013
OU(s): General	**Issue Category:** Institutional Controls			
	Issue: The current IC plan does not include a provision for assessing the potential for vapor intrusion resulting from future remodeling in the TCE northern plume area.			
	Recommendation: Revise the IC plan to include a provision for assessing the potential for vapor intrusion resulting from future remodeling in the TCE northern plume area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Navy	EPA, Ecology	December 2013
OU(s): General	**Issue Category:** Institutional Controls			
	Issue: During this 5-year review period, contamination was discovered at a construction site located outside the established OU boundaries. Because this discovery was outside of any OU footprint, there was no clear process for notification of EPA when contamination was discovered.			
	Recommendation: Update the IC plan to ensure that new discoveries are promptly reported to EPA. Improve the administrative processes for implementing the plan.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Navy	EPA, Ecology	December 2013
OU(s): OU A	**Issue Category:** Remedy Performance			
	Issue: The Navy is redesigning Charleston Beach solely to address the potential release indicated by the erosion of material from the landfill and restore the protectiveness of the OU A remedy. A 90 percent design will be completed in September 2012 with the understanding that there are data gaps related to the possibility that the erosion of upland material has impacted the remedy for adjacent OU B Marine.			
	Recommendation: Complete the 90 percent design of the remedy repair. Sample and analyze intertidal sediments as part of OU B Marine monitoring. Depending on the results of the sampling, consider the need for upland sampling or design modifications.			

Five-Year Review Summary Form (Continued)

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
Yes	Yes	Navy	EPA, Ecology	90% design September 2012; Sampling 2015
OU(s): OU B Terrestrial	**Issue Category:** Remedy Performance			
	Issue: Analysis is not complete of the ongoing transport of mercury and other metals via a primary storm drain line in the western portion of the OU to the marine environment.			
	Recommendation: Complete the analysis of ongoing transport of metals COCs from the terrestrial to marine environment, as well as potential remedies.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Yes	Yes	Navy, USGS	EPA, Ecology	December 2013
OU(s): OU B Marine	**Issue Category:** Remedy Performance			
	Issue: Based on a technical memorandum that evaluated human health risks related to mercury in Sinclair Inlet seafood, mercury has been identified as a COC. Additional data are needed to fill data gaps related to source control, sediment quality, and seafood quality. No clear process has been established for addressing source control issues identified through the ongoing contaminant transport studies.			
	Recommendation 1: Collect additional data to reflect current conditions in Sinclair Inlet and reduce uncertainties associated with the data that were used for the human health risk evaluation technical memorandum.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Yes	Yes	Navy	EPA, Ecology	October 2013
(Cont.)	**Recommendation 2:** Perform a focused feasibility study to document and collate studies related to mercury in sediments, and identify and evaluate potential approaches for reducing human health risks from mercury in Sinclair Inlet. The study will include an evaluation of source control (contaminant transport from the uplands to the marine waters and sediment).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Yes	Yes	Navy	EPA, Ecology	October 2014

Five-Year Review Summary Form (Continued)

(Cont.)	**Recommendation 3:** If data support, develop a Record of Decision amendment or Explanation of Significant Differences to address mercury as a contaminant of concern, select cleanup levels and select the preferred alternative of the focused feasibility study.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Yes	Yes	Navy	EPA, Ecology	January 2015
OU(s): OU B Marine	**Issue Category:** Monitoring			
	Issue: Observations of a relatively thin upper sediment cover in some limited portions of the CAD pit suggest the possibility of thinning of the cover material, possibly through a combination of cover sediments mixing with the underlying sand layer and actual loss of the covering sediment material. Thinning of the CAD pit cover could result in eventual impacts to the protectiveness of the remedy. However, the historical record also shows that the original sediment cover was not uniform in thickness, and the small areas with thin cover observed recently may be an artifact of the original cover placement.			
	Recommendation: The Navy will make a detailed comparison between historical records regarding the CAD pit sediment cover placement and recent reports of possible thinning of the cover material.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Navy	EPA, Ecology	December 2012
OU(s): OU B Marine	**Issue Category:** Monitoring			
	Issue: No decision process has been established for evaluating data generated outside the long-term monitoring program (such as data related to in-water construction projects) relative to the protectiveness of the OU B Marine remedy.			
	Recommendation: Establish a process for evaluating the data generated from recent in-water construction projects relative to the protectiveness of the OU B Marine remedy. Consider the potential application of this process to other future data generated from outside of the OU B Marine long-term monitoring program.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Yes	Yes	Navy	EPA, Ecology	December 2012
OU(s): OU D	**Issue Category:** Changed Site Conditions			
	Issue: The Navy and City of Bremerton have not been able to establish a working relationship that allows effective IC inspections or assessment of the long-term protectiveness of site conditions.			

Five-Year Review Summary Form (Continued)

	Recommendation: Transition to EPA and Ecology the lead regarding engagement with the City of Bremerton and initiate a meaningful dialog that allows additional assessment and effective IC inspections.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Navy	EPA, Navy	October 2013
OU(s): OU D	**Issue Category:** Remedy Performance			
	Issue: Changes in the method of risk calculation for some COCs could mean that current conditions are less protective than previously thought, if park visitors are currently exposed to soil containing COCs.			
	Recommendation: Finalize the existing remedy evaluation report prepared by the Navy without City input.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Navy	EPA, Navy	October 2013

Protectiveness Statement(s)

Operable Unit: OU A	**Protectiveness Determination:** Protectiveness Deferred	**Addendum Due Date** ***(If applicable):*** December 31, 2015
Protectiveness Statement: NA		
Operable Unit: OU NSC	**Protectiveness Determination:** Protective	**Addendum Due Date** ***(If applicable):*** NA
Protectiveness Statement: The remedy continues to be protective.		
Operable Unit: OU B Marine	**Protectiveness Determination:** Protectiveness Deferred	**Addendum Due Date** ***(If applicable):*** December 31, 2015
Protectiveness Statement: NA		
Operable Unit: OU B Terrestrial	**Protectiveness Determination:** Protectiveness Deferred	**Addendum Due Date** ***(If applicable):*** December 31, 2015
Protectiveness Statement: NA		
Operable Unit: OU C	**Protectiveness Determination:** Protective	**Addendum Due Date** ***(If applicable):*** NA
Protectiveness Statement: The cleanup action selected under the state MTCA regulation remains protective of human health and the environment.		

Five-Year Review Summary Form (Continued)

Operable Unit: OU D	**Protectiveness Determination:** Short-Term Protective	**Addendum Due Date** ***(If applicable):*** NA
Protectiveness Statement: For the remedy to be considered protective for the long term, recommendations and follow-up actions listed in Table 8-1 need to be addressed in a timely manner.		
Sitewide Protectiveness Statement (if applicable)		
Protectiveness Determination: Protectiveness Deferred	**Addendum Due Date** *(if applicable):* December 31, 2015	
Protectiveness Statement: NA		

Signature sheet for the Bremerton naval complex third five-year review report for Operable Units A, NSC, B Terrestrial, B Marine, and D.

P. Dawson
Captain, U.S. Navy
Commanding Officer, Naval Base Kitsap

10/12/12
Date

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ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
BHC	benzene hexachloride
BNC	Bremerton naval complex
CAD	confined aquatic disposal
CAP	cleanup action plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIPP	cured-in-place pipe
cm	centimeter
COC	chemical of concern
COI	chemical of interest
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DRMO	Defense Utilization Marketing Office
DVS	data variability study
Ecology	Washington State Department of Ecology
ENR	enhanced natural recovery
ENVVEST	Environmental Investment
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FC	fecal coliform
FISC	Fleet and Industrial Supply Center
FS	feasibility study
geomean	geometric mean
$g/cm^2/yr$	gram per square centimeter per year
g/day	gram per day
HPA	Hydraulic Project Approval
HQ	hazard quotient
HWSA	Hazardous Waste Storage Area
IC	institutional control
IR	Installation Restoration
IRIS	Integrated Risk Information System
LNAPL	light nonaqueous-phase liquid
LTM	long-term monitoring

ABBREVIATIONS AND ACRONYMS (Continued)

MCUL	minimum cleanup level
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/kgOC	milligram per kilogram of organic carbon
mg/L	milligram per liter
MTCA	Model Toxics Control Act
Navy	U.S. Navy
NAVFAC	Naval Facilities Engineering Command
NBK	Naval Base Kitsap
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NSC	Naval Supply Center
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PMP	petroleum management plan
PQL	practical quantitation limit
PSNS & IMF	Puget Sound Naval Shipyard and Intermediate Maintenance Facility
RAB	Restoration Advisory Board
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
SI	site inspection
SIM	selected ion monitoring
SMS	Sediment Management Standards
SOAL	state-owned aquatic lands
SPI	sediment profile imaging
SQS	Sediment Quality Standards
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
TPH	total petroleum hydrocarbons

ABBREVIATIONS AND ACRONYMS (Continued)

TPH-D	total petroleum hydrocarbons—diesel
TPH-G	total petroleum hydrocarbons—gasoline
TPH-Dx	total petroleum hydrocarbons as diesel and heavy oil
VOC	volatile organic compound
TTEC	total toxicity equivalent concentration
USGS	U.S. Geological Survey
WDFW	Washington State Department of Fish and Wildlife

1.0 INTRODUCTION

This report presents the results of the third 5-year review performed for the Puget Sound Naval Shipyard Complex National Priorities List site, more commonly known as the Bremerton naval complex (BNC). BNC includes Naval Base Kitsap (NBK) at Bremerton, the Puget Sound Naval Shipyard and Intermediate Maintenance Facility, and associated tenants. BNC is located along the shoreline of Sinclair Inlet in Bremerton, Washington (Figure 1-1).

The purpose of a 5-year review is to determine whether the remedies selected for implementation in the Record of Decision (ROD) for a site remain protective of human health and the environment. The methods, findings, and conclusions of 5-year reviews are documented in 5-year review reports, which identify issues and provide recommendations to address them. This is the third 5-year review performed for the BNC site. The triggering action for this review was the completion of the second 5-year review in October 2007. Contaminants have been left at the BNC above levels that allow for unlimited use and unrestricted exposure.

The U.S. Navy (Navy), the lead agency for BNC, is preparing this 5-year review pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300). CERCLA Section 121 states the following:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

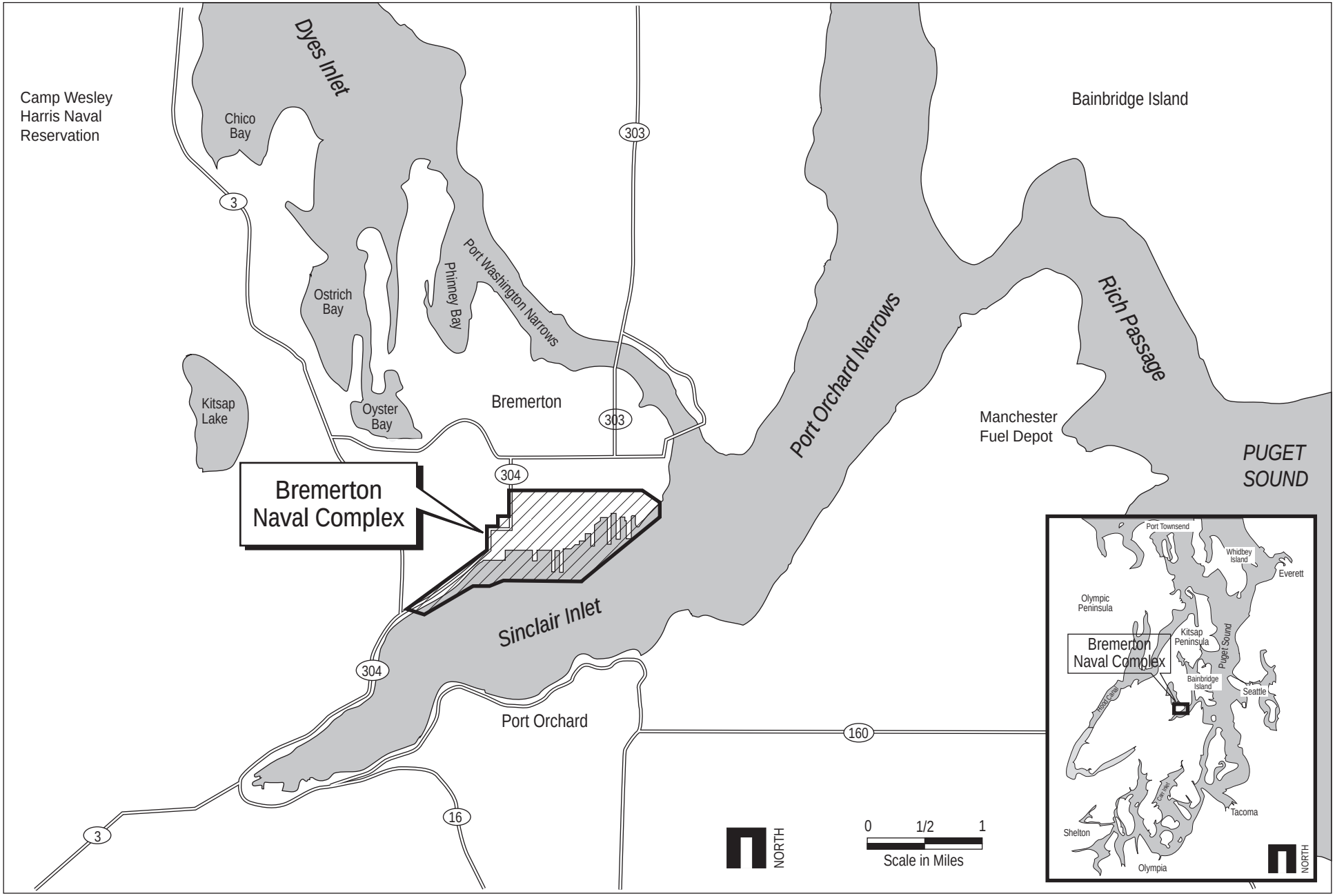
There are a total of six operable units (OUs) at BNC (Figure 1-2). This report covers the remedies selected in the signed RODs for OU A, OU Naval Supply Center (NSC), OU B Marine, OU B Terrestrial, and OU D (U.S. Navy, Ecology, and USEPA 1996, 1997, 2000, 2004a, and 2005). OU C is a petroleum-contaminated site. CERCLA does not address petroleum as a contaminant. Petroleum releases are addressed, in Washington State, under Subchapter IX of the Resource Conservation and Recovery Act (RCRA) and the state Model Toxics Control Act (MTCA). A cleanup action plan (CAP) under MTCA is pending for OU C, and progress toward a remedy at OU C is discussed in Sections 2 and 3 of this report. When a CAP is executed for

OU C, future CERCLA 5-year reviews will include an assessment of the OU C remedy protectiveness to address the parallel MTCA review requirements.

The RODs documenting the remedies implemented at BNC were signed after October 17, 1986. Therefore, this is considered a statutory, rather than a policy, review.

The Navy has conducted this 5-year review of the remedial actions implemented at BNC in Bremerton, Washington. This review was conducted from September 2011 through June 2012 using analytical data generated between September 2006 and August 2011. This report documents the results of the review, issues identified, and recommended actions.

This report was prepared as part of the CERCLA 5-year review process using Navy and U.S. Environmental Protection Agency (EPA) guidance (U.S. Navy 2004a and USEPA 2001).



U.S.NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

Figure 1-1
Bremerton Naval Complex Vicinity Map

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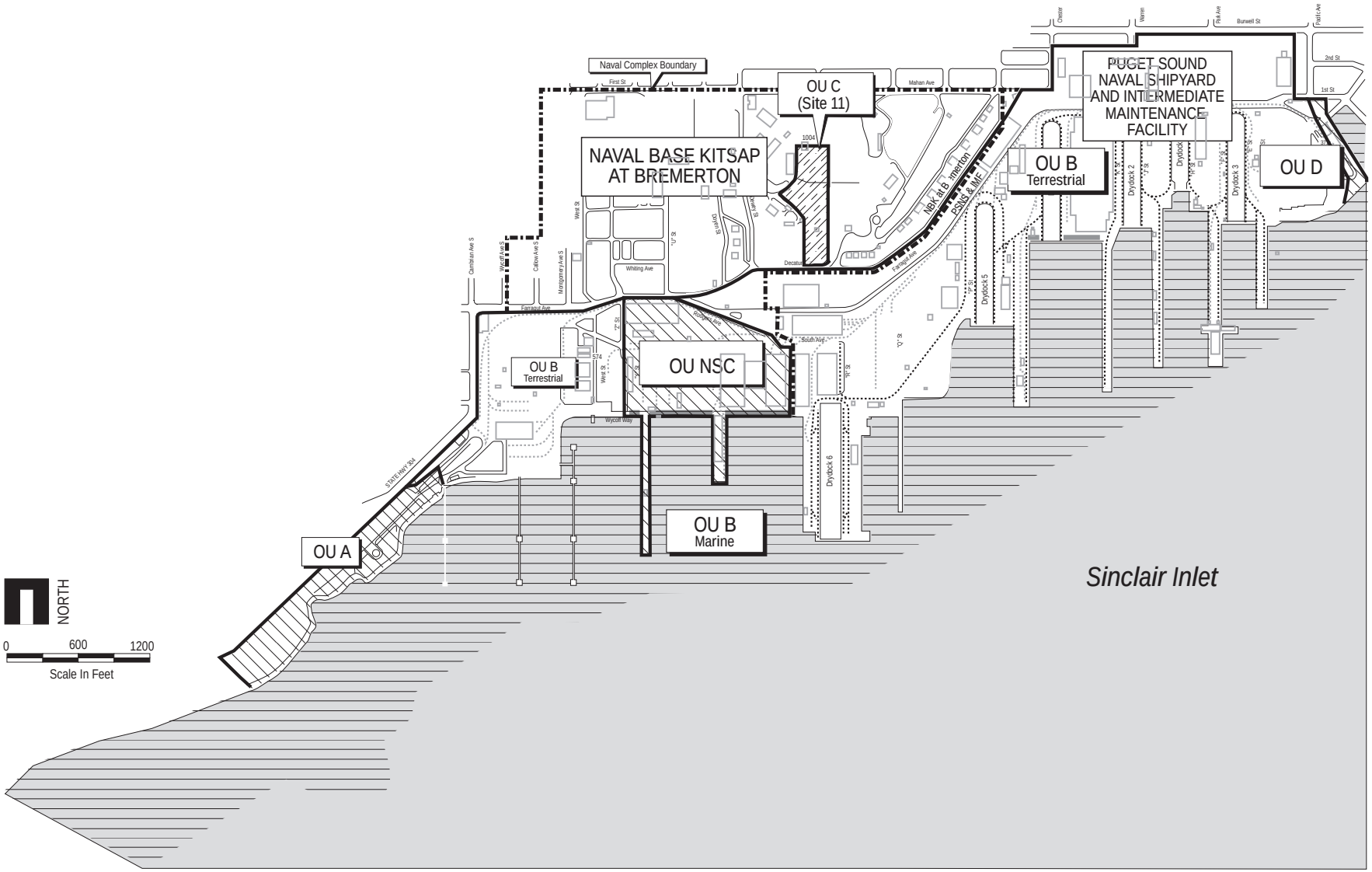

U.S.NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

Figure 1-2
Bremerton Naval Complex Operable Units

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2.0 SITE CHRONOLOGY

Table 2-1 lists the primary events in the chronology of the BNC related to site discovery, investigation, and remediation. Additional details regarding the site activities for individual operable units are provided in the narrative of this section.

Following initial site discovery in 1979, the Navy conducted an initial assessment study in 1983 to identify and assess environmental contamination at the site (U.S. Navy 1983). This study, carried out as part of the Navy's Assessment and Control of Installation Pollutants Program, identified six potentially contaminated sites.

The Navy carried out a supplementary preliminary assessment in 1990, as a follow-up and supplement to the prior initial assessment study (U.S. Navy 1990). Five additional potentially contaminated sites were identified during the preliminary assessment.

A site inspection (SI) carried out by the Navy in 1990 and 1991 included extensive sampling of terrestrial soils, groundwater, and marine sediments (U.S. Navy 1992). The purposes of the SI included refining understanding of the presence of contaminants at the site and collecting data to support EPA scoring of the site under the Federal Hazard Ranking System. Partly in response to SI findings, the Navy undertook a number of removal actions across the naval complex between 1990 and 2001.

The State of Washington issued two enforcement orders for the complex in 1992, one for OU NSC and the other for the remainder of the complex. Subsequent to the issuance of these orders, the Navy and the State agreed to streamline the approach to organizing the planned studies of the complex. The understanding was that the complex would be organized into four OUs for purposes of investigation and remediation. Three of the OUs were comparatively small, self-contained areas. OU NSC occupies approximately 28 acres of land adjoining Sinclair Inlet near the center of the complex. OU A is a narrow shoreline area approximately 12 acres in size located at the far west end of the complex. OU C occupies approximately 8 acres of land in and adjacent to a ravine in the central upland area of the complex. The fourth unit, OU B, consisted of all of the remaining comparatively flat industrial land at the complex, as well as most of the Navy-owned marine area adjacent to the complex. The Navy entered into an interagency agreement with the Washington State Department of Ecology (Ecology) and EPA in August 1998.

The Navy initiated the remedial investigation/feasibility study (RI/FS) process for OU NSC in 1992. Two rounds of field investigation that included extensive environmental sampling were carried out, the first between December 1992 and June 1993 and the second between May and October 1994. The final OU NSC RI report was published in September 1995 (U.S. Navy

1995a) and the final FS in November 1995 (U.S. Navy 1995b). In response to concerns of potential health risks from metal dust on paved surfaces and in shallow soils in a portion of the site, an interim pavement cleaning and soil removal was carried out in 1994. A ROD documenting the remedy for OU NSC was signed in December 1996 (U.S. Navy, Ecology, and USEPA 1996). The remedy consisted of institutional controls (ICs) to limit the potential for contact with or movement of contaminants left on site, upgrading site pavement to limit potential contact with soil and infiltration of precipitation, cleaning of storm drains, and environmental monitoring. The remedial action was carried out between April 1997 and March 1999. A final remedial action closeout report for the site was completed in April 1999 (U.S. Navy 1999a).

A second RI/FS, for OU A, was initiated by the Navy in 1993. Two rounds of field investigation were conducted, from April to June 1993 and June to September 1994. The final OU A RI report was published in August 1995 (U.S. Navy 1995c). The final FS was published in October 1995 (U.S. Navy 1995d). The ROD for OU A was signed in January 1997 (U.S. Navy, Ecology, and USEPA 1997). The primary components of the remedy included ICs, upgrading of pavement, installation of shoreline erosion protection, enhancements to terrestrial and marine habitat, and environmental monitoring. The remedial action took place between April 1997 and November 2000. The final remedial action closeout report was completed in August 1999 (U.S. Navy 1999b).

The RI/FS process for OU B was initiated in February 1994. Two rounds of comprehensive terrestrial and marine sampling were carried out, from March to July 1994 and from July to November 1995. A draft RI report was published in September 1996 (U.S. Navy 1996). Beginning in 1997, the Navy initiated dialogue with the regulatory agencies regarding the potential for coordinating any marine remediation to be undertaken for OU B with a separate military construction Homeport expansion project planned by the Navy. It was theorized that coordinating the two activities could yield economies of scale as well as reducing environmental disruption. Supplementary marine sampling was carried out in OU B from December 1998 to January 1999 to support design of a remedy for the marine portion of OU B. A draft FS was distributed in April 1999.

In the spring of 2000, OU B was formally divided into separate terrestrial and marine OUs to allow the marine remediation to be accelerated and coordinated with Homeport dredging. An early action ROD for OU B Marine was signed in June 2000 (U.S. Navy, Ecology, and USEPA 2000a). The primary active components of the preferred remedy included dredging of contaminated marine sediments and disposal in an excavated seafloor confined aquatic disposal (CAD) pit, capping one seafloor area with a thick layer of clean material, placement of a thin layer of clean material to enhance natural recovery processes in the area around the cap, and shoreline stabilization in an area believed to be subject to slumping. The remedy also relied on natural sediment recovery processes and included ICs to limit potential contact with

contaminants and impairment of remedy measures. The remedy for OU B Marine was implemented between June 2000 and March 2004 (U. S. Navy 2002f).

In the latter stages of the OU B Marine remediation, evidence was found that contaminated sediment being placed in the CAD pit had been released onto adjacent state-owned aquatic lands. Additional sediment sampling was carried out in September 2003 to define the extent of the contaminated sediment release. To address this release, the Navy placed a thin layer of clean sediments in the impacted area in February and March 2004. This final component of the remedy for OU B Marine was documented in an Explanation of Significant Differences (ESD) published in February 2004 that updated the ROD for OU B Marine (U.S. Navy, Ecology, and USEPA 2004b), as well as in a closure report published in June 2004 (U. S. Navy 2004b).

A final RI report addressing OU B Terrestrial and summarizing the remedy selected for OU B Marine was published in March 2002 (U.S. Navy 2002c). The final FS for both OU B Terrestrial and OU B Marine was published in May 2002 (U.S. Navy 2002d). A ROD for OU B Terrestrial was executed in March 2004 (U.S. Navy, Ecology, and USEPA 2004a). The primary components of the selected remedy for OU B Terrestrial included ICs, cleaning and repairs to storm drains, upgrading of pavement and vegetative cover, shoreline stabilization, and monitoring. The remedial action construction activities for OU B Terrestrial took place between June 2003 and September 2006.

OU C is a petroleum unit being managed under the State of Washington's cleanup program, rather than CERCLA. A steam sparging system was installed at OU C in 1996 and was used until 1998 to recover petroleum product. System operation was terminated in response to decreasing product recovery rates. A focused RI/FS for the site published in April 2002 documented the conclusion that further product recovery was impractical (U.S. Navy 2002g). Removal of the sparging equipment was described in a final closure report published in November 2004 (U.S. Navy 2004e). Quarterly monitoring of groundwater in downgradient wells was initiated in January 2001. A CAP for OU C was approved by Ecology in December 2007 (Ecology 2007). The CAP described a selected remedy of No Action with monitoring and ICs and outlined the criteria for reassessment and modification of the selected remedy.

In August 2002, a new OU, OU D, was designated made up of a limited portion of the far eastern end of OU B Terrestrial. This new OU was established to support the planned conveyance to the City of Bremerton of land for creation of a new city park in conjunction with ongoing development in the vicinity of the ferry terminal. Soil sampling was carried out in 2003 to supplement sampling previously carried out in the area during the RIs for OU B Terrestrial. A final RI/FS report for OU D was published in March 2004 (U.S. Navy 2004f). The ROD for the OU D was executed in May 2005 (U.S. Navy, Ecology, and USEPA 2005). Remedy implementation for OU D began in June 2005 and was completed in December 2006.

BNC achieved the CERCLA milestone “construction complete” for all OUs on August 22, 2007 (USEPA 2007a).

Table 2-1
Chronology of Events

Event	Date
Site discovery	1979
Initial assessment study by Navy	1983
Preliminary assessment by Navy	1990
Site inspection by Navy	1990–1991
Removal actions at OU B Terrestrial	1990–2001
RCRA facility inspection by EPA	1992
Washington State MTCA Enforcement Order 92 TC-006 issued for OU NSC requiring preparation of RI/FS, cleanup action plan, and interim action alternatives proposal for surface soil	March 1992
MTCA Enforcement Order 92 TC-112 issued for remainder of BNC	May 1992
RI/FS for OU NSC	October 1992–November 1995
RI/FS for OU A	April 1993–October 1995
RI for OU B Marine and OU B Terrestrial	February 1994–March 2002
BNC added to National Priorities List	May 1994
Interim soil removal action at OU NSC	1994
Steam sparging system installed at OU C as part of demonstration program under MTCA	July 1996
ROD for OU NSC signed	December 1996
ROD for OU A signed	January 1997
Remedial design for OU NSC	April–May 1997
Remedial design for OU A	April–December 1997
Remedial action for OU NSC	June 1997–March 1999
Steam sparging system at OU C expanded	August 1997
Remedial action for OU A	April 1997–November 2000
FS for OU B Marine and OU B Terrestrial	May 1998–May 2002
Federal interagency agreement signed	August 1998
Final closeout report for OU NSC	April 1999
Final remedial action report for OU A	August 1999
Remedial design for OU B Marine	1999–May 2000
Early action ROD for OU B Marine signed	June 2000
Remedial action for OU B Marine	June 2000–March 2004
Addendum to final remedial action report for OU A	December 2000
RI/FS for OU C	April 2002
OU D established	August 2002
First 5-year review for BNC	October 2002
Explanation of Significant Differences for OU B Marine	February 2004
RI/FS for OU D	March 2004
ROD for OU B Terrestrial signed	March 2004
ROD for OU D signed	May 2005
Remedial design for OU D	May 2005

Table 2-1 (Continued)
Chronology of Events

Event	Date
Remedial design for OU B Terrestrial	July 2002–May 2005
Final closure report for OU B Marine	September 2005
Remedial action for OU B Terrestrial	June 2003–September 2006
Final closure report for OU B Terrestrial	September 2006
Remedial action for OU D	June 2005–December 2006
Final closure report for OU D	March 2007
Construction complete for all OUs	August 22, 2007
Second 5-year review for BNC	October 2007
Cleanup Action Plan for OU C approved by Ecology	December 2007
Addendum to second 5-year review for BNC	June 2011

Notes:
BNC - Bremerton naval complex
EPA - U.S. Environmental Protection Agency
FS - feasibility study
MTCA - Model Toxics Control Act
NSC - Naval Supply Center
OU - operable unit
RCRA - Resource Conservation and Recovery Act
RI - remedial investigation
ROD - Record of Decision

3.0 BACKGROUND

BNC is located on Sinclair Inlet, a part of Puget Sound. It is surrounded to the west and north by the City of Bremerton's commercial and residential areas, to the northeast by a Washington State Ferry System terminal, and to the southeast by Sinclair Inlet. The active industrial shipyard site contains approximately 380 acres of terrestrial area and 270 acres of submerged land. The Navy also owns approximately 1,000 acres of railroad area that is contiguous with the shipyard area. The terrestrial portion of the site consists of a relatively flat, low-lying waterfront area created through gradual filling of tideland and marshes and a higher upland area connected to the waterfront area by a moderately steep escarpment.

The site was first used as a resource base and seasonal camp location for the ancestors of the present-day Suquamish Tribe. The area was visited and eventually settled by Euroamericans in the 1700s and 1800s. In 1891, the Navy purchased 190 acres of land on Sinclair Inlet for construction of a ship drydock, repair, and overhaul base. The original area was substantially expanded beginning in the early 1900s by filling and grading shallow areas with soils, dredged sediments, and construction debris and through the purchase of additional adjacent property.

In over 115 years of industrial shipyard operations, primary land uses at BNC have included the following:

- Heavy industry (shipbuilding, ship maintenance and repair, and ship conversion)
- Light industry (vehicle maintenance, etc.)
- Ship berthing/homeporting
- Commercial (providing for purchase of supplies, meals, etc.)
- Residential (officers' and other quarters)

Current land use is much the same as it was historically. Ships have not been constructed at BNC since the early 1970s. Instead, the shipyard engages in ship and submarine maintenance, modernization, repair, inactivation and recycling, and technical and logistics support. BNC facilities include 6 major piers, 6 large drydocks, and more than 100 major buildings.

Land use in the vicinity of BNC currently consists of commercial and residential districts of the city of Bremerton and, to the northeast, water transportation (Washington State Ferries terminal). The resident population of the city of Bremerton is now roughly 38,000 persons, with population swings between 32,000 and 40,000 persons depending on which Navy ships are in port (*Kitsap Sun* 2005).

Groundwater at BNC has not historically been, nor is it expected in the future to be a source of drinking water. The overall groundwater flow at BNC is toward the drydocks and Sinclair Inlet. However, near the shoreline, the direction of groundwater flow reverses with the tides. There are no perennial streams or freshwater bodies within the BNC boundaries.

Some of the fill material historically used to expand the shipyard area is believed to have included wastes containing hazardous substances. The complex has been the site of substantial shipbuilding, ship repair and overhaul, and other fleet support services. Miscellaneous waste materials have been a normal byproduct of shipyard industrial activities since the early 1900s. Before the establishment of environmental regulations, some wastes were disposed of at the BNC using practices considered acceptable at the time, but which later were found to have resulted in adverse chemical impacts to soil and groundwater. The waste materials reportedly have included metal plating wastes, metal filings and shavings, transformers and other electrical components containing polychlorinated biphenyls (PCBs), batteries, acids, oxidizing materials, paint and paint chips, degreasing and cleaning solvents, miscellaneous materials from shipbuilding and ship demolition, and petroleum products. Disposal of wastes, particularly in conjunction with the placement of fill during shipyard expansion, as well as spills and leaks of industrial materials, has led to elevated levels of various chemicals in the subsurface.

Additional information on the individual OUs is presented below.

3.1 OU A

OU A originally included 27 acres of intertidal and subtidal areas adjacent to the filled land area. This marine area was subsequently incorporated into OU B Marine to allow the BNC marine environment to be addressed as a whole. Much of OU A is bounded by a 10- to 15-foot riprap embankment, with an average top elevation of 10 feet above mean sea level.

During the RI/FS process, OU A was divided into three zones:

- Zone I—the Charleston Beach parking lot
- Zone II—the U.S.S. *Missouri* parking lot (and former helicopter pad)
- Zone III—the upland parking lot between the railroad tracks and State Highway 304

These zones differ on the basis of site history, ownership, and degree and type of contamination. Zones I and II were created from filling operations between 1946 and the early 1970s. Fill included dredge spoils, spent sandblast grit, construction debris, and industrial wastes. During

the RI/FS, most of the contaminated media identified at OU A were located within Zone II. Consequently the remedy for OU A, although inclusive of the entire OU, focuses on Zone II.

The investigations at OU A included extensive sampling of groundwater and soil. Approximately 30 groundwater samples were collected from approximately 21 locations during the two phases of remedial investigation. Approximately 118 soil samples were also collected from approximately 17 locations. Limited sampling of stormwater was also performed. The summary of findings in the sections below focuses for simplicity on groundwater and soil.

The primary threats associated with conditions at OU A involve the risk of contact with contaminated soil and the potential for release of contaminants to the marine environment, (e.g., via groundwater transport or erosion of fill material).

3.1.1 Zone I

The Charleston Beach parking lot was expanded to its current size between 1946 and 1956. Presumably the fill used for this purpose was the same material as that used for the helicopter pad in Zone II. No hazardous waste disposal activities in Zone I have been identified. However, industrial activities, including a former coal bunker and fuel loading docks, occupied a portion of this zone in the past.

Exceedances of screening criteria in groundwater samples from Zone I were limited to a few inorganics. Exceedances of industrial soil criteria included the inorganics arsenic and lead and total petroleum hydrocarbons (TPH).

3.1.2 Zone II

Most of the disposal of what is now known as hazardous waste at OU A occurred within Zone II. Fill was placed in Zone II between 1946 and the early 1970s. A helicopter pad was constructed in the center portion of this zone in the early 1960s. The entire U.S.S. *Missouri* parking lot in Zone II was paved in 1995. Prior to 1995, the gravel parking surface was occasionally covered with oil to reduce dust generation. Between 1963 and 1972, approximately 30,000 gallons of liquid wastes were disposed of in unlined pits that drained into Sinclair Inlet. Starting in the mid-1950s, copper slag grit used for sandblasting at BNC and dredge spoils from Drydock 6 construction were evidently used as fill in Zone II. Historical Navy drawings also indicate that burn pits existed in Zone II in the past.

A variety of chemicals were found to exceed screening criteria in groundwater samples from Zone II. Chemicals of interest based on exceedance of screening criteria included several semivolatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs), PCBs, several pesticides, and several inorganics, including arsenic, copper, lead, and zinc.

A variety of chemicals were also detected in soils collected from Zone II. Chemicals found to exceed industrial soil screening criteria included a few PAHs, common inorganics, and TPH. Exceedances for arsenic and lead were found to be comparatively widespread in this zone.

3.1.3 Zone III

Zone III is the upland parking lot between the existing railroad tracks and State Highway 304. This area represents the 1946-era shoreline. Before being converted to a parking lot in the mid-1980s, this area was the location of six railroad tracks (rather than the current three). No record of disposal activities exists for Zone III.

Exceedances of regulatory screening criteria in groundwater in Zone III were limited to a few inorganics. For soil, exceedances of industrial criteria were limited to TPH.

3.2 OU NSC

OU NSC is the designation given to the portion of BNC now known as the Fleet and Industrial Supply Center (FISC). When the RI process for BNC was being planned, FISC was known as the Naval Supply Center (NSC), thus the designation "OU NSC."

OU NSC consists of approximately 28 acres of land created between 1900 and 1950 by the placement of miscellaneous fill materials in tidelands. The current ground surface at OU NSC is flat and almost entirely paved or covered by buildings, except during active construction. OU NSC encompasses a substantial number of relatively old structures, including buildings and a former supply pier. Because of FISC's role in supplying materials to BNC, the buildings within OU NSC are primarily warehouses and offices for staff involved in supply functions.

A concrete and steel quay wall reaching to an estimated depth of 10 feet below ground surface extends along the full length of the waterfront at OU NSC. The quay wall was apparently installed in stages during the landfilling process, presumably to help control erosion of the fill by tidal action.

Until October 1996, the Defense Reutilization Marketing Office (DRMO) operated a metal scrap yard on approximately 3 acres of land within the OU NSC boundaries. DRMO was responsible for supervising and directing the disposition of surplus material from BNC. This responsibility entailed storing, sorting, and arranging the reuse or sale of various materials. Activities at DRMO that led to contamination of soil and groundwater include recovery of scrap metal, recycling of batteries and electrical transformers, and maintenance of vehicles. In 1996, the DRMO scrap-metal operations at OU NSC were terminated.

The primary oil pipeline serving BNC runs through the center of OU NSC, connecting to the steam plant west of OU NSC. An additional pipeline, which has been closed in place, formerly connected to the petroleum storage tanks at OU C, northeast of OU NSC. An oil-reclaiming facility operated for many years at former Building 588, in the southwest portion of OU NSC.

Underground utilities are common throughout most of OU NSC. Sanitary sewers serving BNC were separated from the storm drain system in 1975. There are approximately 15 storm drains within OU NSC, with the outfalls discharging directly to Sinclair Inlet.

Extensive sampling of groundwater and soil was performed as part of the investigation of OU NSC. During the two RI phases, approximately 56 groundwater samples and 169 soil samples were collected from approximately 30 and 19 locations, respectively. More limited sampling of stormwater and catch basin sediments was also performed. For simplicity, the short summary of findings that follows focuses on groundwater and soil, but many of the chemicals detected in these media were also detected in stormwater and catch basin sediments:

- The volatile organic compound trichloroethene (TCE) was found above screening levels in groundwater.
- A number of SVOCs were found at concentrations exceeding screening levels in groundwater and soil.
- A number of pesticides were found above screening levels in groundwater.
- Several of the individual PCB mixtures known as Aroclors were found above screening levels in groundwater and soil.
- TPH exceeded screening levels in groundwater and soil.
- The inorganics arsenic, copper, and lead exceeded screening levels in groundwater and soil.
- Silver and thallium exceeded screening levels in groundwater, and mercury exceeded screening levels in soil.

The primary sources of the chemicals found at OU NSC are believed to be the miscellaneous fill materials used to expand flat working area at BNC, as well as historical spills and releases resulting from site operations.

The primary threats posed by contaminants at OU NSC are associated with potential contact with site soils and the risk of transport of contaminants to the adjacent marine environment (for example, via groundwater movement or through stormwater discharges).

3.3 OU B TERRESTRIAL

OU B Terrestrial includes all of the land area of BNC that is not included in OU A, OU NSC, and OU D, except for the area north of Farragut Avenue in the western portion of BNC and north and northwest of Decatur Avenue in the eastern portion of the complex (approximately 200 acres). OU B Terrestrial is generally flat, completely industrialized, and almost entirely paved. OU B Terrestrial encompasses the heart of the industrial activities at BNC, including all six drydocks.

Much of OU B Terrestrial was developed in stages, by expanding the original shipyard property through the placement of miscellaneous fill materials in marshes, ravines, and shallow intertidal areas along the shoreline. The fill materials used are believed to have included construction debris, soil removed from the upland areas during grading operations, sediments dredged during drydock construction, and miscellaneous solid wastes. A landfill associated with the historical community of Charleston and located in what is now the western portion of OU B Terrestrial is also believed to have been buried during the filling operations.

The site is almost entirely covered by a combination of pavement and buildings. Typical of a large industrialized shipyard facility, the site features numerous roadways, railways, crane tracks, and a complex network of utility systems.

A variety of chemicals has been found to exceed regulatory criteria and were identified as chemicals of interest (COIs) at OU B Terrestrial. Although some sampling and analysis of surface water, drydock seeps and discharges, and stormwater system sediments were performed during the investigation of OU B Terrestrial, soil and groundwater were the most extensively sampled media. For that reason, the following short summary of findings will focus on soil and groundwater, but many of the same contaminants were also commonly detected in the less frequently sampled media:

- Two volatile organic compounds (VOCs), TCE and tetrachloroethene (PCE), were identified as COIs in groundwater. PCE was also designated a COI in soil.

- Numerous SVOCs, including PAHs, were designated COIs in groundwater and soil.

- A variety of pesticides were determined to be COIs in groundwater and soil.
- Several Aroclors (PCBs) were found to be COIs in groundwater and soil.
- TPH was frequently detected throughout OU B Terrestrial and was designated a COI in groundwater and soil.
- All of the six common inorganic elements arsenic, copper, lead, mercury, nickel, and zinc were found to be COIs in unfiltered groundwater and soil. All but mercury were also found to be COIs in filtered groundwater.

The primary sources of the chemicals found at OU B Terrestrial are believed to be miscellaneous wastes included in the fill materials used in developing much of the shoreline area, together with historical spills and releases into the soil in connection with industrial operations at the site. An off-site upgradient source of PCE and TCE has been identified, and the highest PCE concentrations have been measured in groundwater samples from an off-site upgradient well.

The primary threats posed by conditions at OU B Terrestrial are the potential for contaminants to be transported to Sinclair Inlet and the possibility of human contact with contaminated soil. As in all industrial settings, the storm drainage facilities are a particular concern because of their capability to transport contaminants off site. Pathways by which contaminants could reach the inlet include groundwater and intruding seawater entering the storm drain lines, direct groundwater discharge, and slumping or erosion along the shoreline.

3.4 OU B MARINE

OU B Marine is composed of all of the nearshore marine environment associated with the BNC, reaching generally east and west along the shorelines of OUs A, NSC, B Terrestrial, and D and extending an average of approximately 1,500 feet outward into Sinclair Inlet. The site includes an estimated total of approximately 270 acres of subtidal land. OU B Marine includes the marine area adjacent to OU A that at one time was included in OU A.

Most of the shoreline is composed of moderately steep slopes protected by a combination of riprap, gravel mixes, and quay walls. Water depths within OU B Marine range to 45 feet, with the exception of a few slip areas that have been dredged to depths of approximately 50 feet.

Analysis of marine sediment samples during the RI showed that a variety of chemicals, including PCBs, PAHs, and several inorganics, exceeded the Sediment Quality Standards (SQS) and cleanup screening levels (CSLs) included in the Washington State Sediment Management Standards (SMS).

A variety of chemicals were also detected in marine tissue samples collected during the RI at concentrations higher than were measured in reference area samples. These chemicals included PCBs, PAHs, pesticides, and several inorganics.

The primary potential source of contamination in OU B Marine is contaminant discharges via the BNC storm drains. Precipitation flowing across paved and landscaped areas can pick up and transport chemicals adsorbed to soil and fill particles and can also pick up and transport chemicals from contaminated soil and fill in dissolved form. Breaks and gaps in storm drain lines provide another potential source of contaminants by allowing soil and fill materials to enter the storm drain lines.

The RI concluded that the primary threat posed by conditions within OU B Marine was human health risk associated with the presence of PCBs in marine tissues. PCBs found in shallow marine sediments are believed to be retained in the tissues of benthic invertebrates and transferred up the food chain and bioaccumulate in tissues when these invertebrates are consumed by higher order marine species. Potential risks to subsistence seafood consumers by PCB levels measured in English sole constituted the basis for the marine remedy.

3.5 OU C

OU C is a petroleum-contaminated site. CERCLA does not address petroleum as a contaminant. Petroleum releases are addressed, in Washington State, under Subchapter IX of RCRA and the state MTCA. This CERCLA 5-year review includes an assessment of the OU C remedy protectiveness to address the parallel MTCA review requirements.

OU C is located in the north-central upland portion of BNC. The area is topographically higher than most of the industrialized waterfront area of BNC, with elevations ranging from approximately 60 to 100 feet above mean sea level. OU C centers on a steep ravine, which was partially filled prior to construction of two underground and one aboveground petroleum storage tanks. Tank 315, the aboveground storage tank (AST), was removed in the 1990s. Tank 316 was closed, filled with soil and industrial debris, and paved over in 1986. The area above Tank 316 is currently used for parking. Tank 317 was closed and filled with clean soil. Tank 317 is believed to have been the primary source of petroleum contamination found in the subsurface at OU C. Approximately 80,000 gallons of petroleum, primarily bunker C fuel oil, were estimated to be present in the subsurface beneath and downgradient of the OU C tank locations. The potential for petroleum to contaminate groundwater and possibly be transported off site were the primary potential threats identified at OU C.

The Navy initiated a steam sparging demonstration program at OU C in August 1996, testing the potential for mobilizing and recovering petroleum in subsurface soils. Based on the effectiveness of the demonstration program, the system was expanded in August 1997. However, by 1998, system performance was becoming marginal, with petroleum recovery rates significantly less than expected. Investigations in late 1998 and early 1999 demonstrated that groundwater at OU C is strongly influenced by the drawdown caused by the dewatering system at Drydock 6, south of the site. Analysis of groundwater from wells downgradient of OU C suggested that the petroleum may be comparatively immobile, as groundwater migrating to the drydock was not transporting dissolved petroleum. Based on these findings, the Navy proposed that sparging operations be suspended and the potential for natural attenuation of the petroleum assessed. Ecology accepted this proposal on condition that the site be subjected to a focused RI and screening-level FS. The steam sparging system was mothballed in September 1999. Most of the equipment associated with the system was removed from the site in August and September 2004. The total petroleum recovery achieved during sparging system operation was estimated to be approximately 30,000 gallons.

As part of the focused RI/FS, additional wells were installed in July 1999 between OU C and Drydock 6 to monitor for potential migration of petroleum from the site. Baseline sampling was conducted in August 1999, and additional sampling was carried out in December 1999. Quarterly sampling of groundwater was initiated in January 2001. A final focused RI and screening-level FS report for OU C was published in April 2002 (U.S. Navy 2002g). The overall conclusion was that the petroleum is stable and not subject to off-site migration, and, therefore, no further action other than ongoing groundwater monitoring was required to be protective of human health and the environment. The primary objective of implementing a cleanup action at OU C is to prevent migration of free and dissolved phase petroleum hydrocarbon contamination from affecting Drydock 6 and Sinclair Inlet in order to protect human health and the environment (U.S. Navy 2007i).

The dewatering system associated with Drydock 6 was upgraded in the summer of 2006 (Butler 2006). This project has significantly reduced the saltwater intrusion induced by the dewatering system. The project has also reportedly had the effect of lowering the water table in the vicinity of the drydock, with the result that several monitoring wells at OU NSC, OU B Terrestrial, and OU C could no longer be sampled. Replacement wells were subsequently installed.

3.6 OU D

OU D was established in 2002 to support consideration of a possible transfer of land to the City of Bremerton for the development of a public park. Review of alternative park configurations led to an agreement that a parcel of land of approximately 2.5 acres at the extreme east end of BNC would be deeded to the city.

Soil and groundwater were sampled in the OU D area during the OU B RIs. Additional sampling specifically to support the RI/FS for OU D was carried out in 2003. This sampling was limited to surface and subsurface soils, since groundwater at the site tends to be brackish because of its proximity to Sinclair Inlet and will never be considered a drinking water source. The overall findings of these investigations were that the COIs in site soils consisted of one volatile organic compound, PAHs, pesticides, inorganics, and heavy oil.

The primary sources of contamination at OU D are believed to be the materials used as fill in expanding the shipyard area and possible historical releases from industrial operations.

Pathways that could lead to contaminants present at OU D being transported to the adjacent marine environment include leaching of contaminants by site groundwater moving toward Sinclair Inlet and direct discharge in dissolved or particulate form through the storm drain lines serving the site.

The baseline human health risk assessment concluded that risks to site workers and recreational users are acceptable under current and projected future land use conditions. No ecological risk assessment was performed because of the absence of natural habitat in this formerly industrialized area. However, remedial action was undertaken at OU D based on the threat to the marine environment from potential off-site transport of contaminants by groundwater and stormwater.

3.7 OTHER CERCLA-RELATED ENVIRONMENTAL ACTIVITIES

This section discusses environmental activities (such as sampling or removal actions) conducted during this 5-year review period that are related to the listing of BNC as a whole on the National Priorities List, but not associated with any specific OU.

In late 2010, elevated mercury levels were observed in soil planned for removal from a site north of OU NSC where a Child Development Center was being constructed. A subsequent investigation of site soil and groundwater suggested that the source of the mercury was imported contaminated fill material previously used for site surface grading (U.S. Navy 2011c). Prior environmental investigations in the vicinity of the site, predating the surface grading action, had not identified significant soil contamination. As a result, the site is not included in any of the established OUs. In response to the investigation findings, the Navy arranged to have the surface soils at the site removed and disposed of appropriately, replaced the surface material with clean imported fill, and modified the building design to include a vapor barrier system and vapor monitoring facilities.

4.0 REMEDIAL ACTIONS

The RODs for BNC required remedial actions for OU A, OU NSC, OU B Marine, OU B Terrestrial, and OU D. This section summarizes the remedial action objectives (RAOs), selected remedy components, and operation, maintenance, and monitoring requirements for each of the OUs.

Implementation of a petroleum management plan (PMP) is mentioned in some of the RODs for BNC, but is not a specific RAO because petroleum is typically addressed outside of the CERCLA process. The Navy has chosen to address petroleum contamination through a separate petroleum management program applicable to OUs A, NSC, and B Terrestrial. A PMP was developed in 2002 and amended in 2003. Because PMP monitoring is being conducted concurrently with long-term monitoring (LTM) in most cases at BNC, a brief discussion of PMP monitoring is included as part of this section.

4.1 OU A

4.1.2 OU A Remedial Action Objectives

The primary RAOs established in the ROD for OU A are the following:

- Prevent people from coming in contact with soil containing lead, arsenic, PCBs, and PAHs at concentrations greater than acceptable levels.
- Reduce the physical hazards associated with the existing riprap, such as exposed scrap metal, construction debris, and fill materials.
- Limit the erosion of heavy metal and organic constituents in fill materials into Sinclair Inlet marine waters through the existing riprap.
- Reduce the transport of chemicals to groundwater or the marine environment.
- Enhance terrestrial and marine habitat.

4.1.3 OU A Remedy Selection

The components of the selected remedy for OU A are the following:

- Upgrade of the pavement over approximately 3.7 acres

- Installation of erosion protection (additional riprap or stabilized cobble/gravel layer) along approximately 1,400 lineal feet of the existing shoreline, incorporating the mitigation of fish and shellfish habitat loss
- Implementation of ICs, including fencing, warning signs, prohibitions on fish and shellfish harvesting at Charleston Beach, and land use restrictions on residential use
- Compliance with a BNC-wide soil management plan that would apply to all future excavation projects at the BNC
- Implementation of a groundwater monitoring program
- Review of the monitoring at least every 5 years
- Implementation of a monitoring program for all remedy components
- Regular inspections and maintenance of the pavement and erosion protection
- Implementation of marine and terrestrial habitat enhancements

4.1.4 OU A Remedy Implementation

Completion of pavement upgrading, erosion protection, and habitat enhancements was documented in the final remedial action report for OU A (U.S. Navy 1999b) and the addendum to the final remedial action report for OU A (U.S. Navy 2000a). Shoreline erosion protection and beach habitat enhancement consisting of placing additional armor rock and gravel, reducing slopes, and creating a vegetated corridor were carried out between January 26 and March 4, 1998. Additional shoreline erosion protection was constructed between July 10 and November 28, 2000, consisting of the replacement of a failing seawall. Terrestrial habitat enhancement included a vegetated soil pocket and bird nest boxes that were constructed between March 9 and April 28, 1998. Asphalt repair and sealing were performed between July 11 and August 1, 1998.

The remedy for OU A did not involve any actions at Charleston Beach, the southwestern end of OU A. At the time of completion of the remedy, Charleston Beach was made up of an intertidal area separated by a steep riprap embankment from an elevated paved parking area. Subsequent to completion of the OU A remedy, the Charleston Beach area was designated as the site of a project intended to mitigate in-water construction work being performed elsewhere at BNC. The mitigation involved expanding the intertidal habitat along approximately 120 linear feet of Charleston Beach between December 2001 and February 2002. This action included excavating

a portion of the riprap embankment and replacing it with a combination of soft bank and sheet pile, as well as placing fish-mix gravel to provide a more gently sloped beach.

Subsequent to the mitigation action, erosion of the fish mix and bank was found to be occurring at the site, and landfill debris was observed on the beach during the 2007 storm season. An interim action in August 2008 included placement of additional fish mix as a temporary erosion control measure while a more lasting alternative approach was sought. Additional fish mix was placed in this area in 2010 in response to further loss of beach material. Navy studies triggered by the observation of beach erosion have included sediment and soil sampling and analysis to approximate the physical extent of fill material in the intertidal and adjacent upland areas at Charleston Beach (U.S. Navy 2010j) and an investigation of beach dynamics (U.S. Navy 2010k). These studies are ongoing. Analyses of current transport and beach dynamics suggest that the potential for establishing and maintaining improved intertidal habitat at Charleston Beach may be comparatively limited. The most recent work has focused on the possibility of a more permanent approach to controlling potential release of fill material at Charleston Beach combined with new measures to enhance marine habitat at a more suitable location.

Implementation of ICs for BNC was addressed with completion of the final IC work plan (U.S. Navy 2006b). The IC work plan was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). The ICs include access control, groundwater restrictions, excavation management, and land use restrictions. Prior to the completion of the IC work plan, existing access control measures at OU A included security measures for BNC that were in place at the time that the ROD was executed. In addition, administrative control of acceptable groundwater and land use has been maintained by Navy planning divisions. Additional discussion of ICs at BNC is provided in Section 4.7.

The soil management plan requirement is equivalent to the excavation management plan requirement established under the OU NSC ROD (see Section 4.2). Excavation management is covered in the 2009 IC work plan (U.S. Navy 2009d). The IC work plan includes a standard operating procedure for excavation management to provide guidelines for BNC personnel and contractors. NAVSTABREMERTON INSTRUCTION 11310.10D, Outages and Excavations, provides requirements for excavation permits, utility outage, track closures, and road and sidewalk revision requests.

Implementation of a monitoring program for groundwater and all remedy components was satisfied by publication of the final monitoring plan for OU A in October 2000 (U.S. Navy 2000b) and annual monitoring events, which began in 1998 (see Section 4.1.5). Review of monitoring every 5 years is addressed by this 5-year review report.

Inspection and maintenance of pavement and erosion protection had been implemented at the time of the first 5-year review. Inspection requirements for pavement and shoreline protection were originally implemented as part of the LTM process (U.S. Navy 2000b). However, the 2006 operation and maintenance (O&M) plan consolidated the requirements and procedures for pavement cap and shoreline inspection for all applicable OUs (U.S. Navy 2006a).

4.1.5 OU A Operation, Maintenance, and Monitoring

Inspection and Maintenance of Pavement and Erosion Protection

Annual inspection and maintenance of the pavement cap and shoreline protection has been conducted since 1998. During this 5-year review period, annual inspections were conducted. As a result of recommendations made for the 2006 and 2007 annual inspections, an interim repair action was performed to stabilize the bluff and enhance beach habitat at Charleston Beach in August 2008 (U.S. Navy 2008d) and beach replenishment was performed in 2010 (U.S. Navy 2011a). Pavement repairs recommended in 2008, 2009, 2010, and 2011 (U.S. Navy 2008c, 2009e, 2010a, and 2011l) do not appear to have been addressed. It is unclear if catch basin maintenance/cleaning recommendations based on the results of the annual inspections are being implemented as the annual inspection reports do not contain documentation of these activities.

Groundwater Monitoring

LTM during this 5-year review period consisted of groundwater sampling conducted semiannually in 2007 and annually in 2008 through 2011 at three to six monitoring well locations (including background well 346). Sampling has been conducted under the requirements of the comprehensive LTM plans covering all OUs other than OU B Marine (U.S. Navy 2006c, 2007b, 2008e, 2009f, 2010b, and 2011f). LTM performed at OU A during this 5-year review period (2006 through 2011) is summarized in Table 4-1. Changes to the LTM program, including analytes, sampling locations, and sampling frequency, were allowed under the OU A ROD and were approved by EPA and Ecology through review and approval of the first and second 5-year reviews and each LTM plan.

Under the current groundwater monitoring plan (U.S. Navy 2011f), three to five wells (including background well 346) are monitored for at least one of the following metals: arsenic, copper, lead, nickel, and zinc. Analysis of SVOCs was not included in the groundwater monitoring performed during this 5-year review period, as SVOCs were dropped from the analyte list after spring 2003 in accordance with the first 5-year review and recommendations made in the 2002/2003 annual monitoring report (U.S. Navy 2003b).

4.2 OU NSC

4.2.1 OU NSC Remedial Action Objectives

The primary RAOs established in the ROD for OU NSC are the following:

- **RAO for groundwater:** Reduce the potential for arsenic, copper, nickel, lead, pesticides, PCBs, and TPH to reach the groundwater, to the extent feasible, using technologies that are implementable and effective.

- **RAO for soil:** Reduce human exposure to the chemicals of concern (COCs) and reduce or control the contamination of groundwater.

- **RAO for surface water:** Reduce the potential for COCs to be introduced into water flowing through the storm drains and thus discharged to Sinclair Inlet.

- **RAO for storm drain sediment:** Reduce the potential for COCs in storm drain sediment to be discharged to Sinclair Inlet.

4.2.2 OU NSC Remedy Selection

To achieve the RAOs, the following remedial action components were specified in the OU NSC ROD:

- Enhancement of existing paving to reduce human contact with soil and reduce leaching of contaminants from soil by precipitation

- Cleaning of stormwater facilities to remove accumulated soil, fill, and debris

- Repair of damaged stormwater piping identified during assessment and cleaning operations

- Implementation of ICs to limit access to the area via existing security procedures, to restrict groundwater and land usage, and to ensure that residual contamination is taken into consideration if land use or ownership changes in the future

- Development of a storm drain maintenance plan

- Development of an excavation management plan

- Development and implementation of a LTM plan
- Review of the remedial action and monitoring program at least every 5 years

4.2.3 OU NSC Remedy Implementation

Completion of pavement enhancement, cleaning of stormwater facilities, and repair of stormwater piping and catch basins as necessary were documented in the remedial action closeout report for OU NSC (U.S. Navy 1999a) for work performed between June 1997 and March 1999. Storm drains and catch basins were cleaned with a high-pressure water hose and vacuum truck, inspected via video camera, and repaired as necessary. Paving enhancement included paving previously unpaved areas and replacing pavement in the former DRMO yard and FISC parking lot.

Full implementation of ICs for BNC was addressed with completion of the final IC work plan (U.S. Navy 2006b), which was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). The ICs include access control, groundwater restrictions, excavation management, and land use restrictions. Prior to the completion of the IC work plan, existing access control measures included security measures for BNC that were in place at the time that the ROD was signed. In addition, administrative control of acceptable groundwater and land use has been maintained by Navy planning divisions. Additional discussion of ICs at BNC is provided in Section 4.7.

The storm drain system maintenance plan is included in the O&M plan (U.S. Navy 2009c). This plan includes detailed requirements for annual inspection of the storm drain system in accordance with ROD requirements.

Excavation management is covered in the 2009 IC work plan (U.S. Navy 2009d). The IC work plan includes a standard operating procedure providing excavation management guidelines for BNC personnel and contractors. The IC work plan also makes reference to requirements for excavation permits, utility outage, track closures, and road and sidewalk revision requests.

Development and implementation of LTM was satisfied by the publication of the final monitoring plan for OU NSC in October 2000 (U.S. Navy 2000c) and annual monitoring events that began in 1998.

The requirement for a 5-year review of the remedial action and monitoring program is addressed by this 5-year review report.

4.2.4 OU NSC Operation, Maintenance, and Monitoring

Inspection and Maintenance of Pavement and Storm Drains

Annual inspection and maintenance of the storm drain system and pavement cap at OU NSC have been conducted since the ROD was executed, in accordance with ROD requirements. From the time the ROD was signed to the publication of the BNC-wide 2006 O&M plan (U.S. Navy 2006a), these activities were guided by the OU NSC monitoring plan. The most recent inspection and monitoring have been based on the 2009 O&M plan. During this 5-year review period, annual inspections were conducted. Pavement repairs recommended in 2006 through 2010 (U.S. Navy 2007a, 2007c, 2008c, 2009e, 2010a, and 2011c) appear to have been only partially addressed. Annual inspection reports do not document if catch basin maintenance and cleaning recommendations have been implemented.

Groundwater Monitoring

LTM during this 5-year review period consisted of groundwater sampling conducted semiannually (2006 and 2007) and annually (2008 through 2011) at four to six monitoring well locations (including background well 346). Increased dewatering around Drydock 6, resulting from the upgrade to the dewatering system noted in Section 3.5, caused one OU NSC LTM well, 310, to go dry beginning with the winter 2006 sampling event. Groundwater data were not available from this conditional point of compliance during the time period covering the winter 2006 to winter 2007 sampling events. To provide a consistent monitoring point at OU NSC well 310, a deeper well (310R) was installed at the same location in October 2007 to be available for sampling and water elevations in future monitoring rounds. Monitoring well 392 was replaced in August 2008 with a slightly deeper well (392R). The locations of replacement monitoring wells 310R and 392R are shown on Figure 4-1. A summary of the current groundwater monitoring program for OU NSC is presented in Table 4-2. Sampling has been conducted under the requirements of the comprehensive LTM plans covering all OUs other than OU B Marine (U.S. Navy 2006c, 2007b, 2008e, 2009f, 2010b, and 2011f).

In accordance with the recommendations of the first 5-year review, PCB and pesticide COCs are no longer included in the groundwater monitoring program for OU NSC. Under the current groundwater monitoring plan (U.S. Navy 2011f), five wells (including background well 346) are monitored for the metals COCs: arsenic, copper, lead, nickel, and zinc. Wells 310R, 392R, and background well 346 are monitored for diesel-range hydrocarbons either annually (wells 392R and 346) or every 5 years (well 310R) (U.S. Navy 2011f).

Groundwater Monitoring Well Installation

In June 2011, monitoring well 902 was installed near the northern boundary of OU NSC to support vapor intrusion and contaminant source and extent studies associated with the Child Development Center facility (U.S. Navy 2011b). Figure 4-1 shows the location of this well. Soil and groundwater samples were collected from soil cuttings and well development water, respectively, for waste characterization purposes. A groundwater sample was collected from well 902 during the fall 2011 LTM event and analyzed for total mercury (U.S. Navy 2012c). According to the 2011 LTM plan, well 902 will also be sampled during the 2012 sampling event for mercury analysis (U.S. Navy 2011f). Currently this well is not included in the LTM program.

4.3 OU B TERRESTRIAL

4.3.1 OU B Terrestrial Remedial Action Objectives

The following RAOs were established in the ROD for OU B Terrestrial:

- Continue to limit human exposure to site soils and groundwater
- Reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from:
  - Accumulation of sediment or debris in the stormwater system
  - Infiltration of soil and groundwater into the stormwater system
  - Infiltration of surface water into site soil
  - Erosion of shoreline soil

4.3.2 OU B Terrestrial Remedy Selection

To achieve the RAOs, the following remedial action components were specified in the OU B Terrestrial ROD:

- Stormwater system restoration, including cleaning, inspection, and repair or replacement as needed.
- Asphalt/concrete paving or installation of a clean soil cover with vegetation.
- Implement shoreline stabilization measures.

- Implement institutional controls.
- Conduct long-term groundwater monitoring.
- Remedy maintenance.

4.3.3 OU B Terrestrial Remedy Implementation

Some elements of the OU B Terrestrial remedy were initiated prior to finalizing the ROD. The last elements of the remedy were completed in 2006. Approximately 80,000 feet of storm drain piping were inspected, leading to cleaning of approximately 75,000 feet of piping. Approximately 2,000 feet of piping were replaced and another 2,000 feet were repaired. Eighteen catch basins and manholes were replaced or repaired. Approximately 112,000 square feet of asphalt were placed throughout the BNC. A total of 11,200 feet of seawall was inspected, leading to actions to reduce over-steep slopes, augment armoring, control erosion, and enhance shoreline habitat in selected areas. An IC work plan has been prepared to document the procedures to be used to implement the ICs throughout BNC, including those included in the remedy for OU B Terrestrial (U.S. Navy 2006b). The IC work plan was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). Additional details of the remedy implementation are presented in the following sections.

Stormwater System Restoration

The storm drains throughout the balance of OU B Terrestrial were investigated and mapped before being cleaned. When the investigation was complete, the as-built configuration of approximately 88,250 linear feet of pipe had been confirmed and mapped. The information obtained from the investigation was used to develop updated storm drain drawings that provided the basis for monitoring and documenting the subsequent cleaning and inspection efforts (U.S. Navy 2006d).

Subsystems comprising the overall storm drainage network were identified to the extent possible based on their individual outfalls. Generally, the cleaning of each subsystem progressed from the upstream end to the outfall at the Sinclair Inlet shoreline. When the cleaning effort was complete, approximately 75,000 linear feet of piping had been cleaned. The cleaning process involved using high-velocity jetting equipment that employed water pressure to dislodge and flush sediment and debris to the nearest manhole or catch basin, where it was removed using a vacuum truck (U.S. Navy 2006d).

The catch basins and manholes were cleaned by first vacuuming the bulk sediment and debris from the structure. A high-pressure water jet and vacuum were then used to remove any material adhering to the walls or floor of the structure.

All storm drain systems associated with this activity discharge directly to Sinclair Inlet. To prevent cleaning water and suspended solids from reaching the inlet, downstream systems were blocked at the structure being cleaned using expandable plugs.

To minimize the volume of wastewater that was generated, measures were implemented to permit the recycling of cleaning water (U.S. Navy 2006d).

Approximately 79,600 linear feet of storm drain piping was inspected in accordance with the National Association of Sewer Service Companies Specification Guidelines using a minicamera system with audio/videotape and closed-circuit television capabilities. The video was complemented by an audio commentary and an on-screen classification of discrepancies entered by the operator. Computer-generated reports were also produced to document the findings of the inspection both in tabular and graphic format (U.S. Navy 2006d).

Defects or other conditions noted during the inspections included the following (U.S. Navy 2006d):

- Cracked pipe
- Broken pipe
- Deformed pipe
- Circumferential crack
- Sag
- Offset joint
- Infiltration
- Sediment or debris in line
- Open crack
- Crushed pipe
- Collapsed pipe
- Longitudinal crack
- Misalignment
- Separated joint
- Blockage
- Lateral connections

In conjunction with video inspection of the piping systems, the catch basins and manhole structures were visually inspected for evidence of deterioration, damage, and other adverse conditions. The inspection also identified structures having no bottom or having covers, grates, or rings that were damaged or misaligned (U.S. Navy 2006d).

Repair decisions were made during the remedial design and construction phases based on engineering judgment as to what would provide the greatest reduction of environmental risk. The primary focus of the evaluations was to identify storm drain system components exhibiting significant structural damage. Conditions meeting this criterion included collapsed pipe; holes, missing pipe, or misaligned joints that exposed the surrounding soil to potential erosion; and severe fracturing, where failure appeared imminent even though soil was not visible. Hairline cracks that did not significantly impair the integrity of the system were considered outside the scope of the repair criterion (U.S. Navy 2006d).

As the inspections were completed, initial defect evaluations were performed and repair recommendations were made based on the above criteria. The final determinations were made through a series of meetings attended by the Navy contractor and Navy representatives, at which time the inspection reports, videotapes, and evaluations were reviewed and discussed and decisions were made regarding the repairs that were necessary. When complete, 267 work orders were identified for repair, many involving multiple individual repairs (U.S. Navy 2006d).

Two primary repair methods were used to rehabilitate the storm drain systems—conventional cut-and-cover repairs and specialty repairs involving the use of cured-in-place pipe (CIPP) (U.S. Navy 2006d).

Typical cut-and-cover repairs were accomplished by removing the pavement or floor slab above the defective pipe section, excavating to expose the defect, replacing the defective pipe segment, installing pipe bedding, and backfilling and paving the area. This method was used exclusively for the repairs associated with 161 work orders and in conjunction with CIPP applications for 4 work orders. A total of 1,283 linear feet of defective pipe were replaced (U.S. Navy 2006d).

In addition to the above repairs, a major storm drain rehabilitation project was implemented along “R” Street, north of Drydock 6. Inspection results in this area showed that some of the primary storm drain collection lines in this area exhibited extensive deterioration and needed replacement. The storm drain action involved installing 750 linear feet of new pipe and associated drainage structures and abandoning the existing storm drain components that they replaced (U.S. Navy 2006d).

The CIPP repair method involved installing a resin-impregnated felt tube in line with the defect in the host pipe, expanding the liner against the inside circumference of the pipe, and allowing the resin to cure. The result is a new pipe within the host pipe. Two general categories of CIPP repairs were implemented—spot repairs and inversion-type repairs. In the case of spot repairs, short segments of pipe were rehabilitated by positioning a wetted liner over the defect using a roller-mounted expandable bladder. Once in position, the bladder was inflated and the resin allowed to cure under ambient conditions prior to removing the bladder. The inversion-type applications were used for longer repairs beginning at a drainage structure. Using the inversion method, the liner is turned inside out using a static water head to deploy the liner into the defective section of pipe. Once deployed, the resin was cured by filling the liner with hot water. Following sufficient cure time, the water was released and the ends of the felt tube were removed. A total of 1,987 linear feet of CIPP liner was installed (U.S. Navy 2006d).

During the inspections and subsequent repair activities, 21 defective storm drain segments were determined to be no longer in service. These pipes were sealed off at the manhole or catch basin using masonry bricks or grout (U.S. Navy 2006d).

Eighteen catch basins and manholes were identified during the inspection phase as requiring rehabilitation. Repairs to the drainage structures consisted of grouting holes, sealing around pipes where they entered the structures, and casting concrete floors in structures where none existed. Six new manholes and two new catch basins were installed to accommodate pipe repairs or replace severely damaged drainage structures (U.S. Navy 2006d).

Repairs could not be implemented in areas with security restrictions or areas where long-term naval operations prevented access. Other repairs that could not be implemented were located beneath permanent structures, where excavating was not possible or the nature of the defects was such that trenchless repair methods could not be used. The defects associated with these locations were reevaluated and determined to be low risk with regard to the potential for producing an environmental release (U.S. Navy 2006d).

The stormwater system restoration program was completed in August 2006.

Asphalt/Concrete Paving or Installation of Clean Soil Cover With Vegetation

The objective of this remedy component was to construct a physical barrier to infiltration at exposed locations within OU B Terrestrial. The physical barrier consisted of pavement improvements and placing pavement at previously unpaved areas. A total of 57 separate locations were upgraded and/or paved as part of this project (U.S. Navy 2004c).

Field operations were completed between June 13 and December 4, 2003. Approximately 111,763 square feet of asphalt were placed throughout the BNC installation. The project included placement of new pavement in unpaved areas, as well as upgrades to deteriorating pavement. The soil was removed to the appropriate design depth in areas where a surface cover was not present. Four inches of asphalt underlain by approximately 6 inches of base course were placed over the subgrade soil to provide a physical barrier to water infiltration (U.S. Navy 2004c).

One area planned for paving was left unpaved to provide a traffic control measure in the area, as directed by the Navy (U.S. Navy 2004c). This area was observed to be paved during the site visit in 2006.

Shoreline Stabilization

In June 2002, the Navy performed an inspection of the 11,200-foot-long OU B Terrestrial seawall (U.S. Navy 2002h). The objective of the inspection was to collect information regarding the integrity of the seawall at BNC. The integrity of the seawall was of interest in that defects or degradation of the seawall could provide pathways for the erosion of potentially contaminated fill material from behind the seawall into Sinclair Inlet.

The seawall consists of various types of construction, including armor rock, metal sheet pile, concrete and composite sheet pile, and concrete. Based on the inspection results, the sheet pile and/or concrete armored portions of the seawall appeared to be structurally sound and protective of the environment. However, with regard to some of the seawall segments armored with rock, the inspection determined that armoring was sparse throughout and should be supplemented with additional rock. The inspection also showed that armor rock slopes in these segments were generally too steep and should be reduced to 2:1 (horizontal to vertical) to improve static and seismic stability, as recommended by the U.S. Army Corp of Engineers Coastal Engineering Manual. In response to these findings, slopes were reduced and rock armoring was enhanced in selected areas to improve shoreline stability and reduce the potential for migration of potentially contaminated fill material into Sinclair Inlet.

Erosion control measures were implemented in accordance with the approved remedial designs and work plans. The fieldwork began in October 2003. In-water work, which consisted of debris removal and placement of erosion control materials, was completed in March 2004. The upland activities, involving construction of vegetated planter beds and limited asphalt paving, were completed and accepted in May 2004. The remedial fieldwork for the final two segments was completed in September 2005 (U.S. Navy 2006e).

In a few locations, slope reduction was achieved by excavating the top of the bank. However, in most areas, naval operations or buildings along the upland edge of the shoreline prohibited excavating for slope reduction. In these cases, slope reduction was accomplished through the placement of armor rock (U.S. Navy 2006e).

Erosion control system materials consisting of small and large armor rock, rat rock, filter rock, and fish mix were placed along the shoreline. Prior to placement of the armor layer, exposed areas of the slope (areas where no armor was previously visible on the surface) were covered with filter rock. Over the gentler slopes of some segments, geotextile fabric was used in lieu of filter rock. In areas receiving large or small armor rock, the void spaces in the rock layer were filled with rat rock or Type 2 fish mix. Bathymetric surveys were performed during high-tide cycles to produce the as-built record drawings for the completed work along many of the segments. A conventional land survey was performed for the as-built record drawings for two segments (U.S. Navy 2006e).

As part of the habitat compensation measures implemented along the shoreline, the upland areas along three shoreline segments were planted with woody riparian vegetation. Native plant species were selected based on their ability to provide habitat complexity, seasonal variation, and greater success in varied and difficult growing conditions (U.S. Navy 2006e).

Areas along two segments where existing pavement did not already abut the vegetated strip were paved with 3 inches of modified Class B asphalt concrete. To aid in dispersing stormwater draining from the paved areas, a narrow band of clean gravel was placed between the edge of the pavement and the vegetation (U.S. Navy 2006e).

Institutional Controls

The IC objectives for OU B Terrestrial are the following:

- Ensure that access to the site is controlled.
- Ensure that the sole use of groundwater from the site is for monitoring purposes.
- Ensure that excavations carried out at the site are managed appropriately given the contaminants left in place.
- Ensure that the established industrial use of the site is maintained.

The OU B Terrestrial ROD prescribes development of a BNC-wide IC remedial design to define the specific implementation actions necessary to achieve these IC objectives (U.S. Navy, Ecology, and USEPA 2004a). As described in Section 4.7, a BNC-wide IC work plan (U.S. Navy 2006b) was prepared to describe procedures for implementing the IC remedial objectives for OUs A, B Marine, B Terrestrial, D, and NSC at BNC. The IC work plan was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). Inspection and maintenance of the ICs are detailed in the BNC-wide O&M plan (U.S. Navy 2006a).

The ICs will meet the RAO "continue to limit human exposure to site soils and groundwater." The ICs will be applicable throughout the OU B Terrestrial site and, because contaminated soil and groundwater are being left on site, will be maintained until contaminant levels allow for unlimited use and unrestricted exposure.

Long-Term Monitoring

Long-term groundwater monitoring was initiated at OU B Terrestrial in August 2004, satisfying this remedy component. Additional details on the long-term groundwater monitoring conducted during this 5-year review period are provided in Section 4.3.4. The remainder of this section summarizes the ROD requirements for LTM at OU B Terrestrial.

There is no current or expected future beneficial use of groundwater at OU B Terrestrial. It has been concluded through analyses of primary fate and transport mechanisms that site groundwater is sufficiently protective of the marine environment and that no active groundwater remediation

is warranted (U.S. Navy, Ecology, and USEPA 2004a). It has been demonstrated that it is not practicable to meet cleanup levels throughout the site within a reasonable restoration time frame. On this basis, a conditional point of compliance was selected for groundwater at OU B Terrestrial. Groundwater monitoring will meet the RAO "reduce potential for chemical transport and control the threat of recontamination of the adjacent marine environment" by providing information to verify predictions that site groundwater is protective of the marine environment.

The Navy, EPA, and Ecology selected constituents for groundwater monitoring based on a review of the nature and extent of the COIs throughout OU B Terrestrial. The chemicals monitored in groundwater are TCE, 4,4′-dichlorodiphenyltrichloroethane (DDT), 4,4′-dichlorodiphenyldichloroethene (DDE), aldrin, dieldrin, heptachlor epoxide, arsenic, copper, lead, mercury, nickel, and zinc. Though PAHs were previously identified as key chemicals, PAHs had not been detected in recent pre-ROD groundwater monitoring and are not monitored (U.S. Navy, Ecology, and USEPA 2004a).

Because PCBs are only weakly soluble in water, the potential for detecting PCBs in groundwater samples is limited. PCBs therefore were not included for monitoring in groundwater. PCBs are, however, highly soluble in organic solvents, and if petroleum were present in groundwater, any PCB present would tend to accumulate in the petroleum fraction. To evaluate the potential for PCB transport via the groundwater pathway, the Navy agreed to collect and analyze a product or product/water sample for total PCB Aroclors in groundwater monitoring wells containing petroleum free product. If PCBs were not detected, sampling of product for PCB analysis was to be discontinued. In the event PCBs were detected, the Navy, EPA, and Ecology would determine the appropriate follow-up measures (U.S. Navy, Ecology, and USEPA 2004a). One free-product sample was collected in October 2004 and analyzed for PCBs. No PCB was detected.

The Navy is addressing petroleum impacts through a separate BNC-wide petroleum management program (U.S. Navy, Ecology, and USEPA 2004a). Groundwater monitoring relative to petroleum was initiated in 2002. Additional details on groundwater monitoring for petroleum-related chemicals is provided in Section 4.3.4.

4.3.4 OU B Terrestrial Operation, Maintenance, and Monitoring

Inspection and Maintenance

The Navy is conducting operation, maintenance, and monitoring of the OU B Terrestrial remedy under the O&M plan (U.S. Navy 2009c). The O&M plan includes inspection and maintenance requirements identified in the ROD for OU B Terrestrial. These requirements include inspection of ICs, excavation management, pavement/vegetative cap, shoreline, storm drains/catch basins, and monitoring wells. During this 5-year review period, annual inspections were conducted.

Pavement repairs recommended in 2007 through 2010 (U.S. Navy 2007a, 2008c, 2009e, 2010a, and 2011l) appear to have been only partially addressed. Annual inspection reports do not document if catch basin maintenance/cleaning recommendations are being implemented.

Long-Term Monitoring

LTM during this 5-year review period consisted of groundwater sampling conducted either semiannually or annually at 10 monitoring well locations. Increased dewatering around Drydock 6 resulting from the upgrade to the dewatering system noted in Section 3.5 above caused one OU B Terrestrial LTM well, 410, to go dry beginning with the winter 2006 sampling event. Groundwater data were not available from this conditional point of compliance during the time period covering the winter 2006 to fall 2007 sampling events. To provide a consistent monitoring point at OU B Terrestrial well 410, a deeper well (410R) was installed at the same location in October 2007 (U.S. Navy 2009h) to be available for sampling and water elevations in future monitoring rounds. Figure 4-1 shows the location of this well. Sampling has been conducted under the requirements of the comprehensive LTM plans covering all OUs other than OU B Marine (U.S. Navy 2006c, 2007b, 2008e, 2009f, 2010b, and 2011f). Recommendations for adjusting monitoring frequencies for COCs were made through application of the decision criteria included in the OU B Terrestrial ROD (U.S. Navy, Ecology, and USEPA 2004a). A summary of the current groundwater monitoring program for OU B Terrestrial is presented in Table 4-3. The current groundwater monitoring program does not include TCE analysis for well 410R. However, continued TCE analysis at well 410R is recommended based on the data reviewed during this 5-year review (see Section 6.4.3).

The original LTM plan for OU B Terrestrial was completed in July 2004 (U.S. Navy 2004d). As part of the preparation of this plan, the Navy, EPA, and Ecology agreed on an approach for estimating the extent of attenuation between the drydock compliance monitoring wells and the groundwater discharge points to Sinclair Inlet. To determine whether compliance has been achieved, groundwater results from the wells are adjusted based on the estimated attenuation and compared to the conditional point of compliance groundwater criteria established in the ROD.

A well redevelopment action was performed in 2006. Based on the concentrations of metals observed in well LTMP-3 compared to the other LTM wells observed through winter 2006, the Navy determined that monitoring wells for OU B Terrestrial should be redeveloped to reduce particulate metals within the samples. Redevelopment of the OU B Terrestrial wells was completed in September 2006. The fall 2006 sampling event (performed in October 2006) was the first sampling event following redevelopment.

Starting in fall 2008, the Navy elected to provide low-level mercury results using EPA Method 1631 for the 10 OU B Terrestrial wells in order to report results at or below the mercury groundwater compliance criterion of 0.025 μg/L. Prior mercury analysis was performed using

routine sampling and laboratory methods, where EPA SW-846 Method 7470 provided a reporting limit of 0.20 μg/L. The low-level sampling and analysis methodologies continue to provide low-level mercury results.

Beginning in fall 2009, analysis of 10 selected halogenated VOCs was added to the analyte list for samples from several wells to support a soil vapor intrusion study. Beginning in spring 2010, additional VOCs (full list) were requested. During the fall 2010 sampling event, OU B Terrestrial wells 425, 432, 433, and 707 were sampled and analyzed in accordance with the soil vapor intrusion study requirements (U.S. Navy 2011e).

The PMP documents the initial petroleum management activities at BNC (U.S. Navy 2002b). This plan was amended in 2003 (U.S. Navy 2003a). The purpose of the amendment was to establish future petroleum monitoring activities for OU B Terrestrial, OU A, and OU NSC beyond the initial 2 years of monitoring that was completed prior to execution of the OU B Terrestrial ROD. Similar to the OU B Terrestrial LTM, the PMP monitoring has been incorporated into the BNC-wide monitoring plan (U.S. Navy 2011f). The current petroleum monitoring program satisfies the ROD-specified LTM requirements.

Although applicable to OU A, OU NSC, and OU B Terrestrial, the amended PMP requires monitoring of wells located almost exclusively within OU B Terrestrial. Only free-product monitoring of well 392 within OU NSC and well 406R in OU B Terrestrial is currently performed, and no monitoring is required for wells in OU A (U.S. Navy 2011f). Replacement well 406R was installed in October 2007 adjacent to well 406 because free petroleum product had been observed in well 406. Figure 4-1 shows the location of this well. Well 406R was installed to provide a screen interval beneath the water table for monitoring dissolved constituents within the shallow aquifer. Well 406 continues to be used for light nonaqueous-phase liquid measurements only (U.S. Navy 2011f).

Groundwater Monitoring Well Installation

In May 2010, three new monitoring wells (wells 809, 810, and 811) were installed within OU B Terrestrial to support a vapor intrusion study performed at the Hazardous Waste Storage Area (HWSA). The wells are located approximately 350 to 500 feet west-northwest of well LTMP-3 (U.S. Navy 2012b). Figure 4-1 shows the locations of these wells. Sampling of the three new wells for VOCs was performed in May and July 2010 (U.S. Navy 2011e).

In June 2011, monitoring wells 900, 901, 903 through 905, and 907 were installed to support vapor intrusion and contaminant source and extent studies (U.S. Navy 2011b). Figure 4-1 shows the locations of these wells. Wells 904, 905, and 907 were installed in the TCE northern plume area located in the northeastern portion of OU B Terrestrial, near Buildings 435 and 427 and the northern boundary of the controlled industrial area. Data obtained from these wells have

contributed to the development of multiple lines of evidence for analyses to assess vapor intrusion (see discussion of vapor intrusion in Sections 6.4.3 and 7.2.2). Wells 900 and 901 were installed near well LTMP-3 to provide information concerning the presence and potential migration of mercury upgradient of LTMP-3. Well 903 was installed near the eastern boundary of OU B Terrestrial to evaluate remedy protectiveness in OU D (U.S. Navy 2011f).

Additional PCE/TCE Plume Investigation

Based on the results of the vapor intrusion studies performed in the TCE northern plume area (U.S. Navy 2009a, 2009b, and 2012b), the Navy plans to perform plume characterization in this area. One objective of this work is to improve the level and quality of data to fully characterize the northern VOC plume on Navy property at NBK Bremerton. Contractors involved in the closure of underground tanks in connection with the demolition of former Building 871 in this area noted the possibility of previous cyanide contamination from a removed pipeline. In response, the Navy also plans to investigate soil and groundwater in the area to assess the potential presence and concentration of cyanide.

4.4 OU B MARINE

4.4.1 OU B Marine Remedial Action Objectives

The ROD for OU B Marine was signed June 13, 2000 (U.S. Navy, Ecology, and USEPA 2000a). An ESD signed February 19, 2004, identified changes in the boundary of OU B Marine and action levels for the response action on the state-owned aquatic lands (SOAL) next to the Navy's CAD pit. The ESD did not change any of the RAOs stated in the ROD.

The following RAOs were established in the ROD for OU B Marine:

- Reduce the concentration of PCBs in sediments to less than the minimum cleanup level (MCUL) in the biologically active zone (0- to 10-cm depth) within OU B Marine, as a measure expected to reduce PCB concentrations in fish tissue.
- Control shoreline erosion of contaminated fill material at Site 1.
- Selectively remove sediment with high concentrations of mercury collocated with PCBs.

4.4.2 OU B Marine Remedy Selection

The remedy for OU B Marine included the following components:

- Dredging of sediments containing PCBs at concentrations greater than remedial action levels and other sediments with elevated mercury concentrations
- Excavation of a CAD pit for dredged sediment disposal
- Placement of a thick-layer cap offshore of OU A
- Placement of a thin layer of clean sediment in the area surrounding the cap offshore of OU A to achieve enhanced natural recovery (ENR), reducing the contaminant concentrations to which benthic community organisms are exposed
- Habitat restoration in the area offshore of OU A by sediment placement to create a shallower slope
- Shoreline stabilization at Site 1
- Monitoring during implementation of the remedial actions to evaluate short-term environmental impacts and verify proper implementation
- Development and implementation of an LTM plan for the CAD pit and shoreline stabilization, sediments, and marine tissue
- Maintenance of the CAD pit and shoreline stabilization remedy components
- Implementation of ICs, including measures to maintain the integrity of the CAD pit cap and the shoreline stabilization at Site 1

4.4.3 OU B Marine Remedy Implementation

The primary components of the remedy for OU B Marine were implemented between the summer of 2000 and fall of 2001 (U.S. Navy 2002f). A total of approximately 225,000 cubic yards of contaminated sediments was dredged and deposited in the CAD pit. The CAD pit was capped with approximately 17,000 cubic yards of sand and 69,000 cubic yards of clean sediment. Approximately 57,000 cubic yards of clean sediment were used to form the cap and surrounding ENR layer offshore of OU A. A total of approximately 5,000 tons of special rock and gravel mixes was used to enhance nearshore habitat in the OU A vicinity. New sheetpile was installed at Site 1 in the central part of the BNC shoreline, riprap placed to improve armoring and limit erosion, and gravel mix placed to enhance nearshore habitat quality.

In the latter stages of the remedial action, evidence was found suggesting that contaminated sediments had been released during the process of filling the CAD pit. A layer of clean sediment was placed in an arc around the three sides of the CAD pit that are Navy property to cover sediments found to have elevated levels of PCBs. The Navy then undertook a more extensive evaluation of the extent of contaminant release onto the SOAL adjacent to the fourth side of the CAD pit. Based on this investigation, clean sediments were used to cover the contaminated sediments found on the adjacent SOAL. The results of the investigation and the actions to be taken in response were documented in an ESD (U.S. Navy, USEPA, and Ecology 2004b), and the work was carried out in February and March 2004.

A marine monitoring plan for OU B Marine was developed in 2003 and updated in 2005, 2007, and 2010. The plan defines a monitoring program that includes grid-based sampling of shallow sediments throughout Sinclair Inlet and sampling of marine tissues, as well as more localized actions, including sampling of the CAD pit and surveys of the CAD pit and cap/ENR measures adjacent to OU A (U.S. Navy 2003d and 2005c). Inspection and maintenance requirements for shoreline stabilization were incorporated in the 2006 O&M plan (U.S. Navy 2006a).

Implementation of ICs throughout the BNC, including OU B Marine, was addressed through the development of a site-wide IC program, and the ICs are documented in the final IC work plan (U.S. Navy 2006b). The IC work plan was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). The ICs for OU B Marine are intended to maintain the integrity of the shoreline stabilization measures at Site 1 and the CAD pit cap. A floating boom with prominent signage controls access to the central part of BNC where Site 1 is located. To protect the sediment and CAD pit caps, the Navy included access control requirements in the IC work plan. The location of these features is within Navy control, and the National Oceanic and Atmospheric Administration (NOAA) determined that updates to the navigation charts regarding the presence of the CAD pit were not required. This notification supports the establishment of restrictions on marine operations and the depiction of the CAD pit on charts of the area. Because the area is controlled by the Navy and is included in the land use control plan, the Coast Guard and NOAA indicated that they would be making no changes to their information.

4.4.4 OU B Marine Operation, Maintenance, and Monitoring

Monitoring at OU B Marine includes sampling of shallow marine sediments and tissues to assess progress toward cleanup goals, sediment coring and marine surveys to assess whether the remedy components are intact and functioning as planned, and special investigations as needed for more specialized purposes. The results of the four rounds of sampling conducted to date, in fall 2003 and spring 2005, 2007, and 2010, are documented in marine monitoring reports (U.S. Navy 2005b, 2005c, 2009g, and 2012d).

Marine Sediment Sampling

The primary component of the OU B Marine monitoring program involves the collection and analysis of samples of shallow (0 to 10 cm) marine sediment based on two regular square grids that together cover the entirety of Sinclair Inlet. One grid, composed of 71 squares ("cells") 500 feet on a side, covers OU B Marine itself. A coarser grid, composed of thirty-two 1,500-foot cells, covers the remainder of Sinclair Inlet. These grids, created during the development of the 2003 sampling plan, are intended to be used throughout the monitoring program. For each grid cell, a sample intended to be representative of the entire cell is prepared as a composite of three individual samples collected at designated locations within the cell. The individual sample collection locations were predefined at the time of creating the sample grids at randomly chosen locations, which meets the requirements of random (statistical) sampling. The composite sediment samples are analyzed for PCBs, mercury, total organic carbon (TOC), and grain size.

Tissue Sampling

A second component of the monitoring program is the collection and analysis of marine tissue samples, which are also considered to meet the requirements of random (statistical) sampling. English sole are collected using a trawl net, with samples made up from skin-off fillets of 20 fish, each fish a minimum of 22 cm long. The English sole samples are analyzed for PCBs, mercury, and lipids. Because PCB levels in tissues are expected to respond comparatively slowly to expected gradual improvement in sediment quality, not every sampling round includes the collection of English sole. English sole were collected in 2003, 2007, and 2010, but not in 2005. The Navy also conducted a one-time sampling of sea cucumbers in the 2003 sampling round. The sea cucumber samples were analyzed for PCBs.

CAD Pit Sampling

The monitoring program includes several sediment sampling tasks specifically related to the CAD pit.

Sediment cores are collected at the CAD pit to verify the continuing functionality of the cap. A total of four cores are collected, each 4 feet long. One sample is prepared from each 1-foot section of each core. The uppermost three samples from each core are analyzed for PCBs, mercury, TOC, and grain size, while the lowest sample is archived.

Another monitoring program task included in the 2003 and 2005 sampling rounds was to characterize shallow (0 to 10 cm) marine sediments surrounding the CAD pit. The goal is to gain a more detailed understanding of sediment quality in an area potentially impacted during the filling of the CAD pit and not addressed by supplementary cover placement. A total of 15 three-

grab composite samples were collected in the first two sampling rounds and analyzed for PCBs, mercury, TOC, and grain size.

Dredged Area Sampling

Another monitoring program component was incorporated in the 2005 monitoring specifically to address sediment quality in dredged areas. The sampling involved collecting both 0- to 10-cm three-grab composites and shallow cores in two separate dredged areas. The samples were analyzed for PCBs, mercury, TOC, and grain size.

Data Variability Studies

In response to several unexpected and potentially anomalous sediment PCB concentrations measured in the 2003 monitoring event, a number of investigations of the data were undertaken. One investigation consisted of a data variability study (DVS) involving repeated analysis of separate aliquots of archived sediment material, yielding multiple results for a number of the original grid cells. The results of this study demonstrated considerably greater variability in the data than had been foreseen.

To assess possible interlaboratory variability and improve understanding of intrasample variability to assist in data interpretation and decision-making, the Navy undertook a more elaborate DVS during the 2005 monitoring. The 2005 DVS involved preparing eight replicate individual samples for 15 of the grid cell locations and submitting half of the samples to each of two different laboratories. For each cell, one sample was analyzed for PCBs, mercury, TOC, and grain size to fulfill the overall goal of characterizing Sinclair Inlet sediments. The other seven samples were analyzed for PCBs and TOC only. The results of the 2005 DVS confirmed and expanded on the 2003 findings. For example, the highest PCB concentration found in the 2005 DVS was 87 mg/kgOC, while the seven replicates prepared from the same composite sediment had PCB concentrations ranging from 8.4 to 21 mg/kgOC. The Navy considers the highest results to be anomalous and not truly representative of overall sediment conditions.

The results of the 2005 DVS revealed that interlaboratory differences were relatively insignificant and that intrasample variability tends to increase with higher PCB concentration. While the apparently anomalous PCBs values have all involved high PCB concentrations, the findings suggest that unusual PCB values, whether high or low, may not be representative of the composite sample material and should be interpreted with care.

Marine Surveys

The monitoring program for OU B Marine also includes several types of marine surveys. The 2003 monitoring round included a sediment profile imaging (SPI) survey of the CAD pit and

cap/ENR area adjacent to OU A. This survey involves collecting photographs of cross sections of the uppermost sediment layers. The purpose of the SPI survey was to check on the progress of benthic community recolonization of the sediments in these areas that had been disturbed during remediation.

Sub-bottom profiling has also been performed as part of the monitoring for OU B Marine. This survey uses sound beams to penetrate sediment, making it possible to identify and measure the thickness of sediment materials with differing sound-transmitting characteristics. Sub-bottom profiling was performed at both the CAD pit and the cap/ENR area in 2003 and again at the CAD pit in 2005, 2007, and 2010.

Multi-beam hydrographic surveys were also performed at the CAD pit and cap/ENR sites in 2003, 2005, 2007, and 2010.

Physical inspection and hydrographic surveys of the shoreline stabilization implemented at Site 1 are conducted periodically. The Navy conducted a shore walk in the area in 2004 and a hydrographic survey in 2005.

4.4.5 OU B Marine Sediment Sampling Associated With Military Construction Projects

Since the completion of the OU B Marine remedy, marine sediment sampling has been a requirement for construction permits associated with construction projects that include in-water work within OU B Marine. Typically this sampling involves analyzing pre- and post-construction sets of individual 0- to 10-cm grab samples in close proximity to the in-water construction areas to document whether construction activities have impacted the sediments in the vicinity of the construction. In some cases, when the construction has involved removal of piers, the sampling has also included one-time collection of underpier samples to characterize portions of OU B Marine that are not normally accessible for sampling.

The Navy prepares separate sampling plans, subject to agency review and approval, to guide the sampling for each construction project (U.S. Navy 2008f, 2008g, 2010e, and 2010f). The sediment samples are routinely analyzed for PCBs, mercury, TOC, and grain size for consistency with the ongoing OU B Marine monitoring program. To provide data to support Ecology's assessment of compliance with the state antidegradation statute, in accordance with the terms of the project water quality certifications, the samples are also analyzed for the metals arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc.

The data from these construction project sampling activities will be incorporated into the database being assembled through the OU B Marine monitoring program and used to assess the long-term performance of the remedy.

To date, four construction projects have been subject to the sediment sampling requirement:

- Replacement of Pier B and demolition of Pier 8
- Replacement of fender piles at Pier 7
- Repair of quay walls and drydock entrances at Drydocks 1, 3, 4, 5, and 6
- Repair of fender systems at Piers 5 and 6

The Navy has documented the results of the sediment sampling associated with each of these projects in separate sediment sampling reports (U.S. Navy 2010g, 2011g, 2011h, and 2012a).

4.4.6 Other OU B Marine Sampling and Investigation

The Navy has conducted additional monitoring and modeling studies to help improve the environmental quality of Sinclair and Dyes Inlets. These studies include the ongoing Environmental Investment (ENVVEST) Project (Ecology 2012 and SSC Pacific 2012), directed studies by the U.S. Geological Survey (USGS) of mercury contamination in Sinclair Inlet (USGS 2012), and research demonstration studies for the treatability (Chadwick et al. 2011) and bioavailability (Bridges et al. 2011) of contaminated sediments adjacent to Pier 7.

The ENVVEST partnership among Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF), Ecology, EPA, and local stakeholders began conducting a comprehensive water quality improvement project for the watersheds of Sinclair and Dyes Inlets in 2000 (FR 2000; USEPA 2000a and 2000b; and U.S. Navy, USEPA and Ecology 2000b). Through this collaboration and cooperation, the ENVVEST working groups have made major contributions to improving the environmental quality of the Sinclair and Dyes Inlet Watershed (WDOH 2003, Wang et al. 2005, ENVVEST 2006, and Dunagan 2008). The ENVVEST working group completed a watershed monitoring and modeling effort that involved all the stakeholders in conducting a comprehensive sampling program that assessed contaminant loading throughout the watershed (May et al. 2005, Brandenberger et al. 2007, and Cullinan et al. 2007). The data were used to support the fecal coliform (FC) bacteria total maximum daily load study for the inlets and resulted in an integrated watershed and receiving water model of the Inlets and watershed that was used to simulate FC discharge scenarios needed for the total maximum daily load (Johnston et al. 2009). The implementation plan (Lawrence et al. 2012), approved by EPA in July 2012, established the capacity of the two inlets to accept discharges of FC bacteria from streams, stormwater outfalls, sewage treatment plants, and surface runoff and still meet water quality standards.

ENVVEST studies of the historical trend of contamination in the inlets obtained from age-dated sediment cores showed that maximum contamination levels occurred between the 1940s and 1960s, followed by a decreasing trend of contamination for more recent deposits. Sedimentation rates for the inlets, estimated from the age-dated cores, ranged from 0.06 to 0.20 $g/cm^2/yr$ (dry

sediment), and the thickness of the contaminated layer of sediment ranged from 0 to 15 cm to 0 to 45 cm (Crecelius et al. 2003). In conjunction with OU B Marine monitoring in 2003, 2007, and 2010, an ENVVEST study was conducted to address sediment concentrations of copper, lead, zinc, and PAHs in addition to PCBs and mercury. The studies were conducted to provide data to inform the 303(d) listing process and determine whether there has been a decrease in sediment contamination since cleanup and source reduction activities at PSNS & IMF have been implemented. The evaluation showed improvement in the number of chemicals meeting sediment quality standards in Sinclair and Dyes Inlets (Kohn et al. 2005, 2006, and 2008).

However, sediment concentrations of mercury continue to be elevated above sediment management standards, and the identification of mercury sources and sinks and the distribution of mercury in the sediment, water, and biota of Sinclair Inlet have been a focus of directed studies performed by the USGS Washington Water Science Center. The evaluation of total mercury in surface sediments of Sinclair Inlet found that the 2000 to 2001 remediation resulted in a significant reduction of total mercury for Sinclair Inlet as a whole. Nevertheless, the total mercury concentrations in the surface sediments have decreased slowly because of the relatively low rate of sediment burial and possible terrestrial sources of mercury from BNC, resulting in unfiltered total mercury concentrations in the surface waters of Sinclair Inlet that are about three times higher than those measured in the surface waters of central Puget Sound (Paulson et al. 2010). Additional USGS Studies have developed a robust data set of mercury and methylmercury that will facilitate detailed analysis of the sources, sinks, and biogeochemistry of mercury in Sinclair Inlet (Huffman et al. 2012).

To further inform sediment management actions at BNC, a sediment quality verification study was initiated by ENVVEST in 2011 (Brandenberger et al. 2011). Specific objectives of this study were to establish a baseline for assessing continuous process improvement of shipyard operations and other sources of contamination into Sinclair Inlet, characterize silt and sediment in the vicinity of outfalls and drydocks (i.e., operational areas not included in the OU B Marine monitoring), provide data to assess sediment impact zones for National Pollutant Discharge Elimination System discharges, provide data to assess antidegradation requirements for water quality certifications needed for pier and drydock infrastructure improvements, and support research and demonstration projects of sediment treatability and bioavailability at Pier 7.

The demonstration project at Pier 7 is being conducted to demonstrate and validate placement, stability, and performance of reactive amendments for the treatment of contaminated sediments in an area with elevated PCB and mercury contamination. The site investigation mapped contaminant distributions around and under the Pier 7 site and identified a pocket of sediments with elevated contamination levels adjacent to the southwestern end of Pier 7 that were subsequently sampled to obtain bulk material for the laboratory treatability study. The study showed that unamended and amended Pier 7 sediments were not toxic to amphipods (*Eohaustorius estuarius*) and that total PCB bioaccumulation in polychaete worms (*Neanthes*

arenaceodentata) were significantly reduced by the amendment (Kirtay et al. 2012). Based on these results, a field demonstration for Pier 7 and pre- and post-monitoring were scheduled for August to September 2012. The contaminated area will be amended with powdered activated carbon using the AquaGate+PAC™ composite aggregate system to decrease the bioavailability of PCBs in contaminated sediment. Because the powdered activated carbon and the clay mineral associated with the aggregate may also sorb mercury and methylmercury complexes, thereby reducing mercury bioavailability, a subset of the data collected to meet biological and chemical performance objectives for this project will also include mercury-related endpoints.

The pre- and post-implementation monitoring study will consist of 14-day in situ bioassays conducted with the bent-nosed clam (*Macoma nasuta*), polychaete worm (*Nereis virens*), and amphipod (*E. estuarius*), and chemical characterization using the sediment ecotoxicity assessment (SEA) Ring protocol (Rosen et al. 2011). Physical and biological conditions will be documented with the sediment profile imaging camera (Germano & Associates 2012) and traditional benthic infauna sampling. The monitoring will establish preplacement conditions, verify that the placement meets minimum specifications, and evaluate amendment performance after 6, 18, and 30 months of placement.

Ongoing ENVVEST studies include stormwater monitoring of representative stormwater outfalls in the shipyard (TEC and PNNL 2012) and ambient monitoring of the receiving waters of the inlets (Johnston et al. 2010). The purpose of this work is to assess the impact of contaminants discharged into Sinclair and Dyes Inlets, characterize the status and trend of ecological resources, assess the effectiveness of cleanup and pollution control measures, and determine if discharges from all sources are protective of beneficial uses, including aquatic life in the receiving waters of Sinclair and Dyes Inlets (Johnston et al. 2011).

4.5 OU C

4.5.1 Cleanup Action Plan for OU C

In September 2006, the Navy submitted a CAP for OU C to Ecology for review and approval (U.S. Navy 2007i). The CAP described a selected remedy of No Action with monitoring and ICs for OU C and outlined the criteria for reassessment and modification of the selected remedy based on the monitoring results. The CAP was approved by Ecology in December 2007 (Ecology 2007). ICs required by the CAP are the following:

- Prohibit activities at OU C that interfere with monitoring activities.

- Prohibit activities at OU C that may result in the release of petroleum hydrocarbon contamination, which is contained on site as part of the cleanup action.

- Notify Ecology of the Navy's intent to convey any interest in the site.

- Notify Ecology of any proposal to use the site in a manner inconsistent with the land use restrictions.

These ICs have been incorporated into the site-wide IC work plan (U.S. Navy 2009d).

4.5.2 OU C Operation, Maintenance, and Monitoring

The Navy has conducted monitoring at OU C since the 1990s (prior to execution of the CAP). In January 2001, the Navy implemented a 5-year groundwater monitoring program at OU C to monitor and further evaluate the dissolved- and free-phase petroleum hydrocarbon plumes, as well as to prevent migration of contaminants from OU C to Sinclair Inlet. The 5-year groundwater monitoring program consisted of (1) collecting quarterly product thickness measurements in accessible groundwater monitoring wells throughout OU C, and (2) conducting quarterly groundwater sampling and analysis at five identified sentinel wells located downgradient of the free- and dissolved-phase contaminant plume at OU C (U.S. Navy 2007i). The Navy continued quarterly sampling for TPH parameters at the five identified sentinel wells and measured free-product thickness throughout the OU C LTM program at accessible groundwater monitoring wells until 2006.

The sentinel wells are used to detect whether petroleum hydrocarbon contamination is migrating from OU C towards Sinclair Inlet. The trigger level for diesel-range petroleum hydrocarbons is 0.5 mg/L. Detection in a sentinel well above the trigger level is to be followed by four quarters of monitoring to confirm the result (U.S. Navy 2007i).

Monitoring at OU C is now integrated into the site-wide LTM program. During this 5-year review period monitoring consisted of the following:

- Collection of annual groundwater samples from five sentinel monitoring wells (with a sixth alternate well), with analysis for diesel-range petroleum hydrocarbons

- Temporary collection of quarterly groundwater samples from two monitoring wells (GWMT-9 and GWMT-22), as a result of a trigger level exceedance

- Gauging of free-product thickness in six monitoring wells on a semiannual basis for the entire 5-year review period

Monitoring data for OU C are included in the LTM data summary reports.

4.6 OU D

4.6.1 OU D Remedial Action Objectives

The following RAOs were established in the ROD for OU D:

- Reduce the potential for chemical transport to the adjacent marine environment from the following:
  - Accumulation of sediment or debris in the stormwater system
  - Infiltration of soil and groundwater into the stormwater system
  - Infiltration of surface water into the soil
- Continue to limit exposure to site soils and groundwater.

4.6.2 OU D Remedy Selection

To achieve the RAOs, the remedial action components specified in the OU D ROD included the following:

- Site-wide capping, either with asphaltic concrete pavement, or a vegetative cap
- Stormwater system contaminated sediment removal, including cleaning and inspecting storm drain lines and catch basins, repairing or replacing damaged portions of the system, and disposal of removed debris and sediment
- Implementing ICs
- Conducting long-term groundwater monitoring

4.6.3 OU D Remedy Implementation

Site-Wide Capping

Prior to beginning cap construction, numerous existing utilities and other site features were addressed either by removal, abandonment, or modification. These features included concrete

foundations, asphalt pavement, a railroad spur line, sanitary sewer/storm drain systems, power/communication manholes, irrigation lines, compressed air lines, asbestos insulated steam lines, and light poles and fixtures. One monitoring well (OU B-MW-13) was decommissioned by a licensed well driller (U.S. Navy 2007h).

Where required, the perimeter of the area receiving a vegetative cap was excavated to accommodate the transition in grade between the cap and the surrounding area and allow placement of the required cap materials. A low-permeability cap layer was then placed as planned. The cap was tested to ensure a vertical permeability of 10^{-4} centimeters per second or less. Hydroseed or grass sod was then placed on 6 inches of top soil over most of the low-permeability cap (U.S. Navy 2007h).

With EPA approval, topsoil placement and vegetation were deferred in one OU D area, where the City of Bremerton still planned extensive construction activities. The City of Bremerton was responsible for completing the cap in this area. The slope along the westerly edge of the vegetative cap was covered with an impermeable polyethylene membrane and a layer of crushed rock (U.S. Navy 2007h).

The area planned for asphalt paving was prepared with minor excavation, grading, capping with 3 inches of crushed surfacing top course, and compacting. Asphalt was then placed as planned (U.S. Navy 2007h).

These actions meet the RAO of reducing the potential for chemical transport from infiltration of surface water into soil.

Stormwater System Contaminated Sediment Removal

Stormwater system components in the vicinity of OU D were cleaned, repaired, or removed as part of the stormwater system work at OU B Terrestrial (U.S. Navy 2006c) and during the reconfiguration of the eastern property boundary during OU D cap installation (U.S. Navy 2007h). At the conclusion of this work, no Navy storm drain component remained within the boundaries of OU D.

Institutional Controls

The IC objectives for OU D are as follows:

- For the property that is transferred to the City of Bremerton or made available for use, ensure property use is restricted to recreation, and prohibit the development and use of the property for residential housing, schools, or any land use other than recreational.

- Ensure the integrity of the pavement and vegetative cover.
- Ensure groundwater is not withdrawn except for monitoring purposes.

As described in Section 4.7, a BNC-wide IC work plan (U.S. Navy 2006b) was prepared to describe procedures for implementing the IC RAOs for OUs A, B Marine, B Terrestrial, D, and NSC at BNC. The IC work plan was subsequently updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). Inspection and maintenance of the ICs are detailed in the BNC-wide O&M plan (U.S. Navy 2006a).

The ICs meet the RAO "continue to limit human exposure to site soils and groundwater." The ICs are applicable throughout the OU D site and, because contaminated soil and groundwater are being left on site, must be maintained until contaminant levels allow for unlimited use and unrestricted exposure.

Parcels A, B, C, and D comprising OU D were transferred to the City between February 2006 and May 2007 (U.S. Navy 2010d). Land use restrictions were included in the property transfer deed to prohibit development inconsistent with recreational use and to prohibit the use of groundwater. The deed also included specific requirements for construction activities at the site to protect the installed vegetative cap. A discussion of the status and effectiveness of these land use controls is included in Section 6.5.

Groundwater Monitoring

The objective of monitoring the groundwater is to verify that the remedy is effective in minimizing the migration of chemicals into Sinclair Inlet via the groundwater pathway through monitoring. There is no current or expected future beneficial use of groundwater at OU D (U.S. Navy, Ecology, and USEPA 2005).

Groundwater monitoring is being conducted in conjunction with the groundwater monitoring for OU B Terrestrial. One monitoring well (point of compliance well LTMP-5, installed as part of the OU B monitoring) was installed in 2004 and is being used to monitor groundwater from below OU D. This well serves as the conditional point of compliance for groundwater. This monitoring well is sampled to measure concentrations of chemicals in groundwater near the point of discharge to the marine environment. Sampling of well 903, installed in June 2011, was initiated during the fall 2011 LTM event. Groundwater data generated from this well will be used to evaluate remedy protectiveness in OU D. Figure 4-1 shows the location of this well.

The Navy, EPA, and Ecology selected constituents for groundwater monitoring based on a review of the COIs identified for soil at OU D (U.S. Navy, Ecology, and USEPA 2005). The chemicals monitored in groundwater are generally a subset of those monitored for OU B

Terrestrial and currently consist of 4,4′-DDT, 4,4′-DDE, aldrin, dieldrin, endrin, cadmium, and mercury. Groundwater samples collected from well 903 during the fall 2011 LTM event were analyzed for dissolved metals and pesticides (U.S. Navy 2012c).

Because OU D monitoring is conducted concurrently with OU B Terrestrial, long-term groundwater monitoring was initiated in August 2004.

Groundwater monitoring will meet the RAO "reduce the potential for chemical transport to the adjacent marine environment" by providing information to verify predictions that site groundwater is protective of the marine environment.

4.6.4 OU D Operation, Maintenance, and Monitoring

As part of the OU D property transfer agreement between the Navy and the City, the City was to bear the responsibility for ICs and maintaining the remedy at the site. The deed restrictions were to ensure that the ICs were transferred with the property. Groundwater monitoring at OU D was to be maintained by the Navy in conjunction with the monitoring requirements of OU B Terrestrial (U.S. Navy 2010d). Groundwater monitoring associated with OU D is being performed in accordance with the current LTM plan (U.S. Navy 2011f) (see Section 4.3.4).

4.7 INSTITUTIONAL CONTROLS IMPLEMENTATION

The Navy prepared an IC work plan (U.S. Navy 2006b) to describe procedures for implementing the IC RAOs for OUs A, B Marine, B Terrestrial, D, and NSC at the BNC. The IC work plan was also updated in 2008 and 2009 (U.S. Navy 2008b and 2009d). The objective of the ICs is to protect human health, the environment, and the integrity of an engineering remedy by limiting the activities that may occur at a particular contaminated site. These ICs also ensure that property uses remain compatible with cleanup decisions. The ICs at the BNC consist of various combinations of actions relating to access, land use, groundwater use restrictions, and administrative requirements to meet the RAO of limiting human exposure to site soils and groundwater. Site-wide excavation controls include a dig permit process that triggers environmental review of excavations at the facility, when warranted. The ICs for BNC are detailed in the documents listed in Table 4-4 (U.S. Navy 2009d).

The objectives of the ICs implemented at BNC are the following:

- Ensure that access to the BNC is controlled.
- Ensure that the sole use of groundwater is for monitoring purposes.

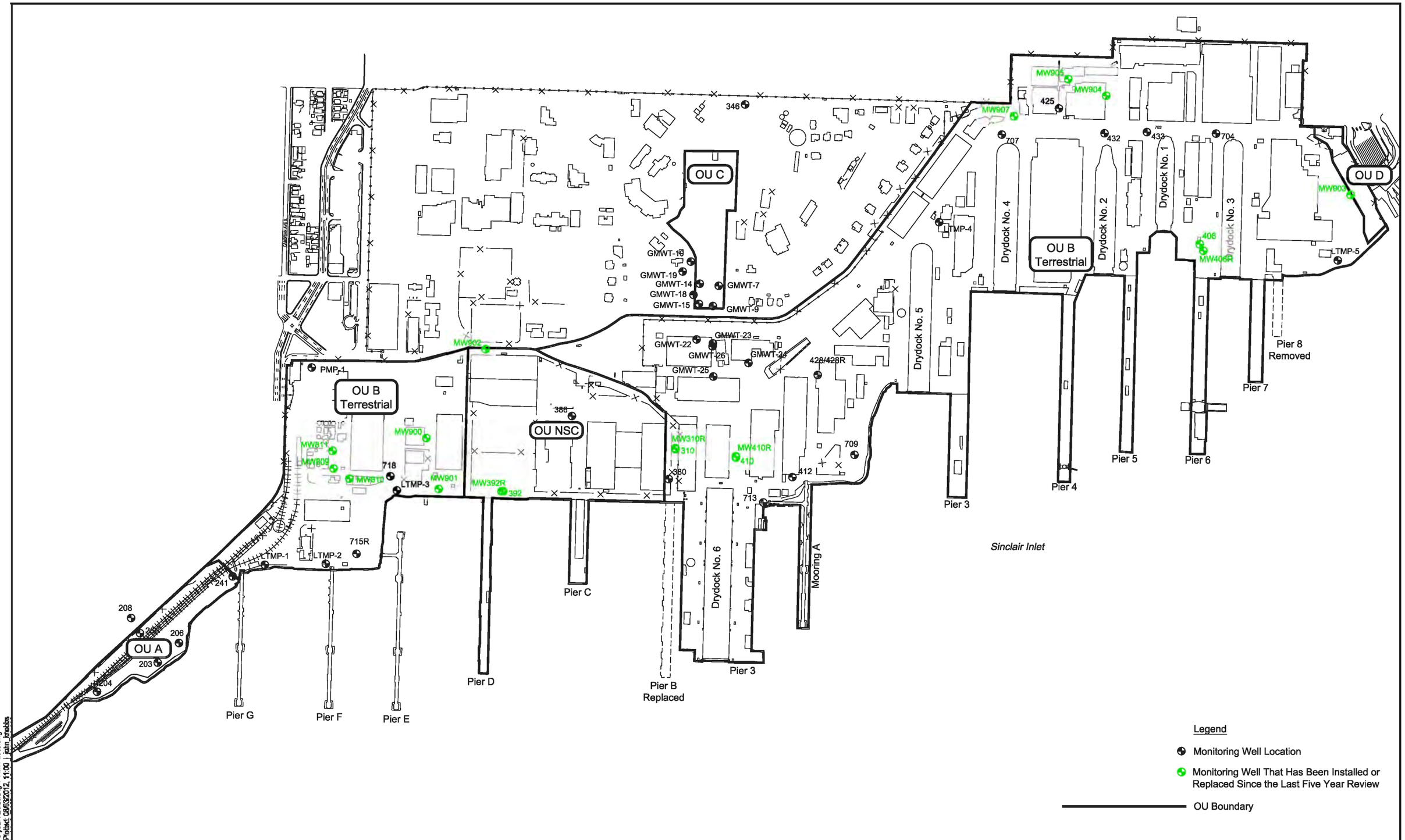
- Ensure that excavations are managed appropriately given the contaminants left in place.
- Ensure that the established industrial use of the site is maintained.

The Navy is responsible for implementing, monitoring, reporting on, and enforcing the ICs. Land use restrictions will be documented and appropriate deed restrictions developed in the event of a future transfer of portions of the property.

Inspection and maintenance of the ICs as detailed in the O&M plan (U.S. Navy 2009c) ensures that the RAO of limiting human exposure to site soils and groundwater is maintained. The ICs will be maintained until contaminant levels allow for unlimited use and unrestricted exposure. Observations are documented on checklists and via photographs, as necessary (U.S. Navy 2009d).

The Navy maintains a central database of properties restricted by ICs in order to manage their responsibilities. The database includes relevant information on the property, types of ICs established, any land use monitoring and management responsibilities, and the location of real estate records. The IC database will be incorporated into the BNC Base Comprehensive Plan to allow for routine considerations for ICs in making land use and planning decisions. The ICs will also be filed with BNC Public Works (i.e., offices responsible for managing the building and grounds, utility systems, and construction) (U.S. Navy 2009d).

In February 2006, the Navy Installation Restoration (IR) Coordinator reviewed the IC work plan with the BNC security supervisors. The Navy IR Coordinator conducted environmental restoration briefs with security personnel during their Phase II training sessions between February and June 2006. These briefs familiarized personnel with the environmental restoration program, the nature of ICs, why ICs are necessary, and how ICs are to be conducted.



U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

Figure 4-1
Locations of Monitoring Wells

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Table 4-1
Long-Term Monitoring History for Operable Unit A

Chemical[a,b,c]	Sampling Events															Comments
	Fall 2002	Spring 2003	Fall 2003	Spring 2004	Fall 2004	Spring 2005	Fall 2005	Spring 2006	Fall 2006	Winter 2007	Summer 2007	Summer 2008	Summer 2009	Summer 2010	Summer 2011	
Well Location 203																
Petroleum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Not selected in PMP.
SVOCs	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	Dropped from analyte list after spring 2003 in accordance with first 5-year review and 2002/2003 annual monitoring report recommendation to not sample (U.S. Navy 2003b)
Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Well Location 204																
Petroleum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Not selected in PMP
SVOCs	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	Dropped from analyte list after spring 2003 in accordance with first 5-year review and 2002/2003 annual monitoring report recommendation to not sample (U.S. Navy 2003b)
Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	
Well Location 206																
Petroleum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Not selected in PMP
SVOCs	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	Dropped from analyte list after spring 2003 in accordance with first 5-year review and 2002/2003 annual monitoring report recommendation to not sample (U.S. Navy 2003b)
Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Well Location 208																
Petroleum	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	Originally petroleum only; dropped per amended PMP (U.S. Navy 2003a)
SVOCs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Metals	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Well Location 241																
Petroleum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Not selected in PMP
SVOCs	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	Dropped from analyte list after spring 2003 in accordance with first 5-year review and 2002/2003 annual monitoring report recommendation to not sample (U.S. Navy 2003b)
Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	X	✓	X	
Well Location 266																
Petroleum	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	Added based on PMP only; dropped because of no detections
SVOCs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Metals	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Well Location 346																
Petroleum[d]	✓	✓	✓	✓	X	X	✓	✓	✓	✓	✓	X	✓	✓	X	
SVOCs	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	Dropped from analyte list after spring 2003 in accordance with first 5-year review and 2002/2003 annual monitoring report recommendation to not sample (U.S. Navy 2003b)
Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	

Table 4-1 (Continued)
Long-Term Monitoring History for Operable Unit A

[a]Chemicals of concern listed in the OU A Record of Decision or required by the petroleum management plan include:

- Petroleum: Petroleum analytes varied by location and sampling event and included some combination of diesel-range, gasoline-range, residual-range organics and benzene, toluene, ethylbenzene, and xylenes (BTEX)
- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and bis(2-ethylhexyl)phthalate
- PCBs: Aroclor 1260
- Pesticides: aldrin, dieldrin, endrin, alpha-chlordane, 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT
- Metals: arsenic, copper, lead, nickel, and zinc

[b]In accordance with the recommendations of the first 5-year review, PCBs and pesticides in groundwater were not analyzed for during this 5-year review period.
[c]One seep sampling station, 224, was established in the original long-term monitoring plan (U.S. Navy 2000b) to be sampled if seeps were found. No seep was found, and this station was dropped from subsequent plans (U.S. Navy 2002a).
[d]Total petroleum hydrocarbons for location 346 represents diesel-range organics only.

Notes:
PCBs - polychlorinated biphenyls
PMP - petroleum management plan
SVOCs - semivolatile organic compounds
✓ - analyte included in monitoring round
X - analyte not included in monitoring round

Table 4-2
Summary of Current Groundwater Monitoring Program for Operable Unit NSC

Well Identification	Laboratory Analysis				
	Total Arsenic	Total Copper	Total Lead	Total Nickel	NWTPH-Dx
310/310R[a]	✓	✓	✓	✓	✓
380	✓	✓	X	✓	X
386	✓	✓	X	X	X
392/392R[b]	✓	✓	X	X	✓

[a]Monitoring well 310 was replaced with 310R in October 2007.
[b]Monitoring well 392 was replaced with 392R in August 2008.

Notes:
NWTPH-Dx – Ecology Northwest total petroleum hydrocarbons – diesel extended
✓ - analyte included in current monitoring program
X - analyte not included in current monitoring program

Table 4-3
Summary of Current Groundwater Monitoring Program for Operable Unit B Terrestrial

Well Identification	Laboratory Analysis[a]		
	TCE	Pesticides[b]	Dissolved Metals[c]
410/410R[d]	X	✓	✓
432	✓	✓	✓
433	X	✓	✓
704	X	✓	X
707	✓	✓	✓
LTMP-1	X	✓	✓
LTMP-2	X	✓	✓
LTMP-3	X	✓	✓
LTMP-4	X	✓	✓
LTMP-5	X	✓	✓

[a]The original long-term monitoring plan required that if free petroleum product was discovered in any monitoring well, an analysis for PCBs would be performed. If no PCB was detected, this monitoring element was to be suspended. One 2004 sample was found to contain free product. PCBs were not detected, and hence no further PCB analysis is planned.
[b]Includes 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, and heptachlor epoxide
[c]Includes arsenic, copper, lead, nickel, zinc, and total mercury
[d]Monitoring well 410 was replaced with 410R in October 2007.

Notes:
PCBs - polychlorinated biphenyls
TCE - trichloroethene
✓ - analyte included in current monitoring program
X - analyte not included in current monitoring program

Table 4-4
BNC Institutional Controls

Institutional Control Source Document	Institutional Controls			
	Access Control	Groundwater Restriction	Excavation Management	Land Use Restrictions
Institutional Control Work Plan (U.S. Navy 2009d)	X	X	X	X
Naval Base Kitsap Shipyard Anti-Terrorism/Force Protection Plan – NAVBASEKITSAPINST 5530.6 CH-5 (U.S. Navy 2008i)	X			
Puget Sound Naval Shipyard Physical Security Plan – NAVSHIPYDPUGETINST 5530.1 (U.S. Navy 2001)	X			
Memorandum of Agreement for Excavation Management at Naval Base Kitsap at Bremerton (U.S. Navy 2007g)		X	X	
Land Use Controls at PSNS & IMF Bremerton Site and Naval Base Kitsap - NAVBASEKITSAPINST 5090.14 and PSNS&INST P5090.50 (U.S. Navy 2007f)	X	X		X

5.0 PROGRESS SINCE LAST FIVE-YEAR REVIEW

Since the second 5-year review in October 2006, the Navy has completed or made significant progress on all of the actions recommended by that review. The recommended actions and notes regarding their completion are summarized in Table 5-1. For some previous recommendations, such as items 1 and 2 in Table 5-1, the Navy improved the existing processes, but additional improvements are recommended. New recommendations related to these same issues are therefore presented in Section 8. Other issues, such as items 7 and 16 through 20, have required ongoing efforts throughout this 5-year review period, which will continue. Those items are carried forward in this 5-year review recommendations and follow-up actions.

Table 5-1
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
General				
1	Develop and implement a BNC-wide program for identifying, prioritizing, and executing general paving and storm drain maintenance work determined to potentially impact the OU B Terrestrial remedy and for tracking deferred maintenance that the Navy has not yet funded.	May 2008	New sections were added to the O&M plan dated May 14, 2008, to address a BNC-wide program for better identifying, prioritizing, and executing general paving and storm drain maintenance work. The Navy continues to work through funding issues associated with executing maintenance.	U.S. Navy 2008a
2	Improve the paving inspection documentation process to simplify tracking areas to be repaired and accurately identify repair locations.	May 2008	New sections were added to the O&M plan dated May 14, 2008, to address a better process for tracking areas to be repaired and accurately identify repair locations.	U.S. Navy 2008a
3	Identify new point-of-compliance wells, or an alternative groundwater sampling strategy, to address the loss of LTM wells 310 at OU NSC and 410 at OU B Terrestrial.	August 2007	Monitoring wells 310 and 410 were replaced by wells 310R and 410R, respectively, in the 2007 LTM plan dated August 31, 2007. In addition, well 406R has been installed to replace 406 because well 406 was fouled with product.	U.S. Navy 2007b
4	Implement the processes and recommendations of the 2006 data quality objectives report for LTM at OU B Terrestrial and reduce the sampling frequency for OU A and OU NSC.	August 2007	Changes, as agreed to by the Project Team, were incorporated into the final, Revision 3, LTM plan dated August 31, 2007.	U.S. Navy 2007b

Table 5-1 (Continued)
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
5	Improve BNC Security Office inspection procedures to assure compliance with ICs.	October 2007	This action is complete. PSNS&IMF INSTRUCTION 5090.50 dated October 29, 2007, addresses this issue. The Navy Technical Representative will collect security information for inclusion in the annual inspection reports.	U.S. Navy 2007f
6	Select one excavation project annually to be inspected during construction, in compliance with the IC work plan.	October 2007	Requirement has been incorporated into LTM contract and is reported in annual inspection reports (beginning with the 2007 annual inspection report dated October 31, 2007).	U.S Navy 2007a
OU A				
7	Perform an engineering evaluation of erosion occurring at the OU A shoreline and implement remedy repairs based on the evaluation.	Ongoing	An interim remedy repair was completed in October 2008. A wind and wave study was initiated in May 2008, with the final report completed January 2010. Based on the results of this study, the overall goal of the design has narrowed to restoring remedy protectiveness. The 90 percent design is scheduled to be completed in September 2012, with the understanding that data gaps remain to be addressed prior to implementation of the preferred alternative, currently projected to begin in 2015. The Navy will arrange for collection and analysis of intertidal sediment samples from Charleston Beach prior to 2015 as part of ongoing OU B Marine monitoring. It has been agreed that the results of this intertidal sediment sampling may suggest the need for upland soil sampling at Charleston Beach or changes in the design.	U.S. Navy 2008d, 2010j, and 2010k
OU NSC				
8	Reinstate analysis of groundwater samples from well 392 at OU NSC for dissolved petroleum compounds.	August 2007	The analysis for dissolved petroleum compounds was reinstated in the 2007 LTM plan dated August 31, 2007.	U.S. Navy 2007b

Table 5-1 (Continued)
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
OU B Terrestrial				
9	Reassess the COC trends for LTMP-1 (OU B Terrestrial) in advance of the next 5-year review.	April 2009	Trend analysis for well LTMP-1 was performed and documented in the final LTM 2007/2008 trend analysis report dated April 2, 2009.	U.S. Navy 2009h
10	Revisit RI/FS groundwater-to-surface water transport evaluations in light of mercury concentrations in wells LTMP-3 and LTMP-5.	Ongoing	A report was published in 2010 on the U.S. Geological Survey's findings from a review of historical data on mercury in sediment, water, and biota of Sinclair Inlet. Results of ongoing studies of mercury sources and methylation and bioaccumulation of mercury are anticipated in 2012.	Paulson, Keys, and Scholting 2010
11	Perform a screening-level (nonquantitative) evaluation of the vapor inhalation pathway for OU B Terrestrial.	March 2012	A final Phase I vapor intrusion evaluation, conceptual site model, report was completed February 13, 2009. The Phase II vapor intrusion study, vapor intrusion pathway quantitative assessment report was completed October 2009. Investigations for sites identified with potential vapor intrusion concerns are complete. Final document was submitted March 13, 2012.	U.S. Navy 2009a, 2009b, and 2012b
12	Resolve changes to be made in groundwater analyte lists and monitoring frequency in the process of updating the monitoring plan for fiscal year 2008.	July 2008	Changes were incorporated into the 2008 LTM plan dated July 31, 2008. Similar evaluations have been built into future LTM contracts.	U.S. Navy 2008e
OU B Marine				
13	Continue with implementation of the decision framework for OU B Marine to better assess progress toward long-term cleanup goals and evaluate potential future Navy actions.	July 2008	Formal dispute delayed completion of this item. The trend analysis indicates that the cleanup goal is expected to be achieved in 2012, and no additional Navy action is necessary at this time, based on the 2007 decision tree framework.	U.S. Navy 2009g and 2012d

Table 5-1 (Continued)
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
14	Perform trend analyses and assess functionality and protectiveness of remedy for OU B Marine once 2007 data are available.	July 2008	Formal Dispute delayed completion of this item. The 2007 data were made available in April 2008, and the trend analysis was completed and presented to agencies in July 2008. The trend analysis indicates the cleanup goal is expected to be achieved in 2012, and the 2010 monitoring results suggest that the remedy continues to be protective. However, other recent findings (e.g., evidence of release of materials from OU A and the western portion of OU B Terrestrial) bring the protectiveness of the OU B Marine remedy into question.	U.S. Navy 2009g and 2012d
15	Collect additional information necessary to perform a risk evaluation and reach conclusions regarding the protectiveness of the remedy with respect to mercury concentrations in Sinclair Inlet sediment and fish tissue.	August 2010	The scope of the human health risk assessment has been expanded to include a "market basket" approach, consistent with the EPA Framework document. A final technical memorandum was completed with the agencies in August 2010 that addresses the incremental human health risk associated with mercury at the site. Additional risk management actions are being developed.	U.S. Navy 2010i
OU D				
16	The Navy will follow up on a prior request to the City of Bremerton for detailed documentation to allow the long-term protectiveness of conditions at OU D to be evaluated.	Ongoing	A letter was sent to the City on March 23, 2007, that forwarded the draft 5-year review and reiterated the Navy concerns. In January 2009, the Navy was provided design drawings for the park from the City of Bremerton's public works department. A draft remedy evaluation report was completed April 2010. The Navy continues to pursue negotiations with the City on an MOA. Discussion of site conditions and potential impact mitigation is expected to follow completion of the MOA.	U.S. Navy 2010d

Table 5-1 (Continued)
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
17	Explore possible approaches such as a Memorandum of Agreement between the Navy and the City of Bremerton for designating responsibility for compliance with ICs, including routine annual monitoring.	Ongoing	The Navy has had internal discussions and plans to meet with the City after they have a chance to review and comment on draft documents. A Navy commander conducted a meeting with the Mayor of the City of Bremerton in March, 2011. The Navy provided the City with a draft MOA and Inspection Checklist in May 2011. The Navy continues to pursue negotiations with the City on an MOA.	U.S. Navy 2010d
18	Develop new ways to formulate ICs that help ensure third party compliance.	Ongoing	The Navy has had internal discussions and continues to pursue negotiations with the City. The Navy has held internal discussions to identify IC and land use control improvements. Updates to the IC plan and O&M documents will reflect these discussions.	U.S. Navy 2010d
OU B Marine Recommendations From Addendum Dated September 13, 2011				
19a	Collect additional data to reflect current conditions in Sinclair Inlet and reduce uncertainties associated with the data that was used for the Technical Memorandum. This will ensure that Navy has sufficient and accurate data (1) to evaluate site risks, (2) to determine whether we need to do additional work to reduce mercury risk, and (3) to accurately measure, during after-action monitoring, whether progress\ improvements have been made from the baseline in reducing mercury risk.	Ongoing	The Navy is working with stakeholders to define tissue sampling needed to support on-going work on an FFS. The outcome will be used to guide development of sampling plans and conduct sampling.	

Table 5-1 (Continued)
Summary of Progress Since Last 5-Year Review

Item No.	Recommendation/ Follow-Up Action	Completion Date	Notes Regarding Completion	Reference
19b	If data support, perform a focused feasibility study to document and collate all studies related to mercury in sediments and identify and evaluate potential approaches for reducing human health risks from mercury in Sinclair Inlet.	Ongoing	FFS has been initiated. Current emphasis is on defining scope of upcoming tissue sampling.	
20	If data support, develop a Record of Decision amendment or Explanation of Significant Differences to address mercury as a contaminant of concern, select cleanup levels, and select the preferred alternative of the focused feasibility study.	Ongoing	FFS is in progress.	

Notes:
BNC - Bremerton naval complex
COC - chemical of concern
EPA - U.S. Environmental Protection Agency
FFS - focused feasibility study
IC - institutional control
LTM - long-term monitoring
MOA - Memorandum of Agreement
NSC - Naval Supply Center
O&M - operation and maintenance
OU - operable unit

6.0 FIVE-YEAR REVIEW PROCESS

6.1 FIVE-YEAR REVIEW TEAM

The Navy is the lead agency for this 5-year review. Project managers and other staff from the EPA, Ecology, and other stakeholder groups have also participated in the review process. Both the EPA and Ecology are cosignatories of the RODs for BNC. All team members had the opportunity to provide input to this report.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

There are specific requirements pursuant to CERCLA Section 117(a), as amended, for certain reports to be released to the public and for the public to be notified of proposed cleanup plans and remedial actions. The Navy's community notification and involvement activities related to the BNC are consistent with CERCLA and are described in the sections that follow.

6.2.1 History of Community Involvement

The Navy originally published a community relations/public participation plan in 1992 and has updated that plan periodically. The plan was most recently updated July 2008 (U.S. Navy 2008h). The revised plan's goals are as follows:

- To encourage communication between the Navy and local community
- To encourage public participation in decision making
- To focus on issues of interest to the community during the restoration and LTM process
- To be open to change based on community involvement needs

In 1994, the Navy undertook a transition from the regulatory-agency-based Technical Review Committee to a more community-based Restoration Advisory Board (RAB). To ensure that the community had sufficient opportunity to participate in the process, 26,000 brochures were mailed to the surrounding community. The address list included all residences and businesses within 1 mile of the complex, as well as elected officials, religious groups, environmental activists, medical professionals, news media, and ethnic groups. In addition, a series of open houses was held to disseminate information on cleanup and allow the community to ask questions about the RAB. About 20 individuals expressed interest in being on the RAB. By

spring 1995, a community co-chair had been selected by the community members of the RAB, bylaws had been written, and the RAB was meeting on a regular basis.

Since the inception of the RAB, general attendance at the meetings has gradually declined. Usually about 12 to 15 people attend the meetings, with about 10 of the people representing the Navy or regulatory community. Meetings are held on an as-needed basis, the general pattern being reduced meeting frequency as the level of investigatory work and remedial activity declines. The most recent RAB meeting was held in August 2008. That meeting included a presentation of the results of the second 5-year review.

Significant documents such as RI/FS reports, Proposed Plans, RODs, and prior 5-year review reports have been made available for public review at three branches of the Kitsap County Regional Library.

6.2.2 Community Involvement During the Five-Year Review

The Navy published a public notice of the 5-year review process in October 2011 in the *Kitsap Sun*, *Northwest Navigator*, and *North Kitsap Herald*. The public notice outlined the 5-year review process and provided an opportunity for the public to submit comments or concerns. No comment was received. Members of the public thought likely to participate were sent interview forms; however, no member of the public chose to participate in the interview process.

During the kickoff meeting for this third 5-year review, EPA expressed the opinion that the Navy's methods for community involvement were outdated. EPA believes that the Navy should use electronic communications, such as websites and social media, to engage the public.

Copies of the final 5-year review report will be placed in the local site repositories at the Kitsap County Regional Libraries. A second public notice will be published to announce the availability of the final report.

6.3 DOCUMENT REVIEW

Documents reviewed during this 5-year review were primarily those that established the remedies and those describing the monitoring of the selected remedies during the time period October 2006 through October 2011. Earlier documents were reviewed as needed to establish a complete summary of the site history. The primary documents that were reviewed are listed as follows:

- The signed RODs (U.S. Navy, Ecology, and USEPA 1996, 1997, 2000, 2004a, and 2005) and the ESD for OU B Marine (U.S. Navy, Ecology, and USEPA 2004b)

- The first and second 5-year review reports (U.S. Navy 2002e and 2007d) and the addendum to the second 5-year review report (U.S. Navy 2011j)

- The current plans for LTM (U.S. Navy 2005c and 2011f) and the previous LTM plans (U.S. Navy 2006c, 2007b, 2008e, 2009f, and 2010b)

- The most recent monitoring reports (U.S. Navy 2011d, 2011j, 2011k, and 2012d)

- O&M plans, IC work plans, PMP, and addenda (U.S. Navy 2002b, 2003a, 2006a, 2006b, 2008a, 2008b, 2009c, and 2009d)

- Interim repair action and beach replenishment reports for OU A Charleston Beach (U.S. Navy 2008d and 2011a)

- Plans and reports related to vapor intrusion studies (U.S. Navy 2009a, 2009b, 2010h, and 2012b)

- Plans and reports related to sediment sampling performed in OU B Marine as part of repairs to or replacement of piers and construction of quay walls and drydock entrances (U.S. Navy 2008f, 2010e, 2010f, 2010g, 2011g, 2011h, and 2012a)

- Soil and groundwater sampling report for Child Development Center (U.S. Navy 2011c)

- OU B Marine Technical Memorandum *Human Health Risk Evaluation of Mercury in Sinclair Inlet Seafood* (U.S. Navy 2010i)

6.4 DATA REVIEW

This section summarizes trends in chemical data collected through the various monitoring programs at BNC from October 2006 through December 2011. The monitoring programs are described in Section 4, and the implications of the data regarding the functionality and protectiveness of the remedies are discussed in Section 7. Site inspection data are discussed separately in Section 6.5.

For OUs A, B Terrestrial, NSC, and D, groundwater monitoring is included in the current comprehensive long-term groundwater monitoring program for BNC. Data generated by this program are reported in data summary reports produced following each sampling event and in annual trend analysis reports.

A statistical trend analysis has been performed for the detected COCs still being monitored for the period covering fall 2006 through fall 2010. The trend analysis uses the nonparametric Mann-Kendall test and an assessment of the coefficient of variation. The Mann-Kendall statistical test is used to determine whether an increasing or decreasing trend over time exists in a data set. The coefficient of variation assessment examines the stability of the measured values over time for wells that do not exhibit an increasing or decreasing trend. If no trend exists at the 80 percent confidence interval and the coefficient of variation is less than or equal to 1, the concentrations are stable. However, if the coefficient of variation is greater than 1, the concentrations are not stable, but rather highly variable over time.

The long-term and recent data trends are discussed in the sections that follow. A statistical trend analysis has not yet been performed for data collected in 2011. However, the 2011 data are included in the discussion below.

6.4.1 OU A Groundwater Monitoring Data

The ROD-specified goals for groundwater at OU A are based on the most stringent federal and state surface water quality criteria. These include ambient water quality criteria for human health based on fish and shellfish ingestion and on the protection of biota. The ROD specifies that these criteria will be adjusted by consideration of practical quantitation limits (PQLs) and ambient groundwater concentrations (U.S. Navy, Ecology, and USEPA 1997). Table 6-1 provides ROD-specified groundwater cleanup levels for established COCs at OU A. Table 6-1 also includes ambient values established for inorganic elements based on statistical analysis of upgradient wells. The ambient values provided for inorganic elements in Table 6-1 are based on ambient background levels for total inorganics in groundwater (BNC-only), as presented in Appendix T of the final RI report for OU B dated March 2002 (U.S. Navy 2002c).

Figure 6-1 shows the locations of the monitoring wells used for LTM for OU A. The August 2002 through October 2011 data for OU A are presented in Table 6-1. The results of the trend analysis for OU A (U.S. Navy 2010c and 2011d) showed that, for most detected COCs, the concentration trend over the last 5 years has been stable or decreasing. However, some COC concentrations at some monitoring wells remain consistently above the remediation goals (RGs). The data collected in 2011 are consistent with the trends observed in the data collected through 2010, because the 2011 COC concentrations are within the range of concentrations historically detected in the OU A wells. Current and long-term trends in COC data for the metals still being monitored at OU A are discussed in the sections below by COC.

Total Arsenic

Arsenic concentrations in groundwater have remained consistently below the ambient concentration of 5 µg/L in two of the four monitoring wells at OU A (wells 204 and 206). Arsenic is consistently above the ambient concentration in well 203. Arsenic has not been detected above the ambient concentration in well 241 since August 2006. The trend in recent data was found to be decreasing in wells 204 and 241, but increasing in wells 203 and 206. The most recent concentration at well 203 (where the highest consistent arsenic concentrations are found) is similar to that detected at the time the ROD was executed.

Total Copper

Copper concentrations in groundwater have remained consistently above the remediation goal (RG) of 2.5 µg/L at two of the four OU A monitoring wells (204 and 241). During this 5-year review period, the copper concentration exceeded the RG during three of five total sampling events (February 2007 [2.56 µg/L], August 2007 [11.1 µg/L] and October 2009 [4.88 µg/L]) at well 203. The trend in recent concentrations was found to be stable at wells 203, 204, and 206 and decreasing at well 241. Copper analysis was discontinued at well 206 subsequent to the February 2007 monitoring event.

Total Lead

Lead concentrations in groundwater have remained consistently below the RG of 5.8 µg/L at all four OU A monitoring wells. The recent data indicate stable or decreasing trends for lead concentrations at each monitoring well except 204. At well 204, an increasing concentration trend was implied by the data collected August 2002 through February 2007. However, the concentrations were well below the RG. Lead analysis was discontinued in each of the OU A wells subsequent to the February 2007 monitoring event.

Total Nickel

Nickel concentrations in groundwater have been consistently below the RG, except at wells 204 and 241, where the concentrations have been consistently above the RG. The current nickel concentrations in these wells are slightly higher than at the time of the ROD. The recent data imply no discernible trend in nickel concentrations at each of the OU A wells. Nickel analysis was discontinued in well 203 subsequent to the August 2008 monitoring event.

Total Zinc

Zinc concentrations in groundwater have been consistently below the RG at wells 203 and 206 and consistently above the RG at well 204. At well 241, zinc concentrations have been above

the RG since February 2007. The current zinc concentrations in wells 204 and 241 are slightly higher than at the time of the ROD. The recent data imply no discernible trend in zinc concentrations at each of the OU A wells. Zinc analysis was discontinued in wells 203 and 206 subsequent to the August 2008 and February 2007 monitoring events, respectively.

Monitoring Recommendations

Nickel analysis in well 206 is currently on a 5-year schedule. The long-term trend analysis report (U.S. Navy 2011d) recommended dropping this analyte for the 2015/2016 monitoring event. The data review in this 5-year review supports this recommendation.

6.4.2 OU NSC Groundwater Monitoring Data

Groundwater RAOs were developed for OU NSC for those COCs identified by comparing laboratory results to chemical-specific regulations and as a result of a baseline risk assessment (U.S. Navy, Ecology, and USEPA 1996). The regulations addressed in the RI report (U.S. Navy 1995a) include MTCA cleanup levels that focus on water quality standards and human health exposure via direct contact or ingestion of groundwater or marine life. Table 6-2 provides ROD-specified groundwater cleanup levels for established COCs at OU NSC. Table 6-2 also includes ambient values established for inorganic elements based on statistical analysis of upgradient wells. The ambient values provided for inorganic elements in Table 6-2 are based on ambient background levels for total inorganics in groundwater (BNC only), as presented in Appendix T of the final RI report for OU B dated March 2002 (U.S. Navy 2002c).

The monitoring wells used in the OU NSC LTM are shown on Figure 6-2. The August 2002 through October 2011 data for OU NSC are presented in Table 6-2.

Petroleum compounds in groundwater, monitored under the PMP include TPH—gasoline (TPH-G), TPH—diesel (TPH-D), TPH as diesel and heavy oil (TPH-Dx), benzene, toluene, ethylbenzene, and xylenes. The petroleum compound data generated at OU NSC during this 5-year review period are also summarized in Table 6-2. Note that the data reported for well 346 is associated with a background monitoring location, not in OU NSC. For simplicity, the petroleum data summarized in this table are discussed with the larger body of petroleum data presented in Section 6.4.3.

Current concentrations of the COCs copper and nickel are substantially lower than concentrations found at the time of the ROD. Arsenic and lead concentrations have been historically low, even at the time of the ROD. Current and long-term trends in COC data for the metals still being monitored at OU NSC are discussed in the sections below by COC.

Total Arsenic

Overall, arsenic concentrations have been consistently below the ambient level of 5 µg/L. During this 5-year review period, one arsenic result exceeded the ambient level—the August 2007 sample from well 386 (5.06 µg/L). Recent data imply an increasing concentration trend at wells 380 and 386. Decreasing trends were noted at wells 310 and 392 prior to being replaced in October 2007 (310R) and August 2008 (392R), respectively. A decreasing trend was noted at well 392R since installation in August 2008. Only three rounds of groundwater sampling have been conducted at well 310R. Therefore, the Mann-Kendall test was not performed, as a minimum of four rounds of data is necessary for the statistical analysis.

Total Copper

During this 5-year review period, copper concentrations in groundwater were below the RG of 2.5 µg/L in all wells except well 380. A single estimated concentration exceeding the RG was reported in the February 2007 sample from well 380 (3.05 µg/L). Recent data imply an increasing concentration trend in well 386. No discernible concentration trend was noted in wells 380 and 310 (prior to replacement in October 2007). Copper concentrations in well 392 were exhibiting a decreasing trend prior to well replacement in August 2008. Four rounds of copper analysis have not been conducted at replacement wells 310R and 392R. Therefore, the Mann-Kendall test was not performed, as a minimum of four rounds of data is necessary for the statistical analysis.

Total Lead

Lead concentrations in groundwater have been consistently below the RG of 5.8 µg/L since the time the ROD was executed, except for a single sample at well 392 in February 2003 (6.48 µg/L). The recent data imply an increasing concentration trend at well 386 and no discernible trend was noted at wells 310R, 380, and 392R. Lead analysis was discontinued in wells 380 and 386 subsequent to the February 2007 and October 2009 monitoring events, respectively.

Total Nickel

Nickel concentrations in groundwater at OU NSC have been consistently below the RG of 7.9 µg/L in wells 386 and 392/392R. The recent data implied a decreasing concentration trend in wells 386 and 392R, and nickel analysis appears to have been discontinued in these wells in February 2007. During this 5-year review period, nickel concentrations rose above the RG at well 380 from August 2007 through August 2010 (three sampling events, with concentrations ranging from 9.8 µg/L to an estimated 24.8 µg/L). Historical (prior to this 5-year review period) exceedances in the nickel RG at well 380 have also been recorded. Nickel concentrations rose above the RG at well 310 in August 2008 (21.5 µg/L) and October 2009 (10.3 µg/L). The recent

monitoring data imply an increasing concentration trend at well 380. Four rounds of nickel analysis have not been conducted at well 310R. Therefore, the Mann-Kendall test was not performed, as a minimum of four rounds of data is necessary for the statistical analysis. Nickel analysis was discontinued in well 386 subsequent to the February 2007 monitoring event.

Monitoring Recommendations

The long-term trend analysis report (U.S. Navy 2011d) recommended decreasing copper analysis at well 386 to a 2-year schedule. The data review in this 5-year review supports this recommendation.

6.4.3 OU B Terrestrial Groundwater Monitoring Data

The OU B Terrestrial LTM program was initiated in summer 2004. Data from fall 2006 through December 2011 were reviewed for this 5-year review period.

The monitoring wells used in the post-ROD monitoring for OU B Terrestrial are shown on Figure 6-3. Monitoring results are provided in Tables 6-3 through 6-6. Where applicable for certain wells, the tables present values corrected for attenuation using the attenuation estimation method discussed in the following paragraph.

Because of the presence of the drydocks and their associated dewatering systems, evaluation of groundwater monitoring data and data trends is more complex at OU B Terrestrial than for the other terrestrial OUs. The final LTM plan for OU B Terrestrial (U.S. Navy 2004d) established a method for estimating the extent of attenuation between the drydock compliance monitoring wells (410/410R, 432, 433, 704, 707, and LTMP-4) and the groundwater discharge points to Sinclair Inlet. The attenuation is assumed to be the result of natural seawater intrusion and seawater intrusion induced by the drydock dewatering systems. The basis for the estimate is the difference in salinity measured in the groundwater sample at a compliance monitoring well from that measured in surface water at the shoreline. The estimation method assumes that constituent concentrations in groundwater will be reduced by the ratio of groundwater salinity to that of Sinclair Inlet surface water salinity. This methodology is not applied to target analyte concentrations in groundwater samples collected from shoreline wells LTMP-1, LTMP-2, LTMP-3, and LTMP-5, because these wells are located immediately adjacent to the shoreline.

The results of the trend analysis for OU B Terrestrial (U.S. Navy 2011d) showed that, for most detected COCs at most monitoring locations, the concentration trend over the last 10 sampling events has been stable or decreasing. The data collected in 2011 are consistent with the trends observed in the data collected through 2010, because the 2011 COC concentrations are within the range of concentrations historically detected in the OU B Terrestrial wells. Several of the monitoring wells exhibit COC concentrations that consistently exceed the compliance criteria.

At these monitoring wells, however, most COC concentrations are not significantly different from those at the time the ROD was executed, when it was "concluded through analyses of primary fate and transport mechanisms that site groundwater is sufficiently protective of the marine environment" (U.S. Navy, Ecology, and USEPA 2004a).

Petroleum compounds in groundwater, monitored under the PMP, include TPH-G, TPH-D, TPH-Dx, benzene, toluene, ethylbenzene, and xylenes. Figure 6-4 shows the locations at BNC monitored for petroleum compounds. The petroleum compound data generated during this 5-year review period are summarized in Tables 6-2 and 6-6. Note that some of the petroleum monitoring locations shown on Figure 6-4 are not in OU B Terrestrial, but rather are within OU A or OU NSC. The petroleum data are summarized comprehensively in this section for simplicity. Some of the same data presented in Table 6-6 are repeated in Table 6-2, because certain petroleum compounds were listed as COCs in the OU NSC ROD (U.S. Navy, Ecology, and USEPA 1996).

Current and long-term trends in COC data for metals, pesticides, TCE, and petroleum compounds still being monitored at OU B Terrestrial are discussed in the sections below by COC.

Dissolved Arsenic

With a single exception, arsenic was not detected above the RG of 5 µg/L in the OU B Terrestrial monitoring wells during this 5-year review period (Table 6-3). Dissolved arsenic was reported at a concentration of 5.45 µg/L in the groundwater sample collected from well LTMP-3 in October 2011. Dissolved arsenic analysis has been discontinued in wells 704, 707, LTMP-1, and LTMP-2.

Dissolved Copper

Copper is consistently detected at dissolved concentrations substantially above the compliance criterion of 3.1 µg/L in wells LTMP-1 and LTMP-3 (measured concentrations up to 209 µg/L [Table 6-3]). Copper concentrations at these two wells are stable. Copper is consistently detected at concentrations below the compliance criterion in the other OU B Terrestrial monitoring wells during this 5-year review period. Dissolved copper analysis has been discontinued in all of the OU B Terrestrial wells, with the exception of LTMP-1, LTMP-3, and LTMP-4.

Dissolved Lead

Analysis for dissolved lead was performed once during this 5-year review period (October 2006) and was not detected above the RG of 8.1 µg/L in the OU B Terrestrial monitoring wells

(Table 6-3). Dissolved lead analysis was discontinued for groundwater samples in all OU B Terrestrial wells subsequent to the October 2006 monitoring event.

Total Mercury

During this 5-year review period, total mercury was consistently detected above the compliance criterion (0.025 µg/L) in wells LTMP-1 (up to 0.21 µg/L), LTMP-3 (up to 4.92 µg/L), and LTMP-5 (up to 0.0615 µg/L) (Table 6-3). In November 2008, the Navy elected to start using clean sampling methodologies and low level mercury analysis by EPA Method 1631, with a typical reporting limit of 0.0005 µg/L. Total mercury was either not detected above the reporting limit or was detected below the compliance criterion in the remaining OU B Terrestrial wells sampled during this 5-year review period. Mercury concentrations are currently exhibiting a decreasing trend or are stable in eight of the nine OU B Terrestrial wells. An increasing trend was identified in well 704 where detected concentrations remain below the RG of 0.025 µg/L.

Dissolved Nickel

Dissolved nickel is consistently detected above the compliance criterion of 8.2 µg/L in wells LTMP-1 and LTMP-3 (Table 6-3). The highest dissolved nickel concentration measured in these wells during this 5-year review period was 29.9 µg/L in well LTMP-1. Dissolved nickel was detected above the compliance criterion in well 410R during two of the five monitoring events performed during this 5-year review period, with the highest concentration detected during the October 2007 monitoring event (15.2 µg/L). Dissolved nickel concentrations are currently stable in wells LTMP-1, LTMP-4, and 410R and are exhibiting decreasing trends at wells LTMP-3 and 707. Dissolved nickel analysis was discontinued in wells LTMP-2, 432, 433, and 704 subsequent to the October 2006 monitoring event.

Dissolved Zinc

Dissolved zinc is consistently detected above the compliance criterion of 81 µg/L in wells LTMP-1 and LTMP-3 (Table 6-3). Zinc is consistently either not detected or detected at dissolved concentrations below the compliance criterion in the remaining wells at OU B Terrestrial. Dissolved zinc concentrations appear to be stable at LTMP-3 and exhibit an increasing trend at LTMP-1. Dissolved zinc analysis was discontinued in each of the OU B Terrestrial wells subsequent to the October 2006 monitoring event with the exception of wells LTMP-1, LTMP-3, and 410R.

4,4′-DDT

4,4′-DDT was detected above the compliance criterion (Table 6-5) in well LTMP-1 during a single monitoring event (October 2006) and in well LTMP-3 during two monitoring events

(October 2006 and October 2007). 4,4′-DDT was consistently not detected at the other OU B Terrestrial monitoring locations during this 5-year review period. However, the PQL achievable by the laboratory for this compound frequently exceeds the compliance criterion. A lack of detection, therefore, does not necessarily indicate the absence of 4,4′-DDT in groundwater above the compliance criterion.

4,4′-DDE

4,4′-DDE was detected above the compliance criterion (Table 6-5) in well LTMP-3 during a single monitoring event (October 2006). 4,4′-DDE is consistently not detected at the other OU B Terrestrial monitoring locations. However, the PQL achievable by the laboratory for this compound frequently exceeds the compliance criterion. A lack of detection, therefore, does not necessarily indicate the absence of 4,4′-DDE in groundwater above the compliance criterion.

Aldrin

Aldrin was not detected above the compliance criterion in any of the OU B Terrestrial wells during this 5-year review period (Table 6-5). However, the PQL achievable by the laboratory frequently exceeds the compliance criterion. Thus, a lack of detection does not necessarily indicate the absence of aldrin in groundwater above the compliance criterion.

Dieldrin

Dieldrin was detected above the compliance criterion in wells LTMP-3 and LTMP-5 during the October 2010 monitoring event and in well 903 during the fall 2011 monitoring event (Table 6-5). Dieldrin was consistently not detected at the other OU B Terrestrial monitoring locations, but the PQL achievable by the laboratory for this compound frequently exceeds the compliance criterion. Lack of detection, therefore, does not necessarily indicate the absence of dieldrin above the compliance criterion.

Heptachlor Epoxide

Heptachlor epoxide was consistently detected above the compliance criterion in well LTMP-3 (Table 6-5) and was detected above the compliance criterion during a single monitoring event at well LTMP-1 (October 2006). This pesticide is consistently not detected at the other OU B Terrestrial monitoring locations. However, as with the other pesticides discussed above, the PQL achievable by the laboratory for this compound frequently exceeds the compliance criterion, and thus lack of detection does not necessarily indicate the absence of heptachlor epoxide above the compliance criterion.

Petroleum Compounds

During the second 5-year review period TPH-G, TPH-D, and benzene were consistently detected above the groundwater compliance criteria in well 208 (Table 6-6), which is located at an off-site upgradient location associated with OU A. Petroleum monitoring at this well was discontinued after 2004 (see also Section 4.2.4).

During this 5-year review period, TPH-D and TPH-Dx were frequently detected at concentrations above the compliance criteria at wells 392/392R, located within OU NSC. This well also occasionally exhibits free-product thicknesses in the range of 0.02 foot and during one monitoring event (April 2008) exhibited a free-product thickness in excess of 8 inches.

Petroleum compounds at all other wells monitored under the PMP have been consistently either not detected or detected at concentrations below the compliance criteria. The trend analysis report (U.S. Navy 2011d) showed all trends for petroleum compounds in groundwater to be stable or decreasing. Petroleum analysis has been discontinued in wells 382, 412, 425, 704, 709, 713, 715/715R, 718, PMP-1, LTMP-1, LTMP-2, LTMP-3, and LTMP-5.

Trichloroethene

TCE has been consistently detected in wells 410R, 432, and 707. In 2010, TCE monitoring was added at well 425 as part of the LTM program. Detected concentrations of TCE were reported in this well in 2010 (see Table 6-4). TCE was consistently not detected in other wells in the OU B Terrestrial monitoring program. TCE concentrations exhibit an increasing trend at well 410R and are stable at wells 432 and 707. The wells where TCE is detected are located at the heads of drydocks, so the attenuation estimation is applicable. When the estimation is performed for the recent TCE concentration data (U.S. Navy 2011d), estimated TCE concentrations discharging to Sinclair Inlet are below the ROD compliance criterion of 55.6 µg/L and the current regulatory cleanup level (MTCA Method B surface water cleanup level) of 12.8 µg/L (see Table 6-4). A review of current applicable or relevant and appropriate requirements (ARARs) is included in Section 7.2.1. Estimated TCE concentrations in groundwater discharging to Sinclair Inlet, based on recent data, are as high as 10.6 µg/L (U.S. Navy 2011d).

VOCs Related to Vapor Intrusion Studies

As discussed in Section 4.3.4, wells 809, 810, and 811 were installed within OU B Terrestrial in May 2010 to support a vapor intrusion study performed at the HWSA. See Figure 4-1 for the locations of these wells. The wells were sampled in May and July 2010. VOCs were either not detected or were detected below their respective groundwater screening levels in the samples collected from wells 809, 810, and 811 in May and July 2010 (U.S. Navy 2012b). The vapor

intrusion study (U.S. Navy 2012b) concluded that no vapor intrusion concern exists at the HWSA (see further discussion in Section 7.2.2).

As discussed in Section 4.3.4, wells 904, 905, and 907 were installed within OU B Terrestrial, near Buildings 427 and 435, to support a vapor intrusion study performed in the TCE northern plume area. See Figure 4-1 for the locations of these wells. The wells were sampled in June 2011. VOCs were either not detected or were detected below their respective groundwater screening levels in the samples collected from wells 904, 905, and 907, with the exception of PCE in well 905. PCE was detected in well 905 at a concentration of 76 µg/L, which is above the groundwater screening level of 62 µg/L (based on EPA's February 2012 PCE toxicity criteria). The vapor intrusion study concluded that PCE does not currently present a health risk above target health goals in indoor air for Buildings 427 and 435. However, PCE concentration trends in well 905 need to be established and assessed over multiple sampling events to support this conclusion (U.S. Navy 2012b).

Monitoring Recommendations

The long-term trend analysis report (U.S. Navy 2012d) documents a number of suggested changes for future monitoring at OU B Terrestrial. These suggestions include alterations in the lists of analyses to be performed and the frequency of sampling on a well-by-well basis. The data review in this 5-year review supports these recommendations.

The vapor intrusion follow-up report (U.S. Navy 2012b) recommended that well 905 be included in the long-term groundwater monitoring program to assess PCE concentrations trends and confirm the results of the June 2011 monitoring data and that wells 809, 810, and 811 continue to be monitored to confirm whether chlorinated solvents remain stable or are decreasing. The vapor intrusion follow-up report also recommended that analysis of TCE daughter products be performed on groundwater samples collected from well 410R once every 5 years. The data review in this 5-year review supports this recommendation. The current groundwater monitoring program does not include TCE analysis at well 410R. Continued TCE analysis at well 410R is recommended based on the data reviewed in this 5-year review.

6.4.4 OU B Marine Monitoring Data

The results of monitoring for OU B Marine are presented in four marine monitoring reports (U.S. Navy 2005b, 2005c, 2009g, and 2012d) and four military construction sediment sampling reports (U.S. Navy 2010g, 2011g, 2011h, and 2012a). The results of this monitoring are summarized briefly below.

Primary Sediment Sampling

Figure 6-5 shows the 500-foot square grid used to guide the primary marine sediment sampling within OU B Marine, and Figure 6-6 shows the 1,500-foot grid used to guide sampling in the remainder of Sinclair Inlet. Together these grids are the basis for characterizing marine sediments throughout Sinclair Inlet. Table 6-7 summarizes the results of the sampling using the 500-foot grid in 2003, 2005, 2007, and 2010, while Table 6-8 summarizes the results of sampling using the 1,500-foot grid. These tables are derived from similar tables presenting the 2003, 2005, 2007, and 2010 results in the 2010 OU B Marine monitoring report (U.S. Navy 2012d).

Table 6-7 shows that the geometric mean (geomean) carbon-normalized PCB concentration[1] declined between 2003 and 2010, from 6.7 to 3.2 mg/kgOC. The table also shows a small decrease in the arithmetic mean mercury concentration within the 500-foot grid over this period, from 1.0 mg/kg in 2003 to 0.73 mg/kg in 2010.

The ROD for OU B Marine documents the PCB MCUL for marine sediments within OU B Marine of 3 mg/kgOC, to be achieved within 10 years of the completion of the remedy, which corresponds to March 2014. The PCB levels measured in 2010 in the 500-foot grid for OU B Marine are close to this target value. Trend analysis using the 2003, 2005, 2007, and 2010 normalized PCB data for OU B Marine predicts that the median geomean PCB concentration in OU B Marine likely reached the MCUL of 3 mg/kgOC in 2011.

Table 6-8 presents the results of the 2003, 2005, 2007, and 2010 sampling performed using the 1,500-foot square grid for the portion of Sinclair Inlet outside of OU B Marine. The table shows that the geomean carbon-normalized PCB concentration for the 1,500-foot grid declined from 2003 to 2010, from 2.6 to 1.7 mg/kgOC. The table also shows that sediment mercury concentrations outside OU B Marine have remained basically unchanged, ranging between a maximum of 0.37 mg/kg in both 2005 and 2007 and a minimum of 0.34 mg/kg in 2010.

Estimated PCB geomeans for all of Sinclair Inlet, calculated from the geomeans for the 500- and 1,500-foot grid sampling, declined from approximately 3.1 mg/kgOC in 2003 to 1.9 mg/kgOC in 2010. Both values exceed the ultimate cleanup goal of 1.2 mg/kgOC for the inlet as a whole.

[1]The concentration of many organic chemicals in marine sediments, including PCBs, is often expressed in terms of the organic carbon content of the sediments. This “carbon-normalized” approach is believed to better represent the actual biological availability of contaminants. PCB concentrations in marine sediment, as well as regulatory criteria for sediment PCBs, are commonly stated in units of milligrams (of PCBs) per kilogram of organic carbon, or “mg/kgOC.” This approach is used in this document.

Sediment Sampling Associated With Military Construction Projects

As discussed in Section 4.4.5, pre- and post-construction marine sediment sampling has been a requirement for construction permits associated with construction projects that include in-water work within OU B Marine. In some cases, when the construction has involved removal of piers, the sampling has also included one-time collection of underpier samples to characterize portions of OU B Marine that are not normally accessible for sampling. The tabulated data for these projects, as reported in the individual project reports, are provided in Appendix A.

Comparisons between the pre- and post-construction data are relevant to assessment of compliance with the state antidegradation statute, in accordance with the terms of the project water quality certifications for the construction projects. However, this antidegradation assessment is not relevant to assessing the protectiveness of the OU B Marine remedy and, therefore, is not discussed further in this report.

The data set collected for these in-water construction projects most relevant to assessment of the protectiveness of the OU B Marine remedy is the post-construction data set. These data are representative of conditions following construction and the last samples collected. Therefore, these data are most relevant to current and future exposure pathways in the areas sampled. All of the pre-construction, underpier, and post-construction data are presented in Appendix A. However, the summary below is focused almost entirely on the post-construction data for PCBs and mercury.

Analyses were performed on 97 post-construction primary samples and 12 field duplicates, for a total of 109 post-construction sediment samples collected from 93 discrete locations distributed from the location of former Pier 8 at the eastern end of the naval complex west to Pier B. Each sample was made up from a single surface grab collected with a van Veen grab sampler.

As has been the case with the ongoing sediment sampling for OU B Marine, occasional anomalous results have been observed for PCBs and mercury, with concentrations at a handful of stations significantly higher than most of the results. Based on elevated PCB and/or mercury findings at contiguous Pier 7 locations P7-04, P7-05, and P7-06 in the pre-construction sampling, the post-construction sampling at these three locations was expanded to include clusters of closely spaced individual grab samples. This evidence of a possible “hot spot” of contamination near Pier 7 was the reason this area was selected for additional study, as mentioned in Section 4.

Figures 6-7 through 6-12 provide a visual summary of the post-construction sediment results, illustrating the sampling locations where analytes exceeded either the Washington State SQS or CSL standards. Because of the close spacing, the results for the three Pier 7 cluster locations are treated as single locations on these figures.

Mercury was detected in all post-construction sediment samples tested (Table 6-9). Concentrations range from an estimated 0.078 to 12 mg/kg. PCBs were detected in 107 of the 109 post-construction sediment samples tested. Detected concentrations range from 0.488 to 290 mg/kgOC.

For the purposes of assessing the implications of the post-construction sediment sampling results for the protectiveness of the OU B Marine remedy, these data can be treated as additional data points in the overall monitoring program area-weighted average geomean PCB calculations. An analysis of this sort was performed in conjunction with the 2010 OU B Marine monitoring using the data for the Pier 7 project, the only in-water construction project that had been completed by 2010. The results are presented in an appendix to the final report for that monitoring (U.S. Navy 2012d). The Pier 7 sampling locations overlap three of the 500-foot-grid cells used in the OU B monitoring. Aggregating the construction project data with the 2010 OU B monitoring results for these three cells approximately doubled the PCB concentration for one cell and moderately elevated the concentration for the other two cells. However, when the revised PCB concentrations for these three cells were used in the area-weighted calculation for OU B Marine as a whole, the final overall PCB value for OU B Marine was unchanged.

Tissue Sampling

English sole were sampled and analyzed as part of the 2007 and 2010 monitoring rounds. As documented in the marine monitoring reports (U.S. Navy 2009g and 2012d), the average reported 2010 PCB concentration was 0.033 mg/kg, the same value recorded in 2007. The average English sole mercury concentration increased from 0.025 mg/kg wet weight in 2007 to 0.056 mg/kg in 2010.

Other Monitoring

As noted in Section 4, in addition to the primary sediment and marine tissue components, the OU B Marine monitoring program also includes a number of secondary components. The detailed results of these monitoring activities can be found in the marine monitoring reports (U.S. Navy 2009g and 2012d). In summary, the hydrographic survey, sub-bottom profiling, and sediment coring at the CAD pit have demonstrated that the CAD pit cap is functioning as planned and is continuing to prevent the release of contaminated sediments. However, there is some evidence that the thickness of the overlying clean sediment cover material may be decreasing in some locations. This would likely represent some combination of loss of cover material, consolidation of the sediment, or mixing of the cover sediment with the underlying sand. Hydrographic surveys of the cap/ENR measures adjacent to OU A have shown that these measures continue to function as planned.

6.4.5 OU C

During this 5-year review period, the trigger level for diesel-range petroleum (0.5 mg/L) was exceeded three times in groundwater samples collected from well GMWT-9 (Figure 6-13) on October 21, 2009 and October 13 and 31, 2011 (Table 6-10). The trigger level for oil-range petroleum (0.5 mg/L) was also exceeded in the groundwater sample collected from GMWT-9 during the October 31, 2011 sampling event. All other results for all wells were below the trigger levels. Because of the diesel-range petroleum trigger level exceedance detected in GMWT-9 during the October 2009 sampling event, the monitoring frequency was increased for this well to quarterly. Diesel-range petroleum concentrations measured from this well in the next four quarterly follow-up samples did not exceed the trigger level. However, the results from October 2011 did exceed the trigger level.

The 2010 Mann-Kendall statistical analysis for OU C concluded the following:

- **Well GMWT-9** – TPH-D is stable over the last 10 sampling rounds. However, its average concentration is near the OU C trigger level.

- **Well GMWT-22** – TPH-D is increasing at the 80 percent confidence interval for the last 10 sampling rounds. However, its concentrations are still below the OU C trigger level.

The results from 2011 do not call into question the conclusions of this trend analysis, with the exception of GMWT-9, where the 2011 results indicate a potential for an increasing trend of diesel- and oil-range petroleum.

In general, the extent and thickness of the floating petroleum product plume remained relatively consistent throughout this 5-year period (Table 6-11). The product extent and thickness data do not indicate movement of the floating product plume towards Sinclair Inlet. Although the product thickness at individual wells has varied over time, the overall thickness and areal extent of the floating petroleum product plume have remained relatively stable.

Based on the results of 2009/2010 trend analysis, the trend analysis report (U.S. Navy 2011d) recommended that the sampling frequency for well GMWT-9 revert to annual and the frequency for GMWT-22 sampling remain annual. Because of the trigger level exceedances in well GMWT-9 in October 2011, the analysis in this 5-year review does not concur with the recommendation for this well in the 2009/2010 trend analysis report. Quarterly monitoring should continue for well GMWT-9.

6.4.6 OU D Groundwater Monitoring Data

Monitoring well LTMP-5 and new well 903 are used to monitor OU D groundwater quality. Well 903 is shown on Figure 4-1 and well LTMP-5 is shown on Figure 6-3. Groundwater monitoring at OU D to verify predictions that site groundwater is protective of the marine environment has been integrated into groundwater monitoring for OU B Terrestrial. The data summarized in Section 6.4.3 for monitoring wells LTMP-5 and 903 are relevant to OU D. Monitoring results from well LTMP-5 show consistent mercury concentrations exceeding the compliance criteria (Table 6-3) and occasional dieldrin concentrations exceeding the compliance criteria (Table 6-5). Dieldrin was detected at an estimated concentration of 0.43 µg/L in well 903 during the fall 2011 LTM event. This is above the ROD RG criteria of 0.0000867 µg/L established for dieldrin. Other pesticides and dissolved metals were not detected at concentrations above compliance criteria in well 903 (U.S. Navy 2012c).

6.5 RESULTS OF SITE INSPECTIONS

Site inspections from 2007 through 2011 were conducted based on the O&M plan and IC work plan for BNC. The 2006 O&M plan was updated in 2008 and 2009 (U.S. Navy 2006a, 2008a, and 2009c). The 2006 IC work plan was also updated in 2008 and 2009 (U.S. Navy 2006b, 2008b, and 2009d). This section describes the inspections carried out between 2007 and 2011 under the combined site-wide plans. The inspection results are discussed by specific OU, including OU A, OU NSC, and OU B T. Annual inspections are not required for OU C. The annual inspection reports summarize the results of the inspections and typically provide recommendations for repair of poor pavement or eroded vegetative cover, catch basin repair/maintenance/cleaning, and/or shoreline stabilization and protection. The annual inspection reports contain limited documentation of repairs made to pavement based on prior inspections. Documentation of catch basin repair/maintenance/cleaning based on prior inspections is not included in the annual reports.

Because the Navy does not yet have an agreement with the City of Bremerton regarding inspections at OU D, no annual inspection has been conducted for this OU other than the shoreline inspections associated with OU B Terrestrial. However, an evaluation of the remedy at OU D was performed in 2010, as discussed in Section 6.5.4. In addition, the LTM plan dated October 2011 (U.S. Navy 2011f) includes monitoring of an additional groundwater monitoring well (well 903) and inspection of the stormwater conveyance pipe located in the western part of OU D. The LTM plan update currently in progress adds a complete remedy inspection requirement for OU D.

The IC inspections were conducted for the entire BNC complex beginning in 2008. The IC inspection results for BNC are discussed on a site-wide basis in Section 6.5.5.

6.5.1 OU A Inspection Results

Annual inspections were conducted at OU A beginning in 2007 and continuing through 2011. Five primary activities were the subject of the annual inspections at OU A: pavement and vegetative cover, shoreline, fencing, signage, and catch basins. Institutional controls inspections, which also include fencing and signage, are discussed in Section 6.5.5.

Pavement and Vegetative Cover Inspection

During the 2007 inspection (U.S. Navy 2007c), asphalt pavement was observed to be generally in good condition, with some small problem areas starting to occur. Vegetation was healthy and abundant away from the shoreline edge. The 2008 and 2009 inspection (U.S. Navy 2008c and 2009e) conclusions were generally similar. Approximately 2,220 feet of cracks were ranked as being in poor condition during the 2008 inspection. This estimate increased to 2,290 feet during the 2009 inspection, in addition to an observed 30 square feet of potholes. The 2010 inspection (U.S. Navy 2010a) conclusions were again similar, with 2,630 feet of significant cracks. During the 2011 inspection (U.S. Navy 20111), a total of 2,632 feet of cracks or deteriorated sealant were observed to be in marginal or poor condition, in addition to 352 square feet of potholes. Vegetated cover was observed to be continuous and have adequate top soil to sustain vegetation. However, many marjoram plants were dead (U.S. Navy 2011l).

Shoreline Inspection

During the 2007 inspection, erosional damage was observed along the Charleston Beach area where the shoreline is not protected by armor rock. The shoreline edge of vegetative cover was eroded because of wave scouring of the bank. Bank loss from erosion along the beach below the vegetative cover was observed to be significant and threatens to displace the underlying landfilled material.

During the 2008 inspection, there was additional erosional damage along the Charleston Beach area, as noted by the erosion gauges. Subsequent to the annual inspection in August 2008, the Navy performed an interim repair action to stabilize the bluff and enhance the beach habitat (U.S. Navy 2008d). During the December 2008 inspection, there was visual evidence of erosion of the fish mix material and depletion of shoreline material at two of the three beach erosion gauges since the interim repair action in August 2008.

During the 2009 inspection, there was little change in erosional gauge measurements since the December 2008 inspection. A small section of shoreline had a vertical cut face with exposed soil, but it did not show any exposed landfill material. During the December 2009 inspection, continued depletion of the fish mix material was observed at two of the three beach erosion gauges.

The 2010 inspection concluded that ongoing erosion resulted in about 13 inches of exposure at gauge A, which is considered a deficiency that requires monitoring every 6 months. A fish mix berm was placed in the upper portion of the beach as part of an interim action in September 2010 to replenish fish mix material. During the December 2010 inspection, very little evidence was noted of any movement of the new fish mix sand and gravel except for a slight wave cut at the toe of the fish mix berm near the west end of the beach.

The 2011 inspection concluded that erosion of the OU A beach resulted in approximately 5.5 inches of exposure at gauge C, which is considered a deficiency that requires monitoring every 6 months. Two sections of the sheet pile wall were also observed to be not vertical or in line with nearby sections (U.S. Navy 2011l).

Catch Basin Inspection

During 2007 a catch basin inspection at OU A was conducted during a storm event. All catch basins and manholes at OU A were in good condition with free flowing water except for one that was submerged with water pooling around the top. In 2008 all catch basins/manholes were located, and no repairs were required. There were no backups or ponding observed during the wet season inspection. Similar observations were made during the 2009 and 2010 inspections except that in 2009, sediment accumulation in two catch basins exceeded 60 percent of the sump depth, triggering cleanout, and in 2010, sediment accumulation in one catch basin exceeded 60 percent of the sump depth. In 2011 all catch basins/manholes were located, and no repairs were required. There were no backups or ponding observed during the wet season inspection. Sediment accumulation in one catch basin exceeded 60 percent of the sump depth (U.S. Navy 2011l).

6.5.2 OU NSC Inspection Results

Annual inspections were conducted at OU NSC beginning in 2007 through 2011. Three primary activities were subject to the annual inspections at OU NSC: pavement and vegetative cover, catch basins, and fencing and signage. IC inspections, which also include fencing and signage, are discussed in Section 6.5.5.

Pavement and Vegetative Cover Inspection

The 2007 inspection identified a number of small unpaved areas and numerous areas of worn or deteriorated pavement that would allow increased water infiltration. OU NSC did not have any vegetative cover areas in 2007.

The 2008 inspection yielded similar conclusions. In addition, poor pavement areas totaled 17,100 square feet, and significant cracks and deteriorated sealants made up another 8,800 lineal feet. The majority of these areas require repair to improve the pavement cap. OU NSC has several small planted areas near Buildings 943 and 514 that were added to the base map during 2008 inspections. None of the vegetated areas had eroded or inadequate topsoil.

During 2009, findings were similar to previous years. In addition, poor pavement areas totaled 102,425 square feet. However, 84,700 square feet, over 80 percent of the total, were due to a construction zone. Significant cracks and deteriorated sealants made up 8,287 feet. Only 30 square feet of poor pavement had been repaired since the 2008 inspection. None of the vegetated areas had eroded or inadequate topsoil in 2009.

In 2010, findings were also similar to previous years. Twenty-nine new features mapped in 2010 increased the poor pavement areas to a total 105,186 square feet. Of that, 84,700 square feet was due to the same construction zone noted in 2009. Significant cracks and deteriorated sealants made up 8,852 feet. The majority of these features, aside from the construction zone, require repair to improve the pavement cap. No poor pavement appears to have been repaired since the 2009 inspection. Vegetated cover areas had adequate topsoil.

In 2011, three new features were noted during the inspection, increasing the marginal to poor pavement areas to 143,243 square feet. Of that, 121,799 square feet was due to the same construction zone noted in 2010. Approximately 84 square feet of poor pavement was repaired following the 2010 inspection. Significant cracks and deteriorated sealants made up 8,850 feet. No vegetated area had eroded or had inadequate topsoil (U.S. Navy 2011l).

Catch Basin Inspection

During the 2007 inspection, most catch basins at OU NSC were observed to be generally in good condition. One catch basin was filled with sediment, which was unchanged from the previous year's inspection, suggesting that the outfall line may be plugged. In addition to the dry season inspection, the catch basins were inspected during a storm event. With the exception of the one catch basin completely filled with sediment, all other catch basins and manholes at OU NSC were in good condition with free-flowing water.

During 2008, most catch basins and manholes were again in good condition. Two catch basins were broken, and one could not be opened. The catch basins inspected during the wet season were in good condition with free-flowing water.

During 2009, most catch basins and manholes were again found to be in good condition. Wet season inspection indicated all catch basins had free-flowing water, but one had a cracked grate. During the dry season inspection, five catch basins could not be accessed, one had a cracked

grate, and sediment accumulation in five catch basins exceeded 60 percent of the sump depth and cleaning them out was recommended.

During 2010, most catch basins and manholes were in good condition. All catch basins had free-flowing water at the time of the wet season inspection. Two catch basins could not be accessed, and sediment accumulation in two catch basins exceeded 60 percent of the sump depth and cleaning them out was recommended.

During 2011, most catch basins and manholes were in good condition with no repairs required. All catch basins had free-flowing water at the time of the wet season inspection. One catch basin could not be accessed, and sediment accumulation in three catch basins exceeded 60 percent of the sump depth and cleaning them out was recommended (U.S. Navy 2011l).

6.5.3 OU B Terrestrial Inspection Results

Annual inspections were conducted at OU B Terrestrial beginning in 2007 and continuing through 2011. Five primary activities were the subject of the annual inspections at OU B Terrestrial: pavement and vegetative cover, shoreline, catch basins, and fencing and signage. IC inspections, which also include fencing and signage, are discussed in Section 6.5.5.

Pavement and Vegetative Cover Inspection

During 2007, inspection at OU B Terrestrial identified numerous areas that increase the potential for precipitation infiltration, including pavement cracks, unpaved areas, depressions, and deteriorating pavement. The small vegetative cover areas appeared in good condition.

During the 2008 inspection, pavement and vegetation conditions were observed to be similar to the 2007 inspection. Poor pavement areas totaled 316,700 square feet, and significant cracks and deteriorated sealants made up 33,600 feet.

During the 2009 inspection, pavement and vegetation were similar to previous years. Poor pavement areas totaled 287,593 square feet, and significant cracks and deteriorated sealants made up 37,849 feet. Approximately 1,800 square feet were repaired after the 2008 inspection. During the vegetative cover inspection, two small areas were found of exposed soil on a steep slope totaling 77 square feet.

During the 2010 inspection, pavement and vegetation were similar to previous years. Poor pavement areas totaled 372,725 square feet, and significant cracks and deteriorated sealants made up 37,949 feet. Following completion of the field inspections, 96,047 square feet of poor pavement area were paved by September 10, 2010. This effectively reduced the poor pavement area to 276,678 square feet. Approximately 713 square feet of other poor pavement area were

repaired since the 2009 inspection. The vegetated covered areas appeared in good condition. Two small areas of exposed soil on a fairly steep slope totaling 77 square feet continued to remain in the same condition as first noted during the 2009 inspection.

During the 2011 inspection, pavement and vegetation were similar to previous years. Marginal to poor pavement areas totaled 312,491 square feet, and marginal to poor cracks and deteriorated sealants made up 38,785 feet. Approximately 1,906 square feet of poor pavement was repaired following the 2010 inspection. The vegetated covered areas appeared in good condition, with no major erosional problems observed. Two small areas of exposed soil on a fairly steep slope totaling 77 square feet first noted during the 2009 inspection were noted to have been repaired (U.S. Navy 2011l).

Shoreline Inspection

Locations of the shoreline segments referred to in the following discussion are shown on Figure 6-14.

During the 2007 inspection, riprap slopes were in good condition with only a couple areas that lacked large armor rock.

During the 2008 inspection, erosional damage was observed to the armor rock at Segment 2. Segment 41A was missing about 100 square feet of “rat rock,” apparently because of landscaping work rather than erosion. Minor areas of filter fabric exposure, invasive ivy, and incipient cracking of a concrete wall were also noted.

During the 2009 inspection, an estimated 3.5 square feet of eroded soil were observed at each of Segments 1 and 40. Segment 41B had two areas of damaged concrete in the seawall of approximately 3 and 4 square feet in size.

In 2010, about 2 to 3.5 square feet of eroded soil was observed in Segment 1 at the same location as noted during the 2009 inspection. This area is not large enough to require further action. The 3.5 square feet of eroded soil at Segment 40 noted in 2009 had been repaired. Segment 41A includes two concrete slabs that have slid 2 to 4 feet downward along the shoreline. No exposed native material or filter fabric was observed. Therefore, according to the O&M plan, no further action is required.

In 2011, a 2- by 3-foot area of eroded soil was observed in Segment 1 at the same location noted during the 2010 inspection. The armor rock at Segment 41B had no deficiencies. At Segment 41A, the inspection team observed that the two southernmost concrete slabs had slid approximately 4 feet downward and rotated outward along the shoreline, exposing the shoreline. An area of filter fabric measuring approximately 500 square feet (25 feet wide by 20 feet high)

and an area of native material measuring approximately 12 square feet (4 feet wide by 3 feet high) had been exposed. An emergency repair to the shoreline segments was completed in July 2011. The interim repair was not engineered, but does provide additional protection to the three concrete slabs on the southernmost section of Segment 41A.

Navy divers conducted an underwater video inspection of the concrete slabs and underwater conditions as part of the repair effort. The inspection documented that the two southernmost concrete slabs that slid are resting on the bottom. The divers reported a pile of sand and gravel at the base of the failed slabs, which the slabs apparently dredged when they slid. The south end of the southernmost slab is resting against an old broken pile. The northern end of the second slab appears to be resting against a boulder, which in turn is resting against another pile. The divers found that the number of boulders increased as they traveled north. The divers reported no visible underwater utilities in the area.

The repair was implemented by placing rock around the failed segments to stabilize the slabs, covering exposed soil, and enhancing shoreline protection (U.S. Navy 2011l). The rock varied in size from small cobbles (less than 20 inches in diameter) to large four-man boulders (36 to 48 inches in diameter) and was placed from barges during low tide. As part of the repair work, sediment sampling was completed from four underwater locations before and after the repairs were made. The pre- and post-repair samples were collected from similar locations and analyzed for metals, PCBs, and TOC. In general, comparison of the pre- and post-repair work samples showed no significant change in chemical composition. Grain size testing was also performed on the samples. Minor differences in chemical and grain size results between the sets of data were attributed to spatial variation in the sampling locations, because it was not possible to collected the pre- and post-repair samples from the exact same position underwater.

The failure occurred sometime between December 17, 2009 and the June 2010 inspection, based upon comparison of the photographs taken during the OU D remedy inspection in December 2009, which did not show signs of failure, to the photographs taken during the June 2010 inspection. The cause of failure is unknown and no formal engineering evaluation was performed. However, it likely that one or more of the following conditions or mechanisms lead to the failure:

- Storm conditions between December 2009 and June 2010, combining high winds and a high-tide event
- Turbulence from vessel traffic, ferry wake, or prop wash
- Direct impact by water craft

- Increased slab weight from large capping rocks believed to have been placed during park construction
- Hydrostatic pressure of groundwater behind the slabs
- Surface water flow undermining the slabs

The available information leads to the conclusion that the most likely causes of failure were high-tide storm events and prop wash causing erosion at the toe of the slabs. Failure may have been exacerbated by the addition of large rocks on the top of the concrete slabs. The rationale for this conclusion is as follows:

- The failed slabs are located at the southernmost end of the concrete-slab retaining wall. These slabs are the most exposed to wind and wave action, as well as to prop wash.
- Several extreme high-tide storm events have been recorded over the last few winters, and these events have been documented to have caused accelerated erosion at other Navy shoreline properties that had otherwise been stable for relatively long periods.
- Although ferry traffic itself is relatively consistent over the years, recent ferry slip construction (such as dolphin replacement) could have introduced a temporary change in prop wash conditions near the slabs (such as operation of cyclonic tug propulsion near shore).

Failure resulting from increased groundwater pressure behind the slabs seems unlikely, because there is a permeable gap between each concrete panel that would tend to relieve hydrostatic pressure. In addition, the two panels that failed are located at the southern end of the wall. The panel exhibiting the most dramatic movement is the last panel in line, which has a free edge to the south such that groundwater can freely drain through the southern riprapped shoreline.

Failure resulting from surface water flow also appears unlikely. Evaluation of photographs prior to the repair showed no sign of concentrated sheet flow in the area immediately above the concrete slabs. In contrast, other areas of the shoreline did exhibit signs of concentrated surface water flow and consequent erosion (the southern end of Harborside Park adjacent to the paving stones). Based on a review of aerial photographs, these areas of erosion caused by concentrated surface water flow appear to have been repaired by the City of Bremerton by placing new rock.

Catch Basin Inspection

During the 2007 inspection, most catch basins appeared to be in good condition. Backups or ponding were noted for four catch basins or manholes in dry weather, and slow flow was identified for one more catch basin during a storm event. Three catch basins were identified as needing repair.

During 2008, again most catch basins were noted to be in good condition. During the wet weather inspection, stuck grate lids and accumulated sediment were observed and required action. Dry weather inspection results included four catch basins that could not be located, nine catch basins/manholes that could not be accessed, three catch basins that were not accessible, two catch basins requiring sediment removal, and one that appeared to be settling and cracked. Three catch basin/manholes had stuck or cemented shut grates.

Again, during 2009, most catch basins were noted to be in good condition. During wet season inspection, 10 catch basins and manholes required maintenance or repairs. During the dry season, seven of the same catch basins/manholes observed during the wet season and an additional four catch basins/manholes required maintenance or repairs.

During 2010, most catch basins appeared to be in good condition. During wet season inspection, four catch basins were noted to require maintenance or repairs. During the dry season inspection, one additional catch basin was noted as requiring repair for a crack in the grate. Five catch basins contained sediment exceeding 60 percent of the sump depth, and cleaning them out was recommended.

During 2011, most catch basins appeared to be in good condition. A total of five catch basins either were not located, not accessible, or not functional for a visible inspection. During the wet season inspection, no accessible catch basins were noted as requiring maintenance or repair. During the dry season inspection, two catch basins were noted to require repair. Four catch basins contained sediment exceeding 60 percent of the sump depth (U.S. Navy 2011l).

6.5.4 OU D Inspection Results

An engineering evaluation of modifications made to the OU D remedy by the City of Bremerton was performed in 2009/2010 (U.S. Navy 2010d). The modifications to the remedy (i.e., construction of a park) were made by the City of Bremerton following implementation of the remedial action by the Navy and transfer of the parcels that comprise OU D from the Navy to the City. The evaluation consisted of an analysis of (1) final grade and site features, (2) excavation activities, and (3) drainage and infiltration. Based on the findings of the OU D remedy evaluation report (see Section 7.1.6), the following potential actions were suggested in the 2010

report to refine the evaluation of site conditions with regard to the functionality of the OU D remedy and/or provide ongoing assessment of the remedy functionality:

- Investigate potential residual sources. The source of materials used to construct the raised landscaping planters could be investigated to confirm that soil containing COC concentrations above cleanup levels was not incorporated into the planters. If sufficient evidence is not available to substantiate the source of material used to develop the planters, then minimally invasive soil sampling could be considered using hand augers.

- Track water usage. Sudden increases in water usage could be indicative of a piping break (either fountain or irrigation piping).

- Further analyze and address drainage and infiltration. A more detailed infiltration analysis could also be performed using EPA's HELP model to quantify infiltration to a specified depth of soil. It may also be possible to directly test the infiltration rate by conducting an on-site test. If it is determined that the current site does not satisfy the requirements in the ROD for site-wide capping (either by theory or empirically), infiltration around the paving stones could potentially be reduced by replacing the sand base with grout, either below or merely surrounding the paving stones. It should be confirmed that the OU D storm drain system is included in the base-wide inspection program and, if not, add this system to the inspection program. The Navy should request that the City repair the surface erosion observed by the southern bulkhead and the east portion of the site to minimize infiltration and off-site migration of sediment.

- Increase groundwater monitoring. Conduct additional monitoring of wells LTMP-5 and 903, and install new wells to access COC trends.

6.5.5 Site-Wide Institutional Controls Inspection Results

Annual IC inspections were conducted at all OUs beginning in 2007 through 2011. These IC inspections included a review of access control (i.e., signage and security), groundwater use, excavation management, and property transfer and were conducted based on the IC work plans prepared in 2006, 2008, and 2009 (U.S. Navy 2006b, 2008b, and 2009d). Beginning in 2008, a summary of trespassing incidents was to be included in the annual inspection reports.

During 2007, sign inspections identified several nonexistent signs and several faded or illegible signs. In addition, a number of signs differed from indications in the O&M plan. It was recommended that some signs be replaced and the plan be updated. No other IC finding was recorded.

In 2008, no problem was identified related to access control, excavation management, prohibiting groundwater use, and transfer of property. Sign inspection conclusions were similar to those noted in 2008. Several trespassing incidents were reported in the 2008 inspection report. However, none of these incidents resulted in exposure to contaminants, and overall access control remained good.

In 2009, no problem was identified related to access control, excavation management, prohibiting groundwater use, and transfer of property. Similar sign conclusions were drawn as in previous years. Some missing signs were associated with piers that have been or were in the process of being demolished, or construction that was completed, and may not require replacement. The same trespassing incidents reported in the 2008 inspection report were reported in the 2009 inspection report.

During the 2010 inspection, no problem was identified related to access control, excavation management, prohibiting groundwater use, and transfer of property. Inspection of signs on fences, shorelines, piers, and floating booms identified several missing signs and five faded and/or illegible signs. All but two of the missing signs were associated with piers that have been or were in the process of being demolished, or with construction that was completed. No trespassing incident was reported in the 2010 inspection report.

In 2011, no deficiency was identified related to access control, excavation management, prohibiting groundwater use, and transfer of property. Inspection of signs on fences, shorelines, piers, and floating booms identified several missing and two faded signs. The missing signs were associated with piers that have been or were in the process of being demolished, or that were present on fencing that was removed since the 2009 IC work plan was written. The two faded signs requiring replacement were located at Montgomery Gate and Charleston Beach. No trespassing incident was reported in the 2011 inspection report (U.S. Navy 2011l).

6.6 RESULTS OF INTERVIEWS

As part of the 5-year review, interviews were conducted with persons familiar with the CERCLA actions at BNC. Interview candidates were identified from a variety of organizations and groups, including the Navy, EPA, Ecology, Suquamish Tribe, Washington State Department of Fish and Wildlife (WDFW), Washington State Department of Transportation, and City of Bremerton. A set of interview questions and instructions were transmitted to interview candidates by e-mail. Not all of those invited to participate chose to do so. Interview questions were subsequently also made available to several other candidates identified by early interviewees. No member of the public chose to participate.

The complete interview responses are included in Appendix B. Highlights of the interviews are summarized below.

6.6.1 Navy Personnel

Five Navy staff completed the interview form. The respondents were in general agreement that the remedies meet the intent of the RODs and overall continue to be effective. Measures that were specifically identified as having led to environmental improvements include pavement upgrades, which decreased infiltration of rainwater and potential for transport of contaminants in soil, storm drain cleaning and repair, which removed a major potential source of contamination from the site, shoreline stabilization, which reduced the potential for erosion of site soil and fill into Sinclair Inlet, and the sediment dredging and disposal action, which moved a large volume of contaminated sediment from the biologically active zone of the inlet.

Several of the interviewees also identified a few deficiencies or areas in need of improvement. The most common concern noted by Navy personnel appeared to be that although inspections are effective and have become comparatively routine, follow-up on the results of these inspections needs improvement. The primary focus of this concern relates to damaged pavement. Repairs that are identified as needed through the inspections are reportedly not commonly addressed in a timely fashion. This observation is born out in the monitoring reports, which note the same damaged pavement is observed in successive inspections. The comment was made by one interviewee that pavement maintenance in some instances seems to be handled in an opportunistic manner, tending to be performed as a secondary component of other construction actions.

A similar comment was made about maintenance identified as needed in areas where vegetative cover substitutes for pavement. Interviewers felt that follow-up on these findings could be improved.

A more general concern of several interviewees was that more attention is needed to budget for performing the maintenance required as a result of the inspection findings. An implicit concern is that the maintenance needs identified through these inspections are not always properly incorporated into routine O&M.

Several Navy respondents expressed concern regarding the age and condition of site storm drain facilities and the increasing risk of loss of integrity, with the potential for infiltration and transport of contaminated groundwater and soil to Sinclair Inlet. One interviewee noted recent evidence of possible cross-connections between the storm drains and the sanitary sewer, with the potential for release of raw sewage to the inlet. It was also noted that inspection of the storm drain facilities is hampered at times by equipment or vehicles blocking access to inlets and catch

basins. Another interviewee expressed concern about the age and condition of site infrastructure in general.

Two Navy interviewees expressed dissatisfaction with the relatively high ongoing expenditures associated with the relatively limited benefit in the form of improved habitat they perceive at the beach mitigation site at Charleston Beach.

6.6.2 Agency Personnel

Environmental Protection Agency

The EPA interviewee feels that remedy implementation at BNC has been very successful and the remedies meet the intent of the ROD.

Another observation by this interviewee is that changes in ARARs and other new information since the last 5-year review need to be assessed in evaluating the protectiveness of the remedies at the site.

This interviewee also believes that although the ICs and land-use controls in use are consistent with the terms of the RODs, the ICs need to be reviewed and possibly broadened in scope, based on recent evidence of soil and sediment contaminant levels remaining in place at the site.

Washington State Department of Ecology

The Ecology interviewee is familiar with all of the upland OUs, but not with OU B Marine. The interviewee believes the upland remedies complied with and met the intent of the RODs and continue to be effective. However, the interviewee expressed concern that follow-up maintenance based on the findings of ongoing inspections is not being performed and could impact future effectiveness of the remedies.

Suquamish Tribe

The Suquamish Tribe interviewee feels that the remedies implemented at BNC have generally been consistent with the intent of the RODs. However, the interviewee also identified exceptions, such as the release of contaminated sediment around the perimeter of the CAD pit during the OU B Marine remedy and failure by the City of Bremerton to observe the established land use controls for the transfer of OU D to the City. Similarly, while the interviewee feels that many elements of the remedies continue to be protective, there are exceptions, including deficiencies in following up on needed maintenance of paving and stormwater facilities.

For OU B Marine, while PCB levels are trending down, levels of mercury in sediment and tissue are a concern to the Tribe, as are pre- and post-construction sediment sampling results that have revealed previously unidentified elevated contaminant levels in a number of locations. Other tribal concerns related to the remedies at BNC include mercury in groundwater and the anticipated impacts to marine habitat associated with additional repair work needed in the Charleston Beach area.

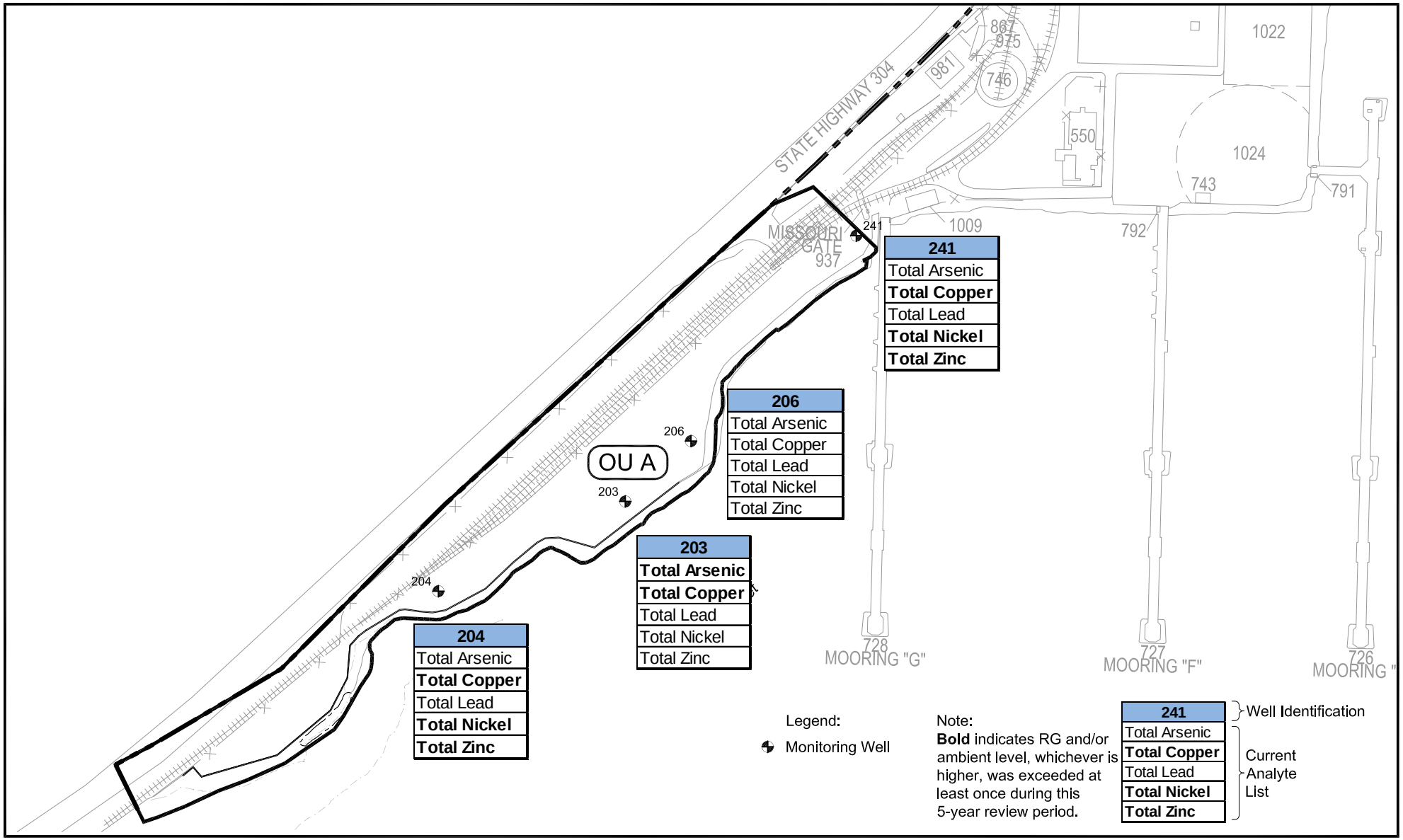
While the Navy's remedial activities have tended to reduce contaminant loads to Sinclair Inlet, this has been of limited direct benefit to the Tribe, since harvest restrictions on marine life remain in place. The interviewee also noted that armoring of portions of the shoreline tends to degrade the quality of the marine habitat. The interviewee feels that both the terrestrial and marine environments must be addressed in a more holistic fashion for remediation to be effective.

Washington State Department of Fish and Wildlife

The WDFW interviewee is primarily familiar with the Navy's marine-related remedies associated with OU A and OU B Marine. The interviewee feels the remedies have been implemented in accordance with the terms of the RODs, but is concerned about loss and degradation of habitat as a result of remedial activities. The interviewee cites the example of habitat degradation caused by using riprap to control erosion of contaminants left in place, rather than removing the contaminated material. In the interviewee's opinion, ongoing maintenance is a necessity to achieve enhanced habitat at Charleston Beach. Based on the history of the BNC site, the interviewee feels it is likely that additional areas of contamination will be found in the future and may require attention.

Navy Consultants

A Navy contractor hired to perform third-party reviews of the remediation activities at BNC and especially familiar with OU B Marine and OU A also responded to the interview questions. This interviewee believes the OU B Marine remedy met the intent of the ROD and that the remedy, together with natural recovery processes, has been successful in gradually reducing the concentration of PCBs in sediment. However, the interviewee also identified mercury in sediment and tissue and elevated contaminant levels in some pre- and post-construction sediment samples to be ongoing concerns. Also of concern to this interviewee was transport of metals from the upland to Sinclair Inlet and loss of beach cover material at Charleston Beach.



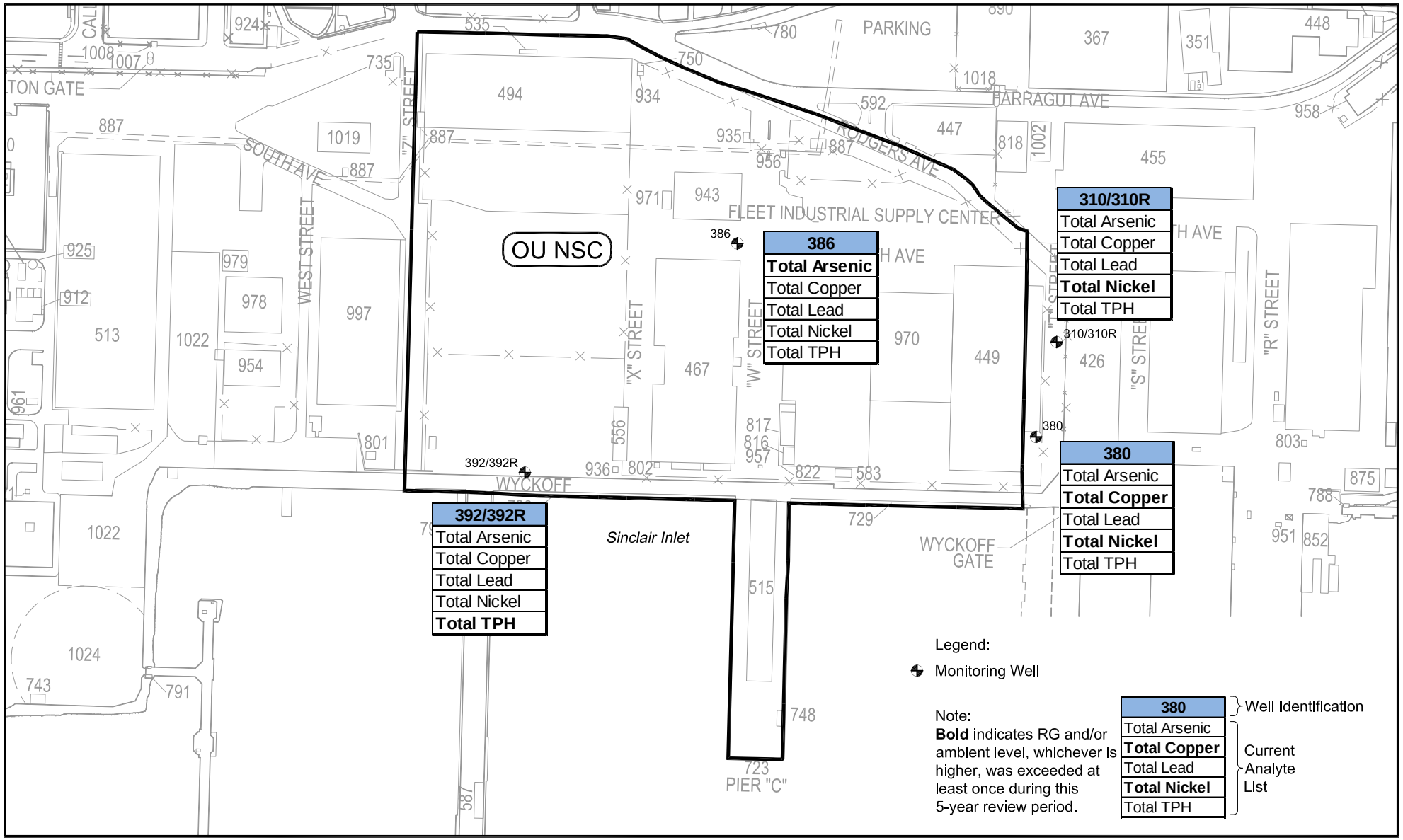
U.S. NAVY

0 150 300
SCALE IN FEET

Figure 6-1
OU A Monitoring Locations

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

T:\PSNS\IDIQ\DO 35\2012 5 year Review\Fig 6-1 OU A Mon Locs.dwg
Mod: 05/15/2012, 14:05 | Plotted: 05/15/2012, 14:06 | john_knobbs



U.S. NAVY

0 150 300
SCALE IN FEET

Figure 6-2
OU NSC Monitoring Locations

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

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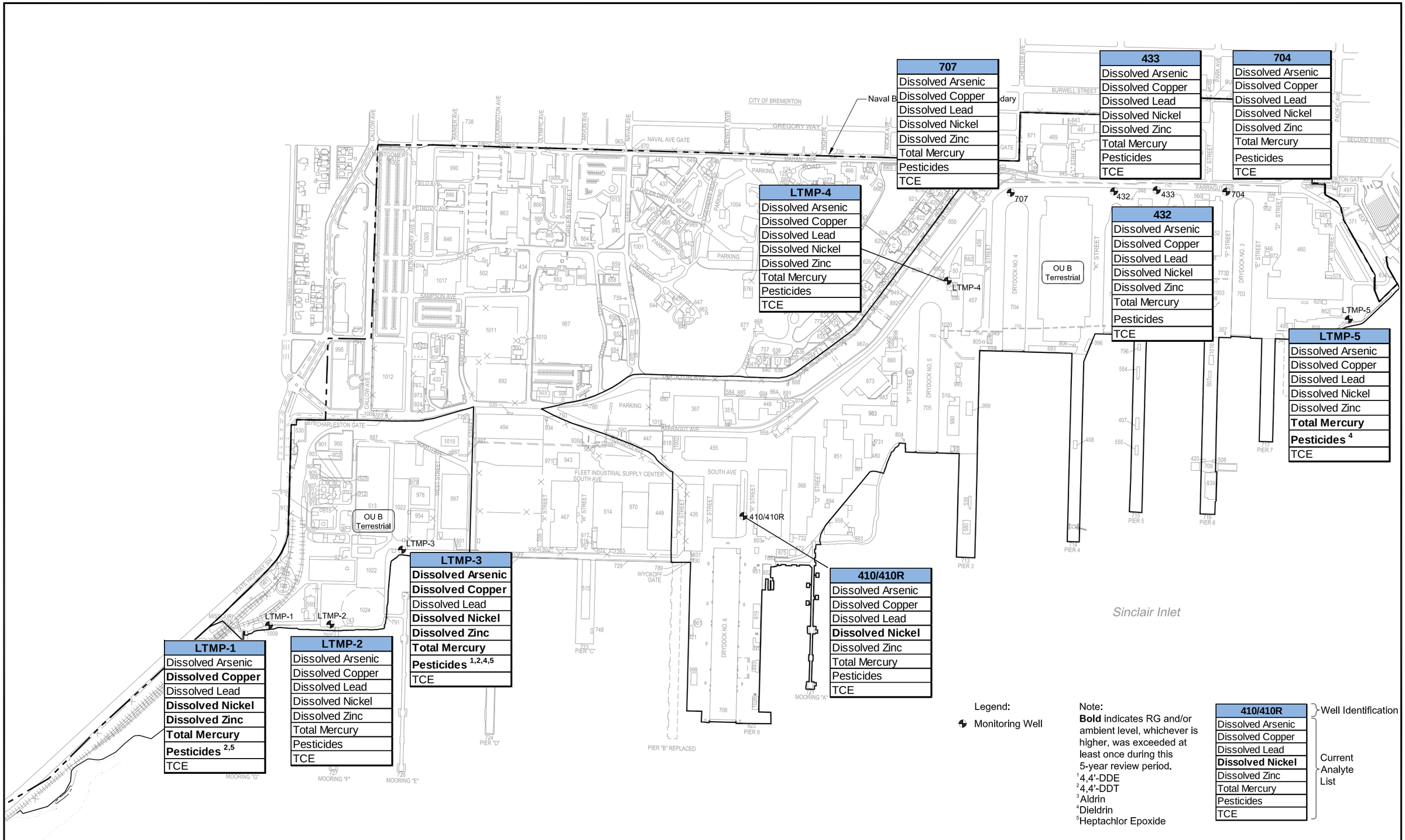
Mod: 05/14/2012, 11:00 | Plotted: 05/15/2012, 14:07 | john_knobbs



U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

Figure 6-3
OU B Terrestrial Monitoring Locations

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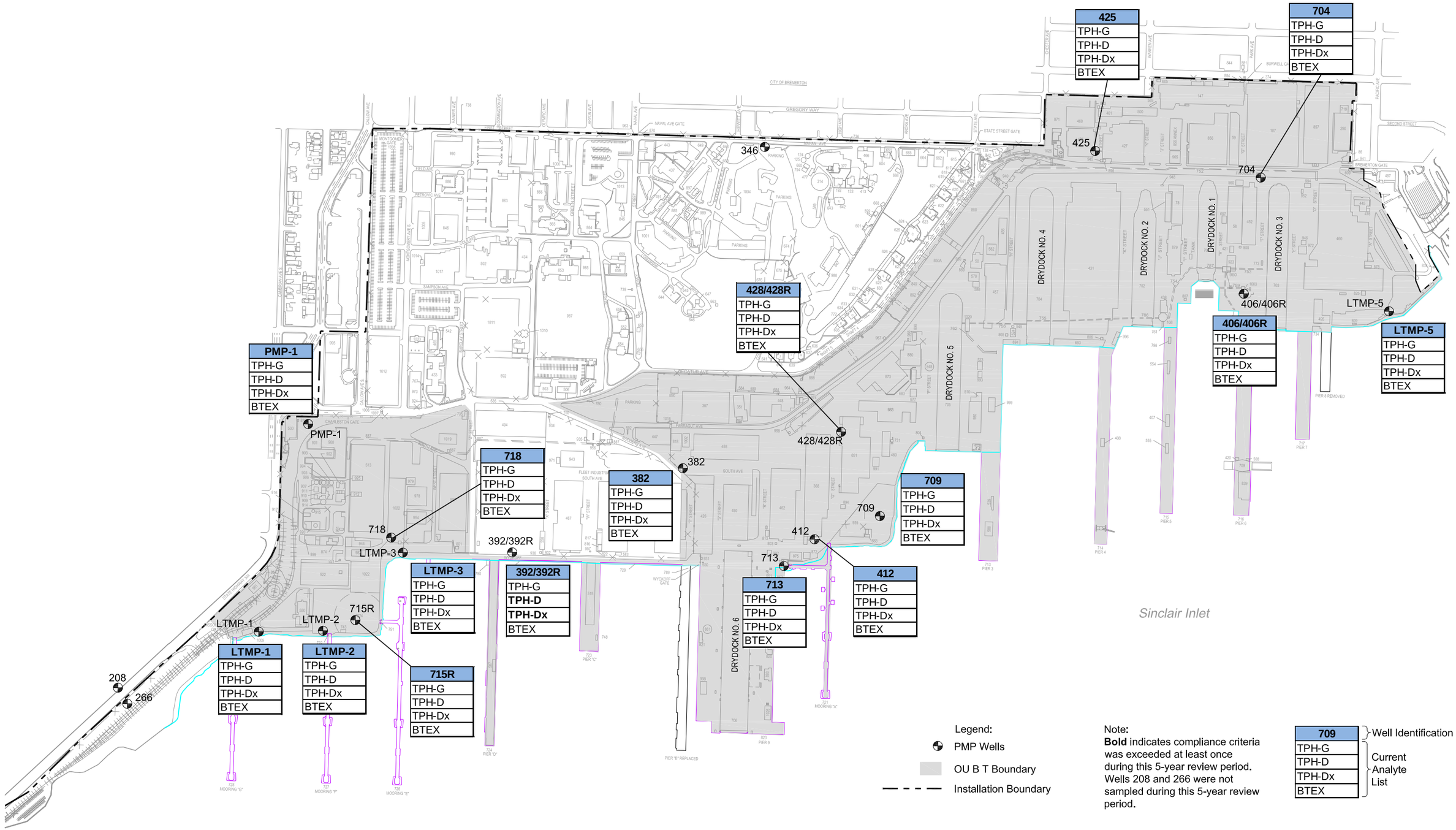

T:\PSNS\IDIQ\DO 35\2012 5 year Review\Fig 6-4 PMP MWs.dwg
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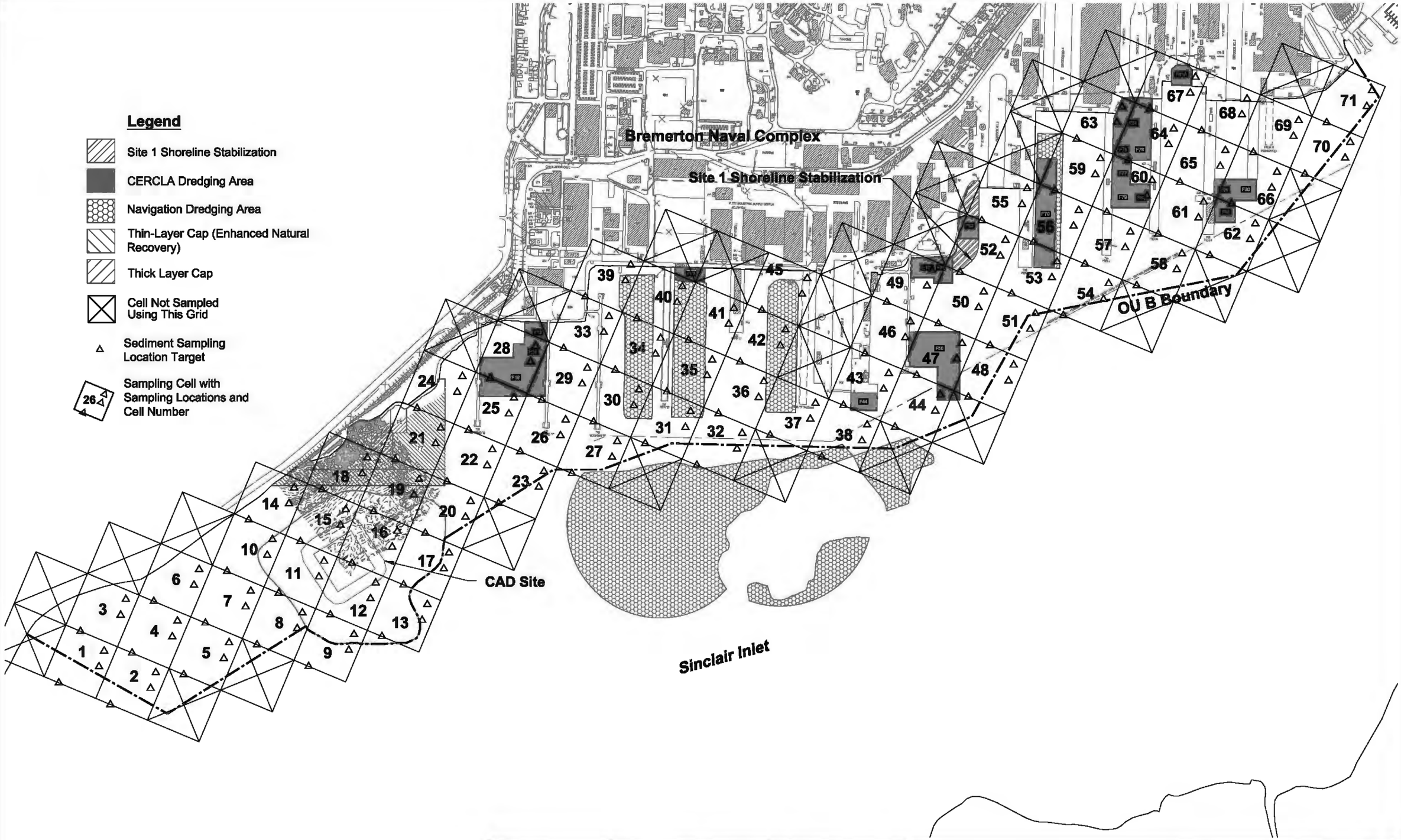
U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

Figure 6-4
PMP Monitoring Well Locations



U.S. NAVY	Bremerton Naval Complex THIRD FIVE-YEAR REVIEW	0 400 800 SCALE IN FEET	Figure 6-5 OU B Marine Surface Sediment 500-Foot Sampling Grid

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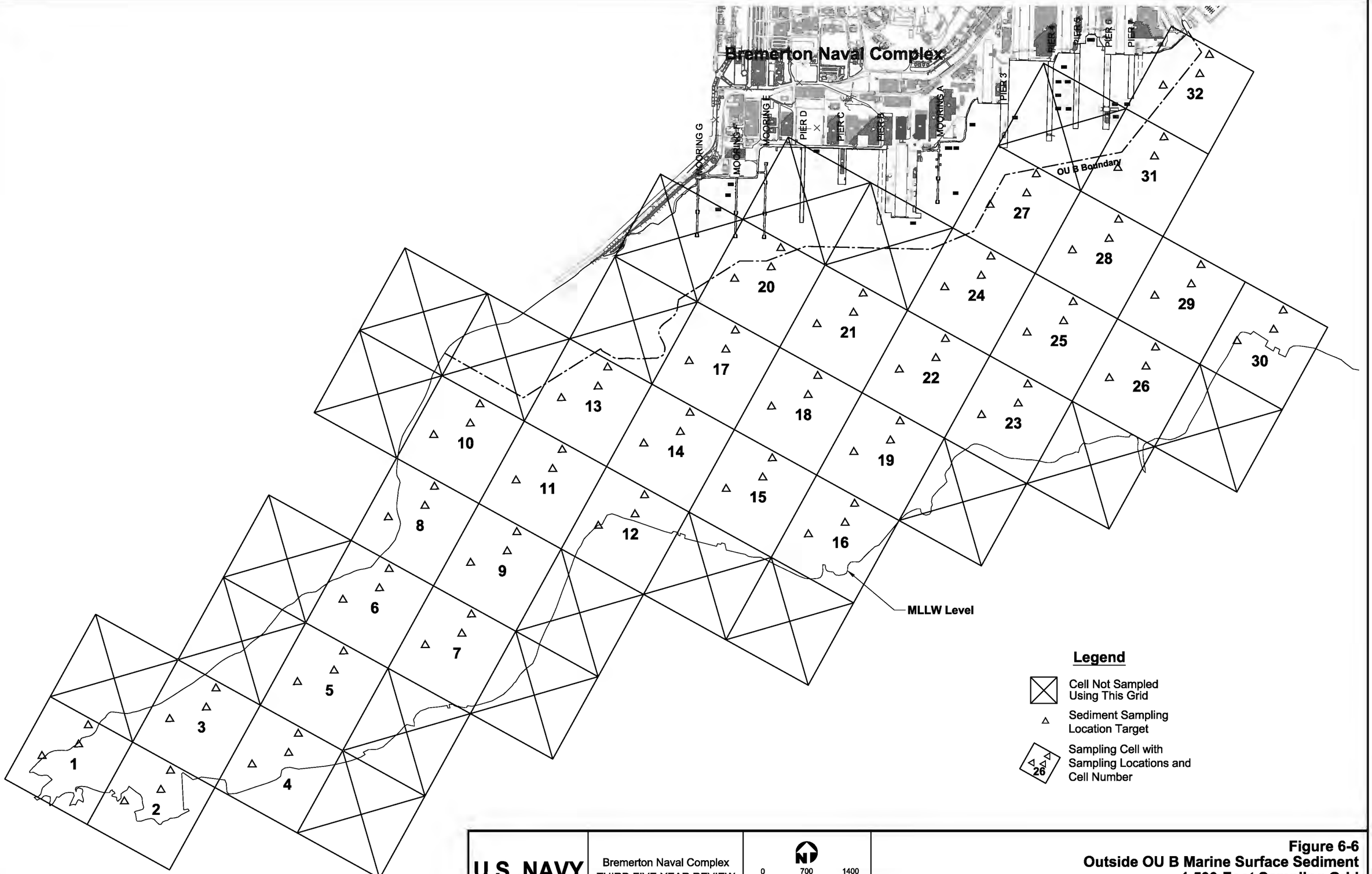

Figure 6-6
Outside OU B Marine Surface Sediment
1,500-Foot Sampling Grid

Drydock No. 1
Drydock No. 2
Drydock No. 3
Drydock No. 4
Drydock No. 5
Drydock No. 6
Mooring A
Pier 3
Pier 4
Pier 5
Pier 6
Pier 7
Pier 8
Removed
Pier 9
Pier 'B' Replaced
Sinclair Inlet
SEE INSET A

Legend

- Post-Construction Sediment Sampling Location
- Concentration Exceeds Cleanup Screening Level (CSL)
- Concentration Exceeds Sediment Quality Standard (SQS)
- Cell Not Sampled Using This Grid
- Sediment Sampling Location Target
- Sampling Cell with Sampling Locations and Cell Number

- Pier 7 sampling: October 2009 and June 2010
- Pier 5 & 6 sampling: March 2011
- Quay Wall and Drydock sampling: December 2010, March 2011, and July 2011
- Pier B & 8 including underpier sampling: October 2009, June 2010, and October 2011

INSET A

SCALE IN FEET

U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

SCALE IN FEET

Figure 6-7
Location of Post-Military-Construction Sediment Samples Containing Mercury at Concentrations Above Screening Levels

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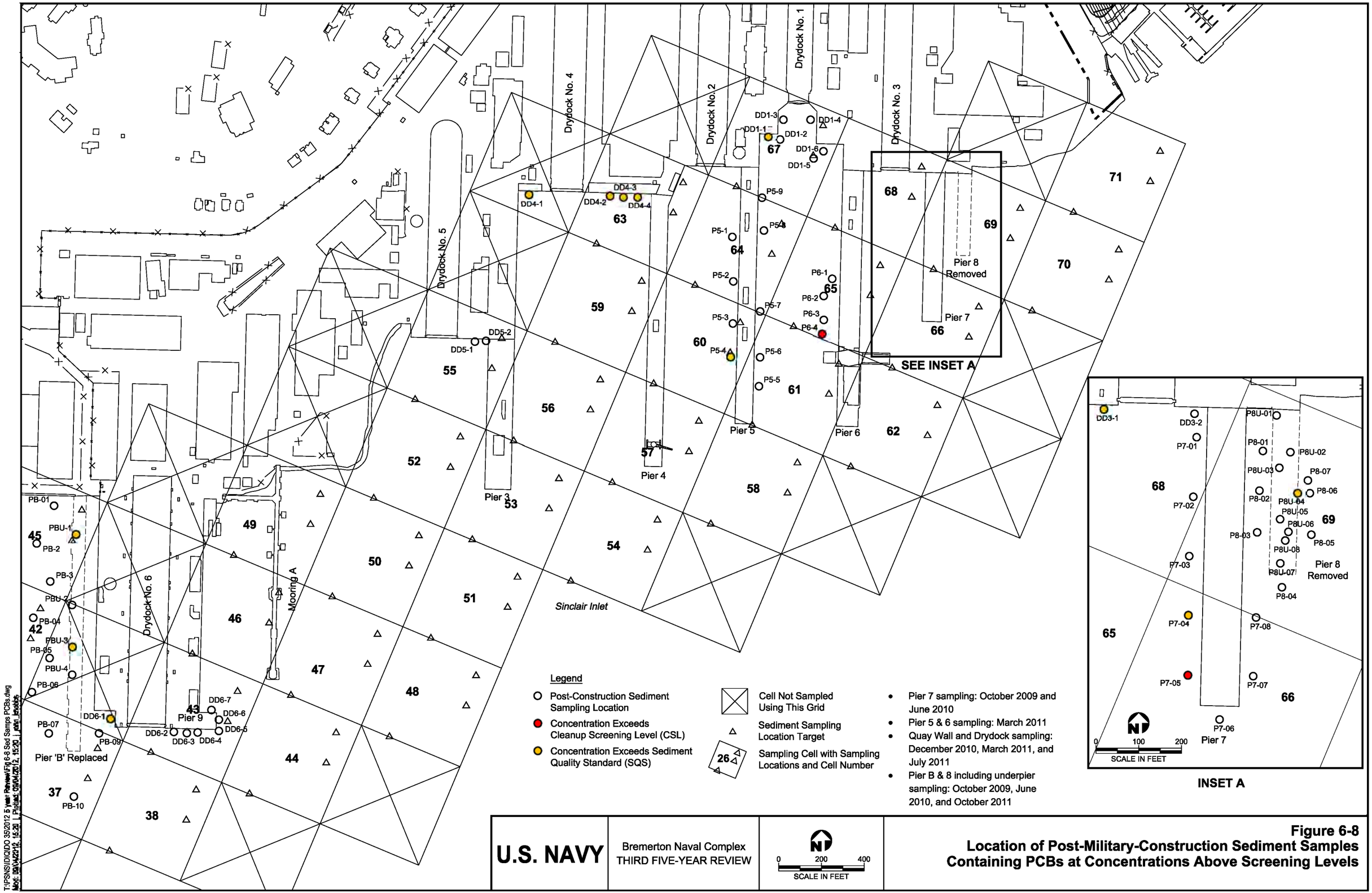


U.S. NAVY	Bremerton Naval Complex THIRD FIVE-YEAR REVIEW	0 200 400 SCALE IN FEET	**Figure 6-8** **Location of Post-Military-Construction Sediment Samples Containing PCBs at Concentrations Above Screening Levels**

T:\PSNS\IDIQ\DO 35\2012 5 year Review\Fig 6-8 Sed Samps PCBs.dwg
Mod: 09/04/2012, 15:20 | Plotted: 09/04/2012, 15:20 | john_brooks

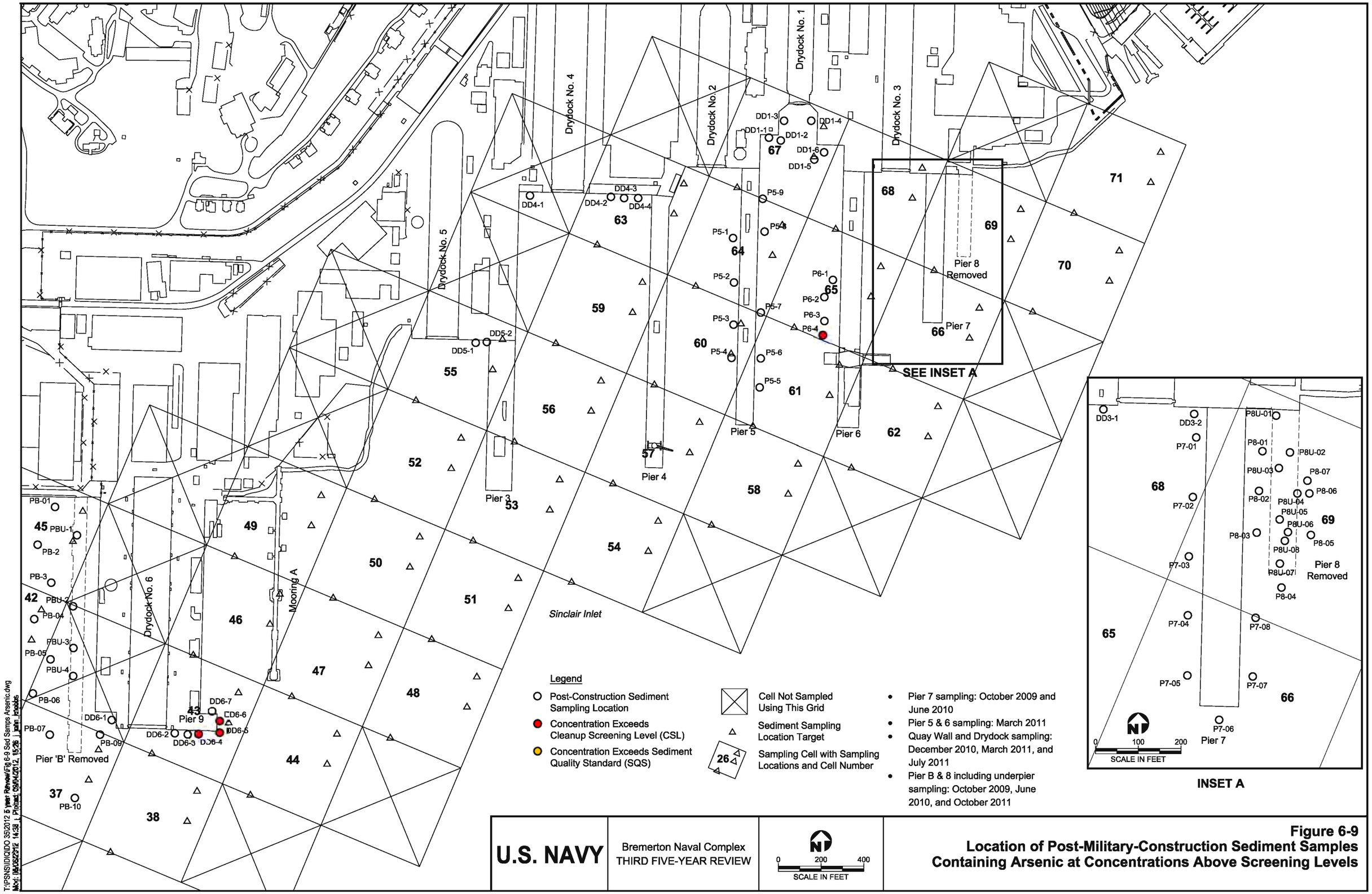
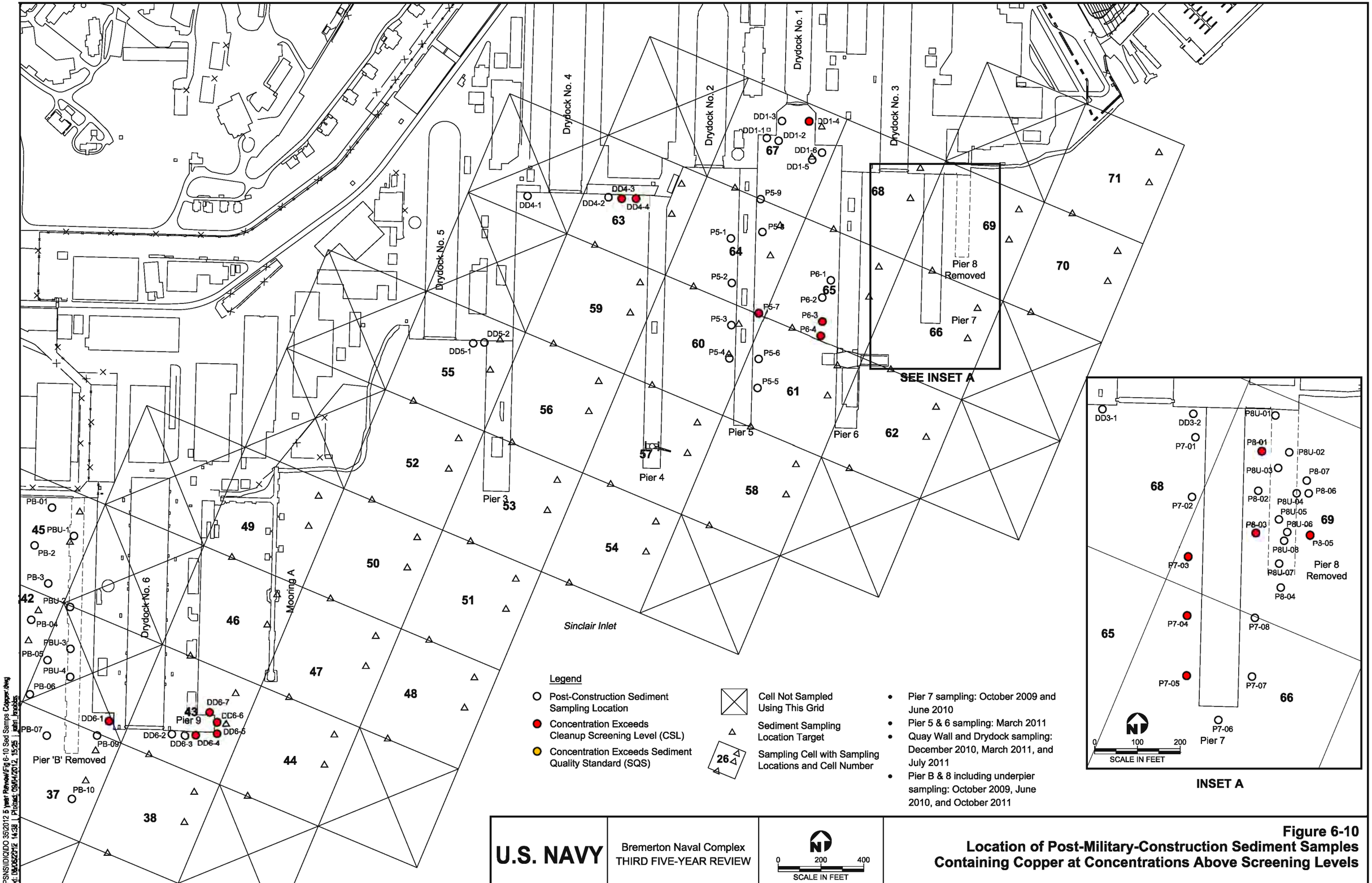


Figure 6-9
Location of Post-Military-Construction Sediment Samples Containing Arsenic at Concentrations Above Screening Levels

T:\PSNS\DI\QDO 35\2012 5 year Review\Fig 6-9 Sed Samps Arsenic.dwg
Mod: 04/05/2012 14:38 | Plotted: 09/04/2012, 15:26 | john_knobbs



U.S. NAVY	Bremerton Naval Complex THIRD FIVE-YEAR REVIEW	0 200 400 SCALE IN FEET	**Figure 6-10** **Location of Post-Military-Construction Sediment Samples Containing Copper at Concentrations Above Screening Levels**

Drydock No. 1
Drydock No. 2
Drydock No. 3
Drydock No. 4
Drydock No. 5
Drydock No. 6
Mooring A
Sinclair Inlet
Pier 3
Pier 4
Pier 5
Pier 6
Pier 7
Pier 8 Removed
Pier 9
Pier 'B' Removed
SEE INSET A

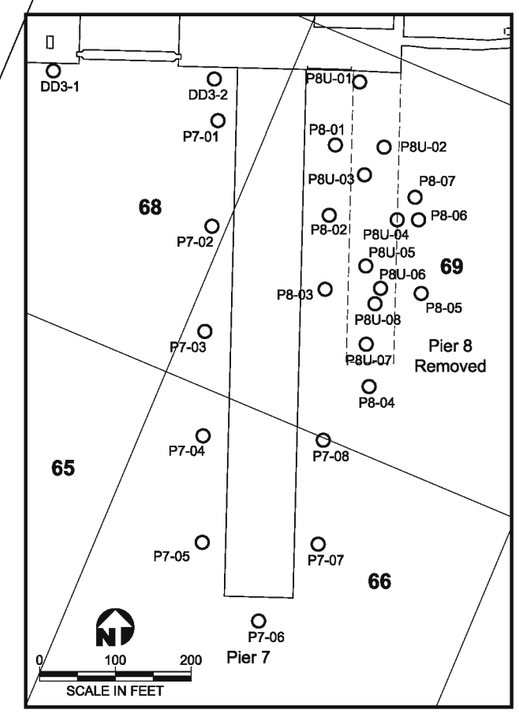
DD1-1 DD1-2 DD1-3 DD1-4 DD1-5 DD1-6
DD4-1 DD4-2 DD4-3 DD4-4
DD5-1 DD5-2
DD6-1 DD6-2 DD6-3 DD6-4 DD6-5 DD6-6 DD6-7
P5-1 P5-2 P5-3 P5-4 P5-5 P5-6 P5-7 P5-8 P5-9
P6-1 P6-2 P6-3 P6-4
PB-01 PB-02 PB-03 PB-04 PB-05 PB-06 PB-07 PB-09 PB-10
PBU-1 PBU-2 PBU-3 PBU-4

37 38 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71

Legend

- Post-Construction Sediment Sampling Location
- Concentration Exceeds Cleanup Screening Level (CSL)
- Concentration Exceeds Sediment Quality Standard (SQS)
- Cell Not Sampled Using This Grid
- Sediment Sampling Location Target
- 26 Sampling Cell with Sampling Locations and Cell Number

- Pier 7 sampling: October 2009 and June 2010
- Pier 5 & 6 sampling: March 2011
- Quay Wall and Drydock sampling: December 2010, March 2011, and July 2011
- Pier B & 8 including underpier sampling: October 2009, June 2010, and October 2011



INSET A

U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

0 200 400
SCALE IN FEET

Figure 6-11
Location of Post-Military-Construction Sediment Samples Containing Chromium or Lead at Concentrations Above Screening Levels

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Mod: 09/05/2012, 14:38 | Plotted: 09/04/2012, 15:22 | jatin_krobbs

Drydock No. 4
Drydock No. 2
Drydock No. 1
Drydock No. 3
Drydock No. 5
Drydock No. 6
Mooring A
Pier 3
Pier 4
Pier 5
Pier 6
Pier 7
Pier 8
Removed
Pier 9
Pier 'B' Removed
Sinclair Inlet
SEE INSET A

Legend

- Post-Construction Sediment Sampling Location
- Concentration Exceeds Cleanup Screening Level (CSL)
- Concentration Exceeds Sediment Quality Standard (SQS)
- Cell Not Sampled Using This Grid
- Sediment Sampling Location Target
- Sampling Cell with Sampling Locations and Cell Number

- Pier 7 sampling: October 2009 and June 2010
- Pier 5 & 6 sampling: March 2011
- Quay Wall and Drydock sampling: December 2010, March 2011, and July 2011
- Pier B & 8 including underpier sampling: October 2009, June 2010, and October 2011

SCALE IN FEET

INSET A

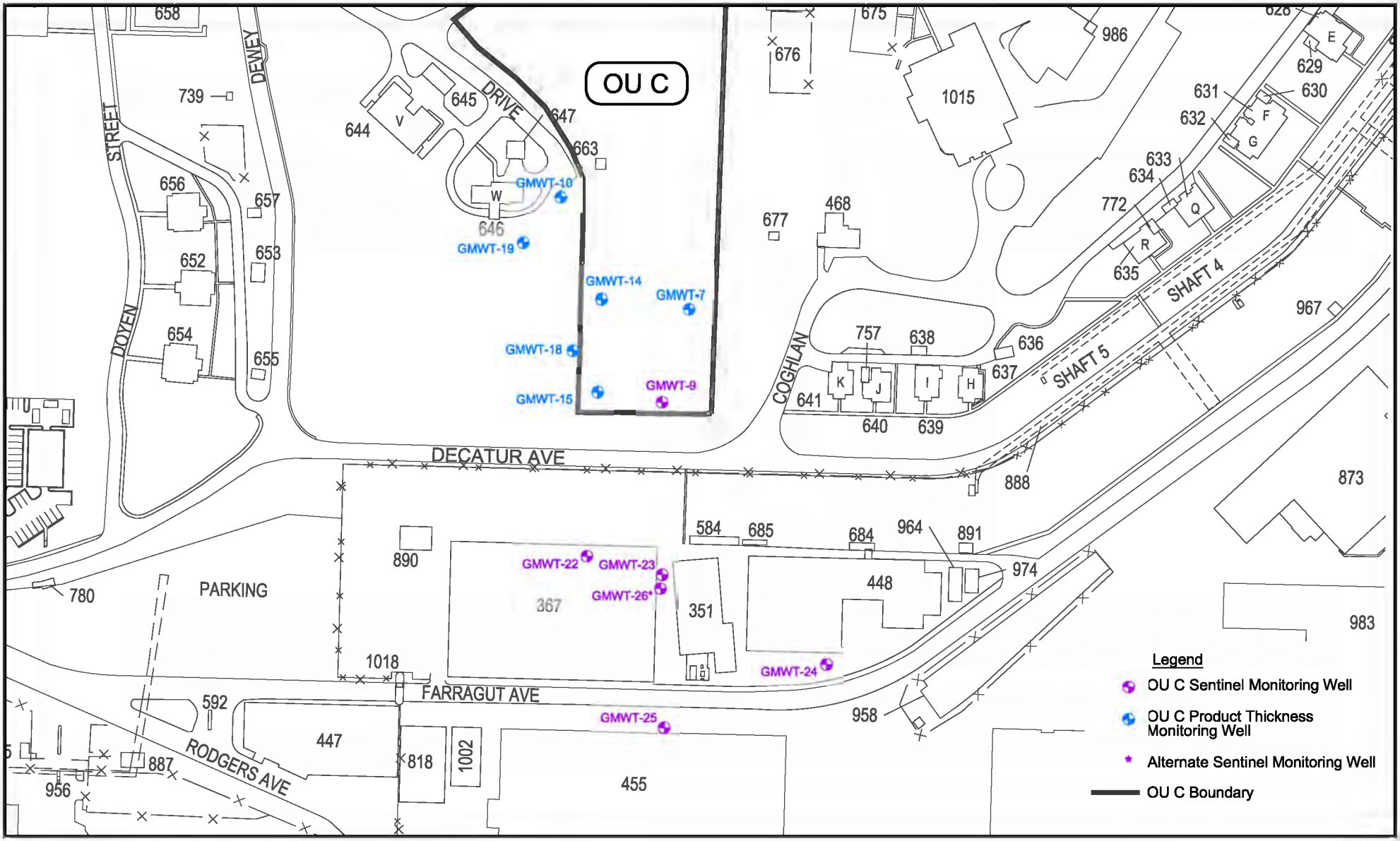
T:\PSNS\DI\QDO 35\2012 5 year Review\Fig6-12 Sed Samps Zinc.dwg
Mod: 09/06/2012, 14:39 | Plotted: 09/04/2012, 15:22 | jahn_knobbs

U.S. NAVY

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

SCALE IN FEET

Figure 6-12
Location of Post-Military-Construction Sediment Samples Containing Zinc at Concentrations Above Screening Levels



U.S. NAVY

0 100 200
SCALE IN FEET

Figure 6-13
OU C Monitoring Well Locations

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

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U.S. NAVY	Bremerton Naval Complex THIRD FIVE-YEAR REVIEW	0 300 600 SCALE IN FEET	**Figure 6-14** **Shoreline Segments**

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Table 6-1
Summary of Analytical Results for OU A Groundwater Sampling

Sampling Location	Sample Date	Total Arsenic (µg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Nickel (µg/L)	Total Zinc (µg/L)
	Ambient Level	**5**	**2.2**	**2**	**10**	**18.5**
	ROD RG	**0.5**	**2.5**	**5.8**	**7.9**	**76.6**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**
203	08/20/2002	***120***	*2.25*	0.031	0.97	1.6
	02/19/2003	***131***	***3.72***	0.062 U	1.25	2.2
	08/11/2003	***98.6***	***3.51***	0.07 U	1.15	1.9 U
	02/23/2004	***85.1 J***	***2.61 J***	0.05 U	2.15 J	2.3 J
	08/30/2004	***99.2 J***	***4.02***	0.077 U	2.29 J	3.53 J
	02/21/2005	***111 J***	3 U	0.145 U	1.84 U	2.97 U
	08/05/2005	***92.8***	*2.32*	0.023	1.65	2.51
	01/16/2006	***76.3***	***2.86***	0.224	2.61	6.51
	08/24/2006	***131***	1.83 J	0.025	1.94	2.1
	02/05/2007	***162***	***2.56 J***	1.6 J	0.73	2.5
	08/01/2007	***182***	***11.1***	NA	NA	NA
	08/04/2008	***150***	1.89	NA	0.94	1.08
	10/02/2009	***188***	***4.88***	NA	NA	NA
	08/16/2010	***157***	1.240	NA	NA	NA
	10/12/2011	***177 J***	NA	NA	NA	NA
204	08/20/2002	**1.36**	***9.52***	0.046	**8.59**	***129***
	02/20/2003	**1.42**	***13.5***	0.129 U	***10.9***	***132***
	08/11/2003	**1.53**	***16.8***	0.12 U	**10**	***154***
	02/23/2004	**1.1 J**	***8.64 J***	0.05 U	***16.3 J***	***114 J***
	08/30/2004	**1.35 J**	***14.2***	0.069 U	***16.6 J***	***160 J***
	02/21/2005	**1.26 J**	***11.5***	0.112 U	***13.1***	***104***
	08/04/2005	**1.16**	***14.1***	0.237	***16.1***	***124***
	01/16/2006	**0.95**	***9.9***	0.214	***13.9***	***112***
	08/24/2006	**1.05**	***11.2 J***	0.065	***14.3***	***140***
	02/05/2007	**1.12**	***9.93 J***	0.144 J	***13.7***	***115***
	08/01/2007	NA	NA	NA	***13.0***	NA
	08/04/2008	**1.58**	***15.1***	NA	***14.9***	***153***
	10/02/2009	NA	NA	NA	**8.17 J**	NA
	08/16/2010	**1.2**	***12.1***	NA	7.19	***93.1***
206	08/20/2002	***7.83***	0.67	0.015 J	0.52	12.6
	02/19/2003	**2.62**	***4.2***	1.96	0.58	9.6
	08/11/2003	**2.86**	1.05	0.37	1.4	1.8 U
	02/23/2004	**2.4 J**	2.12 J	1.2 J	0.88 J	16.6 J
	08/30/2004	**2.14 J**	0.724	0.29	0.28 UJ	5.29 J
	02/21/2005	**2.11 J**	0.91 U	0.341 U	0.29 U	3.14 U
	08/05/2005	**3.4**	1.33 J	0.026 J	**7.97**	0.64 J
	01/16/2006	**3.6**	1.85 J	0.289 J	0.2 U	6.16 J
	08/24/2006	**3.55**	1.06	0.127	1.44	2.1

Table 6-1 (Continued)
Summary of Analytical Results for OU A Groundwater Sampling

Sampling Location	Sample Date	Total Arsenic (µg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Nickel (µg/L)	Total Zinc (µg/L)
	Ambient Level	**5**	**2.2**	**2**	**10**	**18.5**
	ROD RG	**0.5**	**2.5**	**5.8**	**7.9**	**76.6**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**
206 (cont.)	02/05/2007	**3.6**	1.29	0.208	1.16	6.3
	08/01/2007	**3.69**	NA	NA	NA	NA
	08/04/2008	**4.0**	NA	NA	NA	NA
	10/02/2009	**3.69**	NA	NA	NA	NA
	08/16/2010	**2.64**	NA	NA	0.40	NA
	10/11/2011	**3.91 J**	NA	NA	NA	NA
241	08/20/2002	***7.72***	***16.7***	0.944	0.6	15.6
	02/19/2003	***5.21***	***10.7***	0.697	***14.7***	***158***
	08/11/2003	***5.7***	***23.8***	0.22	***18.5***	***161***
	02/23/2004	**4.5 J**	***13.3 J***	1.14 J	***15.4 J***	***83.2 J***
	08/30/2004	**4.93 J**	***15***	0.153	***25.7 J***	*62.5 J*
	02/21/2005	**4.98 J**	***4.81 U***	0.276 U	5.46 U	16.7
	08/04/2005	**3.34**	***12.8***	0.143	***46.6***	***499***
	01/16/2006	**2.64**	***11.3***	0.358	***36.7***	***409***
	08/24/2006	***9.06***	***7.10 J***	0.468	3.30	8.79
	02/05/2007	**4.26**	***5.11 J***	0.241 J	***18.7***	***81.5***
	08/01/2007	NA	NA	NA	NA	NA
	08/04/2008	**4.0**	***3.59***	NA	***22.5***	***156***
	10/02/2009	NA	NA	NA	NA	NA
	08/16/2010	**3.17**	***14.0***	NA	***23.3***	***337***
346[a]	08/21/2002	**3**	0.11 U	0.004 U	0.82	0.2 U
	02/20/2003	**3.31**	0.14 U	0.042 U	0.61 U	0.4 U
	08/13/2003	**2.09**	0.46 U	0.16	1.03	1.4 U
	02/24/2004	**2.7 J**	0.14 J	0.07 U	0.16 UJ	0.6 J
	08/31/2004	**1.75 J**	***9.49***	0.041 U	***94.9 J***	6.86 J
	02/22/2005	**1.71 J**	0.22 U	0.047 U	0.37 U	0.47 U
	08/03/2005	**2.7**	0.26 J	0.014 J	1.08	0.78 J
	01/17/2006	**2.8**	0.2 UJ	0.04 UJ	0.4 UJ	1.14 J
	08/25/2006	**2.71**	0.09 J	0.020 U	0.39	9.7
	02/05/2007	**2.65**	0.06 B	0.009 U	0.62	0.5
	08/01/2007	**2.79**	0.06 B	0.009 U	0.45	4.7 J
	08/04/2008	NA	NA	NA	NA	NA
	10/02/2009	**2.66**	0.13	0.030 U	0.47	0.31
	08/17/2010	**2.89**	0.10 UJ	0.030 UJ	0.51	0.80 UJ
	10/12/2011	**2.77 J**	0.18 J	0.030 UJ	1.08	NA

[a]Background monitoring location (see Figure 6-4), not in OU A.

Table 6-1 (Continued)
Summary of Analytical Results for OU A Groundwater Sampling

Notes:
Bold sampling value exceed the RG value.
Italic sampling value is a detection above ambient level, but below cleanup level.
Bold and italic sampling value exceeds both the ambient level and RG value.
B - Concentration is above the method detection limit, but below the reporting limit.
J - estimated value
µg/L - microgram per liter
NA - not analyzed
OU - operable unit
RG - remediation goal
ROD - Record of Decision
U - not detected above method reporting limit

Table 6-2
Summary of Analytical Results for OU NSC Groundwater Sampling

Sampling Location	Sample Date	Total Arsenic (µg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Nickel (µg/L)	TPH (Total) (µg/L)	TPH-D (µg/L)	TPH-G (µg/L)	TPH-Dx (µg/L)
Ambient Level		**5**	**2.2**	**2**	**10**	**NE**	**NE**	**NE**	**NE**
ROD RG		**0.5**	**2.5**	**5.8**	**7.9**	**1,000**	**NE**	**NE**	**NE**
Current Reg. Level		**0.0982**	**3.1**	**8.1**	**8.2**	**NE**	**500**	**800**	**500**
310/310R	08/21/2002	**0.96**	0.54	0.009 J	1.25	189 J	58 J	21 U	110 J
	02/20/2003	**1.05**	0.58 U	0.058 U	1.91	158 U	45 U	21 U	92 U
	08/13/2003	**0.88**	1.2	0.05 U	3.07	105 J	39 J	12 U	54 U
	02/24/2004	**0.8 J**	0.48 J	0.03 U	1.48 J	12 U	NA	12 U	NA
	08/31/2004	**0.57 J**	*2.42*	0.73	**9.3 J**	NA	NA	NA	NA
	02/21/2005	0.41 J	1.59 U	0.289 U	**9.69**	NA	NA	NA	NA
	08/04/2005	0.38 J	0.949	0.102	**8.77**	NA	NA	NA	NA
	02/06/2007	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)
	08/02/2007	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)	NA (Dry)
	08/05/2008	**3.65**	NA	NA	***21.5***	NA	NA	NA	NA
	10/01/2009	NA	NA	NA	***10.3***	NA	NA	NA	NA
	08/17/2010	**2.46**	1.00	0.061 UJ	3.30	NA	110 UJ	NA	110 UJ
	10/13/2011	**3.78 J**	1.48 J	0.108	6.16	NA	NA	NA	NA
380	08/21/2002	0.29 J	*2.49*	0.536	4.19	193 J	52 J	21 U	120 J
	02/20/2003	0.14 J	*2.41*	0.286	1.69	209 J	68 J	21 U	120 J
	08/12/2003	0.24 J	***4.24***	2.72	***51.2***	332 J	120 J	12 U	200 J
	02/24/2004	0.2 UJ	0.33 J	0.21 U	**8.29 J**	12 U	NA	12 U	NA
	08/30/2004	0.17 J	2.02	0.474	***12.6 J***	NA	NA	NA	NA
	02/22/2005	0.16 J	1.66 U	0.531 U	***14***	NA	NA	NA	NA
	08/03/2005	0.27 J	1.75	0.54	4.6	NA	NA	NA	NA
	01/17/2006	0.16 J	1.29	0.095	1.48	NA	NA	NA	NA
	08/28/2006	0.21 J	1.73	0.256	***33.8***	NA	NA	NA	NA
	02/06/2007	0.42 B	***3.05 J***	*2.02 J*	4.18	NA	NA	NA	NA
	08/02/2007	NA	NA	NA	***11.6***	NA	NA	NA	NA
	08/05/2008	0.50 J	*2.48*	NA	**9.80**	NA	NA	NA	NA
	10/01/2009	NA	NA	NA	***23.5 J***	NA	NA	NA	NA
	08/17/2010	0.16 J	1.670	NA	***24.8 J***	NA	NA	NA	NA
	10/11/2011	NA	NA	NA	5.17	NA	NA	NA	NA
386	08/20/2002	0.42 J	1.37	0.018 U	2.88	21 U	NA	21 U	NA
	02/20/2003	**0.82**	1.06	0.014 U	3.54	247 J	46 U	21 U	180 J
	08/12/2003	**0.55**	1.35	0.02 U	4.63	104 J	36 U	13 J	55 J
	02/24/2004	**0.6 J**	1.09 J	0.04 U	2 J	548 U	36 U	12 U	500 U
	08/30/2004	**0.56 J**	1.12	0.01 U	2.5 J	NA	NA	NA	NA
	02/22/2005	**0.61 J**	1.34 U	0.361 U	3.41 U	NA	NA	NA	NA
	08/03/2005	**0.61**	1.25	0.027	3.19	NA	NA	NA	NA
	01/17/2006	**3.1**	*2.42*	0.102	2.86	NA	NA	NA	NA

Table 6-2 (Continued)
Summary of Analytical Results for OU NSC Groundwater Sampling

Sampling Location	Sample Date	Total Arsenic (µg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Nickel (µg/L)	TPH (Total) (µg/L)	TPH-D (µg/L)	TPH-G (µg/L)	TPH-Dx (µg/L)
Ambient Level		**5**	**2.2**	**2**	**10**	**NE**	**NE**	**NE**	**NE**
ROD RG		**0.5**	**2.5**	**5.8**	**7.9**	**1,000**	**NE**	**NE**	**NE**
Current Reg. Level		**0.0982**	**3.1**	**8.1**	**8.2**	**NE**	**500**	**800**	**500**
386 (cont.)	08/25/2006	***9.82***	***3.94***	0.121	1.61	NA	NA	NA	NA
	02/06/2007	**3.51**	1.65	0.039 J	1.33	NA	NA	NA	NA
	08/01/2007	***5.06***	*2.25*	0.140	NA	NA	NA	NA	NA
	08/05/2008	**2.74**	1.78	0.132	NA	NA	NA	NA	NA
	10/01/2009	**1.61**	1.67	0.053 U	NA	NA	NA	NA	NA
	08/17/2010	**1.64**	1.66	NA	NA	NA	NA	NA	NA
	10/11/2011	**2.67 J**	1.68 J	NA	NA	NA	NA	NA	NA
392/392R	08/21/2002	**0.7**	***8.71***	0.878	1.18	**5,421 J**	4,000 J	21 U	1,400
	02/19/2003	**1.18**	***5.37***	***6.48***	2.85	**6,821**	3,000	21 U	3,800
	08/12/2003	**0.99**	***5.45***	1.11	0.85	**5,812**	4,200	12 U	1,600
	02/24/2004	**1.3 J**	1.61 J	0.48 J	0.8 J	**13,212 J**	5,100 J	12 U	8,100
	08/31/2004	**1.36 J**	*2.35*	0.599	0.75 UJ	NA	NA	NA	NA
	02/22/2005	0.44 J	0.32 U	0.07 U	0.19 U	NA	NA	NA	NA
	08/05/2005	**1.02**	0.639	0.157	0.24	NA	NA	NA	NA
	01/18/2006	0.37 J	0.657	0.201	0.72	NA	NA	NA	NA
	08/28/2006	0.47 J	***5.37***	0.908	0.68	NA	NA	NA	NA
	02/06/2007	0.16 B	0.81 J	1.29 J	0.44 J	NA	NA	NA	NA
	08/02/2007	NA	NA	NA	NA	**7,700**	5,400	NA	2,300
	08/15/2008	**4.11** J	0.298	NA	NA	NA	290 U	NA	520 U
	08/17/2010	0.10J	0.082 J	NA	NA	NA	110 U	NA	110 U
	10/11/2011	NA	NA	NA	NA	NA	1,400 Y	NA	570 L
346[a]	08/21/2002	**3**	0.11 U	0.004 U	0.82	566 UJ	45 U	21 U	500 UJ
	02/20/2003	**3.31**	0.14 U	0.042 U	0.61 U	104 U	45 U	21 U	38 U
	08/13/2003	**2.09**	0.46 U	0.16	1.03	102 U	36 U	12 U	54 U
	02/24/2004	**2.7 J**	0.14 J	0.07 U	0.16 UJ	102 U	36 U	12 U	54 U
	08/31/2004	**1.75 J**	***9.49***	0.041 U	***94.9 J***	NA	NA	NA	NA
	02/22/2005	**1.71 J**	0.22 U	0.047 U	0.37 U	NA	NA	NA	NA
	08/03/2005	**2.8**	0.26 J	0.014 J	1.08	778 J	28 J	250 U	500 U
	01/17/2006	**3**	0.2 U	0.04 U	0.04 UJ	1,020 U	260 U	250 U	510 U
	08/25/2006	**2.7**	0.10	0.012 J	0.45	1,030 U	260 U	250 U	520 U
	02/06/2007	**2.75**	0.07 B	0.009 U	0.53	530U	NA	NA	NA
	08/02/2007	**2.79**	0.06 B	0.009 U	0.45	500U	250 U	NA	500 U
	08/05/2008	NA	NA	NA	NA	NA	NA	NA	NA
	09/30/2009	**2.72**	0.13	0.030 U	0.47	0.31 J	270 U	NA	530 U
	08/17/2010	**2.89**	0.10 UJ	0.030 UJ	0.51	NA	110 U	NA	110 U
	10/12/2011	**2.77 J**	0.18 J	0.030 UJ	1.08 J	NA	NA	NA	NA

Table 6-2 (Continued)
Summary of Analytical Results for OU NSC Groundwater Sampling

[a]Background monitoring location (see Figure 6-4), not in OU NSC.

Notes:
Bold sampling value exceeds the RG value.
Italic sampling value is a detection above ambient level, but below cleanup level.
Bold and italic sampling value exceeds both the ambient level and RG value.
B - Concentration is above the method detection limit, but below the reporting limit.
J - estimated value
L - Chromatographic fingerprint of the sample resembles a petroleum product with a lighter component than the calibration standard.
µg/L - microgram per liter
NA - not analyzed
NE - not established
OU NSC - Operable Unit Naval Supply Center
Reg. - Regulatory
RG - remediation goal
ROD - Record of Decision
TPH - total petroleum hydrocarbon
TPH-D - total petroleum hydrocarbons—diesel
TPH-Dx - total petroleum hydrocarbons as diesel and heavy oil
TPH-G - total petroleum hydrocarbons—gasoline
U - not detected above method reporting limit

Table 6-3
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
LTMP-1	08/18/2004	NA	NA	NA	NA	NA	0.2 U
	12/02/2004	NA	NA	NA	NA	NA	0.2 U
	03/03/2005	2.8 J	**20.6 J**	0.32	**9.2**	**230**	0.2 U
	05/12/2005	2.5 J	**29.2**	0.42	**10 J**	**303**	0.2 U
	07/14/2005	1.88 J	**64.2**	0.575	**12.2**	**414 J**	NA
	10/19/2005	1.78	**74.4**	1.38	**19.8**	**498**	**0.27**
	01/19/2006	1.76	**57.8**	0.384 J	**9.37**	**394 J**	**0.12 J**
	04/17/2006	1.06 J	**38**	1.06	**17.8 J**	**559**	**0.13 B**
	10/10/2006	1.81	**40.5**	1.03	5.66	**234 J**	**0.21 B**
	10/09/2007	NA	**81.8**	NA	**29.9**	**823**	**0.15 B**
	10/14/2008	NA	**85.2**	NA	**19.5**	**645**	NA
	11/10/2008	NA	NA	NA	NA	NA	**0.156**[b]
	04/01/2009	NA	NA	NA	NA	NA	**0.057**[b]
	10/21/2009	NA	**54.3**	NA	**14.6 J**	**472**	NA
	11/04/2009	NA	NA	NA	NA	NA	**0.089**[b]
	04/05/2010	NA	NA	NA	NA	NA	**0.174**[b]
	10/13/2010	NA	**54.3 J**	NA	**13.9**	**436**	NA
	11/08/2010	NA	NA	NA	NA	NA	**0.117**[b]
	04/05/2011	NA	NA	NA	NA	NA	**0.116**[b]
	10/31/2011	NA	**84.8**	NA	**19.5**	**680**	**NA**
	11/10/2011	NA	NA	NA	NA	NA	**0.113b**
LTMP-2	08/18/2004	NA	NA	NA	NA	NA	0.2 U
	12/02/2004	NA	NA	NA	NA	NA	0.2 U
	03/03/2005	0.5 UJ	0.9 J	0.02 U	1.1	2.1	0.2 U
	05/11/2005	0.5 UJ	0.9	0.02 U	2.4 J	1.8	0.2 U
	07/14/2005	0.15 J	0.917	0.028	1.68	1.3 J	NA
	10/19/2005	1.5	1.08	0.023 U	2.16	2.6	0.2 U
	01/19/2006	0.09 J	0.676	0.02 U	0.59	1.03 J	0.2 U
	04/12/2006	5.0 U	2.43	0.10 U	6.42	3.99 U	0.2 U
	10/10/2006	0.93	1.07	0.012 B	1.80	2.0 J	0.02 UJ
	10/09/2007	NA	NA	NA	NA	NA	0.20 U
	10/14/2008	NA	NA	NA	NA	NA	NA
	11/03/2008	NA	NA	NA	NA	NA	0.005[b]
	03/30/2009	NA	NA	NA	NA	NA	0.023[b]
	10/21/2009	NA	NA	NA	NA	NA	NA
	11/02/2009	NA	NA	NA	NA	NA	0.00265[b]
	04/05/2010	NA	NA	NA	NA	NA	0.00724[b]
	10/13/2010	NA	NA	NA	NA	NA	NA
	11/08/2010	NA	NA	NA	NA	NA	0.0178[b]

Table 6-3 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
LTMP-3	08/30/2004	NA	NA	NA	NA	NA	**2.4**
	12/01/2004	NA	NA	NA	NA	NA	**2.89 J**
	03/01/2005	**6.1 J**	**103**	1.78	**19.5**	**303**	**2.48**
	05/12/2005	**5.9 J**	**88**	1.99	**18 J**	**262**	**6.69**
	07/14/2005	4.73 J	**105**	2.9	**21.6**	**307 J**	NA
	10/19/2005	4.95	**123**	2.75	**21.6**	**526**	**3.34**
	01/19/2006	4.71	**83.6**	1.09 J	**20.7**	**338 J**	**2.05**
	04/12/2006	**17.6 BJ**	**87.1**	1.83	**34.5**	**234**	**3.82**
	10/10/2006	4.88	**189**	3.78	**10.7**	**554 J**	**4.92**
	10/10/2007	4.36 J	**209**	NA	**20.7**	NA	**3.44**
	10/14/2008	3.74	**62**	NA	5.7	**134**	NA
	11/10/2008	NA	NA	NA	NA	NA	**3.68**[b]
	04/02/2009	NA	NA	NA	NA	NA	**1.19**[b]
	10/23/2009	4.95	**114**	**NA**	**18.6 J**	**301**	NA
	11/05/2009	NA	NA	NA	NA	NA	**0.774**[b]
	04/05/2010	NA	NA	NA	NA	NA	**2.34**[b]
	10/14/2010	4.98	**65.9 J**	NA	**8.75**	**171**	NA
	11/08/2010	NA	NA	NA	NA	NA	**1.76**[b]
	04/05/2011	NA	NA	NA	NA	NA	**0.614**[b]
	10/31/2011	**5.45**	**157**	NA	**14**	**384**	NA
	11/14/2011	NA	NA	NA	NA	NA	**2.17**[b]
LTMP-4[a]	08/27/2004	NA	NA	NA	NA	NA	0.0006 U
	11/30/2004	NA	NA	NA	NA	NA	0.001 U
	02/24/2005	0.007 J	0.016 J	0.00009 J	0.045	0.003 J	0.0006 U
	05/10/2005	0.03 J	0.005	0.0002	0.04 J	0.005	0.0006 U
	07/14/2005	0.042	0.011	0.0002	0.014	0.003	NA
	11/08/2005	0.030	0.011	0.00012	0.018	0.002	0.001 U
	01/24/2006	0.031	0.032	0.00008 U	0.062	0.002	0.0008 U
	04/13/2006	0.011	0.016	0.00005 U	0.035	0.007	0.0003 U
	10/11/2006	0.016	0.067	0.00143	0.055	0.005	0.001 U
	10/15/2007	0.030	0.026	NA	0.074	NA	0.001 U
	10/16/2008	0.034 U	0.014	NA	0.042	NA	NA
	11/04/2008	NA	NA	NA	NA	NA	0.00002[b]
	3/31/2009	NA	NA	NA	NA	NA	0.00001[b]
	10/23/2009	0.2	0.01	NA	0.02	NA	NA
	11/02/2009	NA	NA	NA	NA	NA	0.000011[b]
	03/31/2010	NA	NA	NA	NA	NA	0.000008 U[b]
	10/19/2010	0.01	0.003	NA	0.01	NA	NA

Table 6-3 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
LTMP-4[a]	11/04/2010	NA	NA	NA	NA	NA	0.00031[b]
(cont.)	11/01/2011	0.048	0.016 J	NA	0.082	NA	NA
LTMP-5	08/19/2004	NA	NA	NA	NA	NA	**0.5**
	11/30/2004	NA	NA	NA	NA	NA	0.2 U
	02/28/2005	1.2 J	**3.1**	0.21 J	2.6	8.7	**0.23**
	05/10/2005	1 J	**3.2**	0.2	1.6 J	7.7	**0.26**
	07/14/2005	1.13 J	1.45	0.183	1.09	7.16 J	NA
	10/18/2005	1.01	1.35	0.289	1.02	6.96	**5.24**
	01/19/2006	1.01	1.22	0.081 J	**14.9**	16 J	0.2 U
	04/17/2006	0.92 U	1.04	0.071	2.86	7.76	0.2 U
	10/10/2006	1.05	1.37	0.306	0.94	7.01 J	0.02 BJ
	10/11/2007	NA	NA	NA	1.19	NA	0.20 U
	10/15/2008	NA	NA	NA	NA	0.86	NA
	11/06/2008	NA	NA	NA	NA	NA	**0.042**[b]
	04/01/2009	NA	NA	NA	NA	NA	**0.028**[b]
	10/23/2009	NA	NA	NA	0.74 J	NA	NA
	11/04/2009	NA	NA	NA	NA	NA	0.0245[b]
	04/01/2010	NA	NA	NA	NA	NA	**0.0522**[b]
	10/14/2010	NA	NA	NA	NA	NA	NA
	11/08/2010	NA	NA	NA	NA	NA	**0.0482**[b]
	04/05/2011	NA	NA	NA	NA	NA	**0.0353**[b]
	11/10/2011	NA	NA	NA	NA	NA	**0.0615**[b]
410[a]	08/25/2004	NA	NA	NA	NA	NA	0.011
	12/03/2004	NA	NA	NA	NA	NA	**0.100 U**
	03/02/2005	0.17 J	0.38 J	0.004 U	1.24	34	**0.048**
	05/11/2005	0.09 J	0.05	0.001 U	0.04 J	1.9	0.0006 U
	07/14/2005	0.13	0.06	0.04	0.17	0.13	NA
	10/21/2005	0.11	0.22	0.01	3.20	0.38	0.02 U
	01/23/2006	NA	NA	NA	NA	NA	NA
	04/14/2006	NA	NA	NA	NA	NA	NA
	10/11/2006	NA	NA	NA	NA	NA	NA
410R[a]	10/12/2007	NA	NA	NA	**15.2**	NA	0.138 U
	10/20/2008	NA	NA	NA	**9.9**	NA	NA
	11/05/2008	NA	NA	NA	NA	NA	0.02152[b]
	03/31/2009	NA	NA	NA	NA	NA	0.00333[b]
	10/20/2009	NA	NA	NA	2.08 U	NA	NA
	11/03/2009	NA	NA	NA	NA	NA	0.003[b]
	03/31/2010	NA	NA	NA	NA	NA	0.01[b]
	10/18/2010	NA	NA	NA	7.03	0.79	NA

Table 6-3 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
410R[a] (cont.)	11/04/2010	NA	NA	NA	NA	NA	0.01[b]
	04/04/2011	NA	NA	NA	NA	NA	0.0152[b]
	11/01/2011	NA	NA	NA	7.73	0.816 J	NA
	11/10/2011	NA	NA	NA	NA	NA	0.013
432[a]	08/20/2004	NA	NA	NA	NA	NA	0.002 U
	12/01/2004	NA	NA	NA	NA	NA	0.0017 U
	02/23/2005	0.008 J	0.004 J	0.0006 J	0.075	0.014 J	0.002 U
	05/11/2005	0.02 J	0.002	0.0002	0.05 J	0.005	0.001 U
	07/13/2005	0.037	0.006	0.001	0.011	0.013	NA
	10/21/2005	0.027	0.007 U	0.00047	0.038	0.026	0.002 U
	01/23/2006	0.032	0.004	0.00002 U	0.036	0.006	0.002 U
	04/14/2006	0.007	0.001	0.00003 U	0.004	0.013	0.0003 U
	10/11/2006	0.011	0.014	0.00227	0.032	0.017	0.003 U
	10/16/2007	0.006	NA	NA	NA	NA	0.001 U
	10/20/2008	0.02 U	NA	NA	NA	NA	NA
	11/04/2008	NA	NA	NA	NA	NA	0.00006[b]
	03/30/2009	NA	NA	NA	NA	NA	0.00001[b]
	10/20/2009	0.01	NA	NA	NA	NA	NA
	11/03/2009	NA	NA	NA	NA	NA	0.00001[b]
	04/01/2010	NA	NA	NA	NA	NA	0.00001 U[b]
	10/19/2010	NA	NA	NA	NA	NA	NA
	11/05/2010	NA	NA	NA	NA	NA	0.0000044 U[b]
433[a]	08/26/2004	NA	NA	NA	NA	NA	0.0006 U
	12/02/2004	NA	NA	NA	NA	NA	0.0006 U
	02/22/2005	0.002 J	0.0003 J	0.0006 UJ	0.0006 U	0.002 UJ	0.0006 U
	05/12/2005	0.002 J	0.001	0.001	0.002 J	0.004	0.0006 U
	07/13/2005	0.004	0.0004 U	0.00008	0.002 U	0.002 U	NA
	10/21/2005	0.003	0.002	0.00009 U	0.002	0.003	0.001 U
	01/20/2006	0.003	0.000	0.00008 U	0.000	0.001	0.001 U
	04/14/2006	0.0008 U	0.000	0.00003 U	0.001	0.002 U	0.0003 U
	10/09/2006	0.008	0.001	0.00016	0.004	0.008	0.001 U
	10/11/2007	NA	NA	NA	NA	NA	0.007 U
	10/15/2008	NA	NA	NA	NA	NA	NA
	11/04/2008	NA	NA	NA	NA	NA	0.00005 U[b]
	03/31/2009	NA	NA	NA	NA	NA	0.00001 U[b]
	10/23/2009	NA	NA	NA	NA	NA	NA
	11/03/2009	NA	NA	NA	NA	NA	0.00003968 U[b]
	04/01/2010	NA	NA	NA	NA	NA	0.00000088 U[b]

Table 6-3 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
433[a] (cont.)	10/20/2010	0.03	NA	NA	NA	NA	NA
	11/05/2010	NA	NA	NA	NA	NA	0.0000012 U[b]
704[a]	08/19/2004	NA	NA	NA	NA	NA	0.007 U
	11/30/2004	NA	NA	NA	NA	NA	0.0006 U
	03/01/2005	0.002 J	0.002	0.0006 U	0.0006 U	0.002 U	0.0006 U
	04/15/2005	0.003	0.002	0.0001	0.003	0.002 U	0.0006 U
	07/13/2005	0.003	0.002	0.00008 U	0.002	0.002 U	NA
	10/18/2005	0.003	0.002	0.00008 U	0.003	0.002	0.001 U
	01/23/2006	0.003	0.002	0.00008 U	0.002	0.001	0.001 U
	04/14/2006	0.001	0.001	0.00002	0.001	0.002 U	0.0003 U
	10/09/2006	0.003	0.002	0.00005	0.002	0.008	0.001 U
	10/10/2007	NA	NA	NA	NA	NA	0.007 U
	10/16/2008	NA	NA	NA	NA	NA	NA
	11/03/2008	NA	NA	NA	NA	NA	0.00006[b]
	03/30/2009	NA	NA	NA	NA	NA	0.00018[b]
	10/20/2009	NA	NA	NA	NA	NA	NA
	11/02/2009	NA	NA	NA	NA	NA	0.00016[b]
	03/31/2010	NA	NA	NA	NA	NA	0.00011[b]
	10/20/2010	NA	NA	NA	NA	NA	NA
	11/04/2010	NA	NA	NA	NA	NA	0.00013[b]
707[a]	08/23/2004	NA	NA	NA	NA	NA	0.007 U
	12/01/2004	NA	NA	NA	NA	NA	0.007 U
	02/23/2005	0.006 UJ	0.006 J	0.0003 J	0.16	0.025 J	0.003 U
	05/10/2005	0.125 UJ	0.01	0.0005 U	0.39 J	0.05	0.005 U
	07/14/2005	0.03	0.02	0.01	0.32	0.10	NA
	10/20/2005	4.9 U	1.04	0.05	6.91	1.53	**0.13 U**
	01/23/2006	0.16	0.42	0.18	**10.30**	2.32	**0.052**
	04/13/2006	0.04 U	0.014	0.001 U	0.040	0.025 U	0.002 U
	10/09/2006	0.09	0.023	0.002	0.176	0.14	0.012 U
	10/15/2007	NA	0.034	NA	NA	NA	0.007 U
	10/20/2008	NA	0.042	NA	NA	NA	NA
	11/06/2008	NA	NA	NA	NA	NA	0.00090[b]
	04/01/2009	NA	NA	NA	NA	NA	0.00027[b]
	10/20/2009	NA	0.02	NA	NA	NA	NA
	11/04/2009	NA	NA	NA	NA	NA	0.0013[b]
	04/01/2010	NA	NA	NA	NA	NA	0.0003[b]
	10/19/2010	NA	NA	NA	0.17	NA	NA
	11/05/2010	NA	NA	NA	NA	NA	0.0003[b]

Table 6-3 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Metals

Sampling Location	Sample Date	Dissolved Arsenic (µg/L)	Dissolved Copper (µg/L)	Dissolved Lead (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Total Mercury (µg/L)
	ROD RG	**5**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
Current Regulatory Level		**0.0982**	**3.1**	**8.1**	**8.2**	**81**	**0.025**
346	11/01/2011	2.9	0.13 J	NA	0.80 J	0.38 J	NA
	11/09/2011	NA	NA	NA	NA	NA	0.00017 BJ[b]

[a]Value presented is corrected for attenuation. The laboratory-measured value was reduced by the ratio of groundwater salinity in the well to that of sea water in Sinclair Inlet to obtain the value presented in the table.
[b]Mercury analysis was performed using EPA Method 1631.

Notes:
Results for arsenic, copper, lead, nickel, and zinc are dissolved concentrations. In 2004, only total metals analyses were performed and are not directly comparable to the RGs (which are based on dissolved concentrations).
In July 2005 to fall 2008, dissolved mercury, instead of total mercury, analysis was performed on the samples using a routine laboratory method EPA SW-846 Method 7470 with a typical reporting limit of 0.20 µg/L that was greater than the mercury groundwater compliance criterion of 0.025 µg/L. The Navy elected, starting November 2008, to use clean sampling methodologies and low-level mercury analysis by EPA Method 1631 with a typical reporting limit of 0.0005 µg/L.

Bold sampling value exceeds the RG.
B - Concentration is above the method detection limit, but below the reporting limit.
EPA - U.S. Environmental Protection Agency
J - estimated value
µg/L - microgram per liter
NA - not analyzed
OU B - Operable Unit B
RG - remediation goal
ROD - Record of Decision
U - not detected above method reporting limit

Table 6-4
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – TCE

		ROD RG	55.6			ROD RG	55.6
		Current Regulatory Level	12.8			Current Regulatory Level	12.8
Sampling Location	**Sample Date**	**TCE (µg/L)**		**Sampling Location**	**Sample Date**	**TCE (µg/L)**	
LTMP-1	08/18/2004	0.2 U		LTMP-4[a]	04/13/2006	0.004 U	
	12/02/2004	0.2 U			10/11/2006	0.0006	
	03/03/2005	0.2 U			10/15/2007	NA	
	05/12/2005	0.2 U		LTMP-5	08/19/2004	0.2 U	
	07/14/2005	0.5 U			11/30/2004	0.2 U	
	10/19/2005	0.5 U			02/28/2005	0.2 U	
	01/19/2006	0.5 U			05/10/2005	0.2 U	
	04/17/2006	0.5 U			07/14/2005	0.5 U	
	10/10/2006	0.5 U			10/18/2005	0.5 U	
	10/09/2007	NA			01/19/2006	0.5 U	
LTMP-2	08/18/2004	0.2 U			04/17/2006	0.5 U	
	12/02/2004	0.2 U			10/10/2006	0.5 U	
	03/03/2005	0.2 U			10/11/2007	NA	
	05/11/2005	0.2 U		346	10/18/2010	0.50 U	
	07/14/2005	0.5 U			11/01/2011	0.50 U	
	10/19/2005	0.5 U		410[a]	08/25/2004	0.8039	
	01/19/2006	0.5 U			12/03/2004	11.52	
	04/12/2006	0.5 U			03/02/2005	3.57	
	10/10/2006	0.5 U			05/11/2005	1.17	
	10/09/2007	NA			07/14/2005	1.06	
LTMP-3	08/30/2004	0.2 U			10/20/2005	1.55	
	12/01/2004	0.2 U			01/23/2006	NA	
	03/01/2005	0.2 U			04/14/2006	NA	
	05/12/2005	0.2 U			10/11/2006	NA	
	07/14/2005	0.5 U			01/23/2006	NA	
	10/19/2005	0.5 U		410R[a]	10/12/2007	10.34	
	01/19/2006	0.5 U			10/20/2008	10.65	
	04/12/2006	0.5 U			10/20/2009	4.69	
	10/10/2006	0.5 U			10/18/2010	8.91	
	10/10/2007	NA		425	10/18/2010	1.25	
LTMP-4[a]	08/27/2004	0.00056 U		432[a]	08/20/2004	0.5303	
	11/30/2004	0.00109 U			12/01/2004	0.427	
	02/24/2005	0.0006 U			02/23/2005	0.51	
	05/10/2005	0.0006 U			05/11/2005	0.28	
	07/14/2005	0.002 U			07/13/2005	0.65	
	11/08/2005	0.002 U			10/21/2005	0.69	
	01/24/2006	0.002 U			01/23/2006	0.61	

Table 6-4 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – TCE

		ROD RG	55.6			ROD RG	55.6
		Current Regulatory Level	12.8			Current Regulatory Level	12.8
Sampling Location	**Sample Date**	**TCE (µg/L)**		**Sampling Location**	**Sample Date**	**TCE (µg/L)**	
432[a]	04/14/2006	0.11		704[a] (cont.)	07/13/2005	0.002 U	
	10/11/2006	0.91			10/18/2005	0.002 U	
	10/16/2007	0.22			01/23/2006	0.002 U	
	10/20/2008	0.19			04/14/2006	0.004 U	
	10/20/2009	0.21			10/09/2006	0.002 U	
	10/19/2010	0.828			10/10/2007	NA	
	11/01/2011	0.55		707[a]	08/23/2004	0.132	
433[a]	08/26/2004	0.00056 U			12/01/2004	0.097	
	12/02/2004	0.00059 U			02/23/2005	0.023	
	02/22/2005	0.0006 U			05/10/2005	0.073	
	05/12/2005	0.0006 U			07/14/2005	0.34	
	07/13/2005	0.002 U			10/20/2005	5.06	
	10/19/2005	0.002 U			01/23/2006	1.58	
	01/20/2006	0.002 U			04/13/2006	0.03	
	04/13/2006	0.004 U			10/09/2006	0.16	
	10/09/2006	0.002 U			10/15/2007	0.11	
	10/11/2007	0.17 U			10/20/2008	0.27	
704[a]	08/19/2004	0.00056 U			10/20/2009	0.18	
	11/30/2004	0.00055 U			10/19/2010	0.181	
	03/01/2005	0.0006 U			12/19/2011	0.077	
	04/15/2005	0.0006 U					

[a]Values presented is corrected for attenuation. The laboratory-measured value was reduced by the ratio of groundwater salinity in the well to that of sea water in Sinclair Inlet to obtain the value presented in the table.

Notes:
µg/L - microgram per liter
NA - not analyzed
OU B - Operable Unit B
RG - remediation goal
ROD - Record of Decision
TCE - trichloroethene
U - not detected above method reporting limit

Table 6-5
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Pesticides

Sampling Location	Sample Date	4,4'-DDE (µg/L)	4,4'-DDT (µg/L)	Aldrin (µg/L)	Dieldrin (µg/L)	Heptachlor Epoxide (µg/L)
	ROD RG	**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
Current Regulatory Level		**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
LTMP-1	08/18/2004	0.0019 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
	12/02/2004	0.00021 U	0.0018 U	0.00044 U	0.0005 U	0.00034 U
	03/03/2005	**0.0006 J**	0.0005 U	**0.00022 J**	0.0005 U	0.0005 U
	05/12/2005	0.0014 U	0.0015 U	0.0005 U	0.0005 U	0.0005 U
	07/14/2005	0.0011 U	0.00097 U	0.00049 U	0.00051 U	0.00098 U
	10/19/2005	0.00096 UJ	0.00096 U	0.00048 U	0.00048 U	0.00098 U
	01/19/2006	0.00049 U	0.0017 Ui	0.00049 U	0.00049 U	0.00049 Ui
	04/17/2006	0.00048 U	0.0012 Ui	0.00048 U	0.00048 U	0.00048 Ui
	10/10/2006	0.00049 U	**0.0011**	0.00049 U	0.00049 U	**0.00048 PJ**
	10/09/2007	NA	NA	NA	NA	NA
	10/13/2010	0.00019 U1	0.00051 U1,i	0.00033 U1	0.0005 U1,i	0.00021 U1
LTMP-2	08/18/2004	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
	12/02/2004	0.00021 U	0.0005 U	**0.001 J**	0.0005 U	0.00034 U
	03/03/2005	0.0011 U	0.0005 U	0.0005 U	0.0005 U	0.0014 U
	05/11/2005	0.0014 U	0.0005 U	0.0005 U	0.0005 U	0.00065 U
	07/14/2005	0.00096 U	0.00096 U	0.00048 U	0.00048 U	0.00098 U
	10/19/2005	0.00096 U	0.00096 U	0.00048 U	0.00048 U	0.00098 U
	01/19/2006	0.00049 U	0.00049 Ui	0.00049 Ui	0.00049 U	0.00049 Ui
	04/12/2006	0.00050 U	**0.0011**	0.00050 U	0.00050 U	0.00050 U
	10/10/2006	0.00049 Ui	0.00049 U	0.00049 Ui	0.00049 U	0.00049 U
	10/9/2007	NA	NA	NA	NA	NA
	10/13/2010	0.00019 U1	0.00017 U1	0.00033 U1	0.00037 U1	0.00021 U1
LTMP-3	08/30/2004	0.0005 U	**0.0048**	0.0005 U	0.0005 U	0.00051 U
	12/01/2004	0.00024 J	**0.002**	**0.00037 J**	0.00013 U	**0.00041 J**
	03/01/2005	0.0005 U	0.0005 U	0.0005 U	0.0012 U	0.00081 U
	05/12/2005	**0.0029**	**0.0017**	0.0005 U	0.0005 U	0.0005 U
	07/14/2005	0.00097 U	**0.0059**	0.00049 U	0.00049 U	0.00098 U
	10/19/2005	0.00096 UJ	0.0016 U	0.00048 U	0.00048 U	0.00098 U
	01/19/2006	0.00049 U	**0.0014**	0.00049 U	0.00077 Ui	**0.0002 PJ**
	04/12/2006	**0.00044 PJ**	**0.0046**	0.0005 U	0.0005 U	**0.00057 PJ**
	10/10/2006	**0.00065 PJ**	**0.0014**	0.0005 Ui	0.0005 U	**0.00048 PJ**
	10/10/2007	0.0028 Ui	**0.0034 PJ**	NA	NA	NA
	10/14/2010	0.00019 U1	0.00045 U1,i	0.00033 U1	**0.00039 PJ**	**0.00022 J**
LTMP-4[a]	08/27/2004	0.000001 U	0.000001 U	0.000001	0.000001 U	0.000001 U
	11/30/2004	0.000001 U	0.000001 U	0.000002 U	0.0000007 U	0.000002 U
	02/24/2005	0.000002 U	0.000001 U	0.000002	0.000002 U	0.000002 U
	05/10/2005	0.000002 U	0.000002 UJ	0.000002 U	0.000002 U	0.000002 U

Table 6-5 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Pesticides

Sampling Location	Sample Date	4,4'-DDE (µg/L)	4,4'-DDT (µg/L)	Aldrin (µg/L)	Dieldrin (µg/L)	Heptachlor Epoxide (µg/L)
	ROD RG	**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
Current Regulatory Level		**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
LTMP-4[a] (cont.)	07/14/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	11/08/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	01/24/2006	0.000001	0.000002 U	0.000002 U	0.000002 U	0.000002 U
	04/13/2006	0.000001 U	0.000001 U	0.000001 U	0.000001 U	0.000001 U
	10/11/2006	0.000002 U	0.000002 U	0.000002 U	0.000002 U	0.000002 U
	10/15/2007	NA	NA	NA	NA	NA
	10/19/2010	0.000003 Ui	0.000003 Ui	0.000005 Ui	0.000006 Ui	0.000003 Ui
LTMP-5	08/19/2004	0.0009 U	0.00061 U	0.0006 U	0.0005 U	0.0005 U
	11/30/2004	0.00021 U	0.00022 U	0.00043 U	0.0005 U	0.00034 U
	02/28/2005	0.0028 U	0.0003 J	0.0005 U	**0.00094**	0.00075 U
	05/10/2005	0.0011 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
	07/14/2005	0.00099 U	0.00099 U	0.0005 U	0.0005 U	0.00099 U
	10/18/2005	0.00096 U	0.00096 U	0.00048 U	0.00048 U	0.00098 U
	01/19/2006	0.0005 U	0.0008 Ui	0.0005 U	0.0005 U	0.0005 Ui
	04/17/2006	0.00048 U	0.00048 Ui	0.00048 U	0.00048 U	0.00048 Ui
	10/10/2006	0.0005 U	0.0005 Ui	0.0005 Ui	0.0005 U	0.0005 U
	10/11/2007	NA	NA	NA	NA	NA
	10/14/2010	0.00019 U1	0.0019 U1,i	0.00033 U1	**0.0004 J**	0.00021 U1
410[a]	08/25/2004	0.00004 U	0.00003 U	0.00011 U	0.00003 U	0.000069 U
	12/03/2004	0.0001 U	0.0001 U	0.00017 U	0.00039 U	0.00017 U
	03/02/2005	0.0005 U	0.00011 U	0.00011 U	0.0001 U	0.0001 U
	05/11/2005	0.00014 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
	07/14/2005	0.000078 U	0.000078 U	0.000039 U	0.000039 U	0.00008 U
	10/21/2005	0.000093 U	0.000093 U	0.000047 U	0.000047 U	0.000095 U
	1/23/2006	NA	NA	NA	NA	NA
	4/14/2006	NA	NA	NA	NA	NA
	10/11/2006	NA	NA	NA	NA	NA
	10/12/2007	NA	NA	NA	NA	NA
	10/18/2010	0.0001 Ui	0.00008 Ui	0.00015 Ui	0.0003 Ui	0.00023 Ui
432[a]	08/20/2004	0.000006 U	0.0000006	0.000006 U	0.000006 U	0.000006 U
	12/01/2004	0.0000002 U	0.0000002 U	0.0000003 U	0.0000004 U	0.000009 U
	02/23/2005	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
	05/11/2005	0.000003 U	0.000003 UJ	0.000003 U	0.000003 U	0.000003 U
	07/13/2005	0.000011 U	0.000011 U	0.000006 U	0.000006 U	0.000011 U
	10/21/2005	0.000011 U	0.000011 U	0.000006 U	0.000006 U	0.000011 U
	01/23/2006	0.000006 U	0.000019	0.000006 U	0.000016 U	0.000006 U
	04/14/2006	0.000001 U	0.000001 U	0.000001 U	0.000001 U	0.000001 U

Table 6-5 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Pesticides

Sampling Location	Sample Date	4,4'-DDE (µg/L)	4,4'-DDT (µg/L)	Aldrin (µg/L)	Dieldrin (µg/L)	Heptachlor Epoxide (µg/L)
	ROD RG	**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
Current Regulatory Level		**0.000356**	**0.000356**	**0.0000816**	**0.0000867**	**0.0000636**
432[a] (cont.)	10/11/2006	0.000008 U	0.000008	0.000008 U	0.000008 U	0.000008 U
	10/16/2007	NA	NA	NA	NA	NA
	10/19/2010	0.000003 Ui	0.000003 Ui	0.000005 Ui	0.000013 Ui	0.000003 Ui
433[a]	08/26/2004	0.000001 U	0.000003	0.000004 U	0.000001 U	0.000001 U
	12/02/2004	0.0000006 U	0.0000007 U	0.0000001 U	0.0000004 U	0.000001 U
	02/22/2005	0.000003 U	0.000002 U	0.000002 U	0.0000003 J	0.000002 U
	05/12/2005	0.000004 U	0.000002 U	0.000004	0.000002 U	0.000002 U
	07/13/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	10/21/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	01/20/2006	0.000002 U	0.000005 U	0.000002 U	0.000002 U	0.000002 U
	04/14/2006	0.000004 U	0.000005	0.000004 U	0.000004 U	0.000004 U
	10/09/2006	0.000002 U	0.000002 U	0.000002 U	0.000002 U	0.000002 U
	10/11/2007	NA	0.00076 U	NA	NA	NA
	10/20/2010	0.00001 Ui	0.00002 Ui	0.00001 Ui	0.00001 Ui	0.00001 Ui
704[a]	08/19/2004	0.000001 U	0.000002	0.000001 U	0.000001 U	0.000001 U
	11/30/2004	0.0000006 U	0.000001 U	0.0000009 U	0.000001 U	0.0000009 U
	03/01/2005	0.000007 U	0.000002 U	0.000002 U	0.000002 U	0.000007 U
	04/15/2005	0.000002 U	0.000003 U	0.000002 U	0.000002 U	0.000002 U
	07/13/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	10/18/2005	0.000004 U	0.000004 U	0.000002 U	0.000002 U	0.000004 U
	01/23/2006	0.000002 U	0.000002 U	0.000002 U	0.000002 U	0.000002 U
	04/14/2006	0.000004 U	0.000004 U	0.000004 U	0.000004 U	0.000004 U
	10/09/2006	0.000002 U	0.000002 U	0.000002 U	0.000002 U	0.000002 U
	10/10/2007	NA	NA	NA	NA	NA
	10/20/2010	0.00001 Ui	0.00001 Ui	0.00001 Ui	0.00002 Ui	0.00001 Ui
707[a]	08/23/2004	0.00002 U	0.00002 U	0.00002 U	0.00002 U	0.00002 U
	12/01/2004	0.000007 U	0.00002 U	0.00001 U	0.00002 U	0.000017 U
	02/23/2005	0.00002 U	0.000006 U	0.000006 U	0.000006 U	0.000006 U
	05/10/2005	0.00001 U	0.00001 UJ	0.00001 U	0.00001 U	0.00001 U
	07/14/2005	0.000083 U	0.000083 U	0.000042 U	0.000042 U	0.000084 U
	10/20/2005	0.00107 U	0.00107 U	0.000506 U	0.000506 U	0.00107 U
	01/23/2006	0.000152	0.00033 U	**0.000198**	0.00033 U	0.00033 U
	04/13/2006	0.000004 U	0.000004 U	0.000004 U	0.000004 U	0.000004 U
	10/09/2006	0.000028 U	0.000028 U	0.000028 U	0.000028 U	0.000028 U
	10/15/2007	0.000017 U	NA	0.000017 U	NA	NA
	10/19/2010	0.00001 Ui	0.00001 Ui	0.00002 Ui	0.00005 Ui	0.00001 Ui

Table 6-5 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Pesticides

[a]Value presented is corrected for attenuation. The laboratory measured value was reduced by the ratio of groundwater salinity in the well to that of sea water in Sinclair Inlet to obtain the value presented in the table.

Notes:
Bold sampling value exceeds the RG.
J - estimated value
i - The method reporting limit/method detection limit has been raised because of chromatographic interference.
µg/L - microgram per liter
NA - not analyzed
OU B - Operable Unit B
P - The relative percent difference is greater than 40 percent for results from the gas chromatograph's primary and confirmation columns.
RG - remediation goal
ROD - Record of Decision
U - not detected above reporting limit
U1 - not detected above method detection limit

Table 6-6
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
LTMP-1	08/18/04	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	12/02/04	NA	NA	NA	NA	NA	NA	NA
	03/03/05	50 U	55 U	550 U	0.5 U	1 U	1 U	2 U
	05/12/05	NA	NA	NA	NA	NA	NA	NA
	07/14/05	NA	NA	NA	NA	NA	NA	NA
	10/19/05	250 U	20 J	500 U	0.5 U	1 U	1 U	2 U
	01/19/06	NA	NA	NA	NA	NA	NA	NA
	04/17/06	250 U	260 U	510 U	0.50 U	1.0 U	1.0 U	2 U
	10/10/06	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/03/07	250 U	15 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/09/07	50 U	27 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/08/08	250 U	17 J	32 J	0.5 U	0.35 J	1.0 U	2.0 U
	10/14/08	NA	110 U	110 U	NA	NA	NA	NA
	10/21/09	NA	260 U	520 U	NA	NA	NA	NA
	10/13/10	NA	NA	NA	NA	NA	NA	NA
LTMP-2	08/18/04	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	12/02/04	NA	NA	NA	NA	NA	NA	NA
	03/03/05	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	05/11/05	NA	NA	NA	NA	NA	NA	NA
	07/14/05	NA	NA	NA	NA	NA	NA	NA
	10/19/05	250 U	26 J	500 U	0.5 U	1 U	1 U	2 U
	01/19/06	NA	NA	NA	NA	NA	NA	NA
	04/12/06	250 U	17 J	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/10/06	250 U	260 U	500 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/03/07	250 U	25 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/09/07	50 U	35 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/08/08	250 U	26 J	47 J	0.5 U	1.0 U	1.0 U	2.0 U
	04/03/07	250 U	25 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/09/07	50 U	35 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/08/08	250 U	26 J	47 J	0.5 U	1.0 U	1.0 U	2.0 U
	10/14/08	NA	110 U	110 U	NA	NA	NA	NA
	10/21/09	NA	260 U	520 U	NA	NA	NA	NA
	10/13/10	NA	NA	NA	NA	NA	NA	NA
LTMP-3	08/30/04	50 U	88	500 U	0.5 U	1 U	1 U	2 U
	12/01/04	NA	NA	NA	NA	NA	NA	NA
	03/01/05	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	05/12/05	NA	NA	NA	NA	NA	NA	NA
	07/14/05	NA	NA	NA	NA	NA	NA	NA
	10/19/05	250 U	250 U	500 U	0.5 U	1 U	1 U	2 U

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
LMTP-3 (cont.)	01/19/06	NA	NA	NA	NA	NA	NA	NA
	04/12/06	250 U	25 J	52 J	0.50 U	1.0 U	1.0 U	2 U
	10/10/06	250 U	270 U	530 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/03/07	250 U	17 J	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/10/07	50 U	22 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/09/08	250 U	18 J	39 J	0.5 U	1.0 U	1.0 U	2.0 U
	10/14/08	NA	110 U	110 U	NA	NA	NA	NA
	10/21/09	NA	260 U	520 U	NA	NA	NA	NA
	10/14/10	NA	NA	NA	NA	NA	NA	NA
LTMP-5	08/19/04	50 U	95	520 U	0.5 U	1 U	1 U	2 U
	11/30/04	NA	NA	NA	NA	NA	NA	NA
	02/28/05	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	05/10/05	NA	NA	NA	NA	NA	NA	NA
	07/14/05	NA	NA	NA	NA	NA	NA	NA
	10/18/05	250 U	250 U	500 U	0.5 U	1 U	1 U	2 U
	01/19/06	NA	NA	NA	NA	NA	NA	NA
	04/17/06	250 U	260 J	520 U	0.50 U	1.0 U	1.0 U	2 U
	10/10/06	250 U	270 U	530 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/02/07	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/11/07	50 U	23 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/11/08	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/15/08	NA	110 U	110 U	NA	NA	NA	NA
	10/23/09	NA	100 U	400 U	NA	NA	NA	NA
	10/14/10	NA	NA	NA	NA	NA	NA	NA
208[a]	08/20/02	**1,600 J**	**2,400 J**	300 J	**100**	5.7	8.1	14.4
	02/19/03	210 J	**2,600**	430 J	**19**	0.65 U	0.89 J	2.79
	08/11/03	**1,100**	**1,500**	220 J	**25**	1.3 U	1.4 J	3.49
	02/23/04	510 J	**670 J**	500 U	**21**	1.2 U	4.9	3.6
266[b]	02/19/03	21 U	45 U	64 J	0.12 U	0.09 U	0.051 U	1.5 U
	08/11/03	12 U	36 U	54 U	0.082 U	0.08 U	0.092 U	121 U
	02/23/04	12 U	38 J	54 U	0.059 U	0.07 U	0.092 U	251 U
382	08/25/04	50 U	62	520 U	0.5 U	1 U	1 U	2 U
	02/24/05	50 U	65 J	500 U	0.5 U	1 U	1 U	2 U
	11/08/05	250 U	59 J	85 J	0.5 U	1 U	1 U	2 U
	4/19/06	NA	NA	NA	NA	NA	NA	NA
	10/05/06	250 U	63 J	68 J	0.5 U	1.0 U	1.0 U	1.0 U
	04/05/07	250 U	74 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/12/07	50 U	120 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	4/14/08	250 U	250 U	500 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/20/08	NA	68 J	130 U	0.5 U	1.0 U	1.0 U	2.0 U

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
382	10/22/09	NA	110 U	410 U	NA	NA	NA	NA
(cont.)	10/18/10	NA	NA	NA	NA	NA	NA	NA
392	08/21/02	21 U	**4,000 J**	**1,400**	NA	NA	NA	NA
	02/19/03	21 U	**3,000**	**3,800**	NA	NA	NA	NA
	08/12/03	12 U	**4,200**	**1,600**	NA	NA	NA	NA
	02/24/04	12 U	**5,100 J**	**8,100**	NA	NA	NA	NA
	10/18/05	NA	NA	NA	NA	NA	NA	NA
	04/19/06	250 U	**2,700**	**530**	0.50 U	1.0 U	1.0 U	2 U
	10/06/06	250 U	**7,700 DY**	**3,100 L**	0.5 U	1.0 U	1.0 U	1.0 U
	04/05/07	250 U	**2,500 Z**	**1,200 Z**	0.5 U	1.0 U	1.0 U	1.0 U
	10/16/07	50 U	**4,700 Y**	**2,600 L**	0.5 U	1.0 U	1.0 U	2.0 U
	04/11/08	NS	NS	NS	NS	NS	NS	NS
392R[c]	10/17/08	20 J	**1,100 Y**	470 L	0.5 U	1.0 U	1.0 U	2.0 U
	10/19/09	17 J	480 YJ	190 J	0.50 U	0.50 U	0.50 U	0.50 U
	04/07/10	NA	460 Z	200 J	NA	NA	NA	NA
	10/20/10	250 U	**700 Y**	270 L	0.50 U	0.12 J	0.50 U	1.0 U
	03/28/11	NA	**1,400 Y**	**770 L**	NA	NA	NA	NA
	11/02/11	16 J	**1,300 Y**	**770 L**	0.50 U	0.15 J	0.50 U	1.0 U
406	10/18/05	250 U	27 J	41 J	0.5 U	1.0 U	1.0 U	2.0 U
	04/18/06	250 U	270 U	530 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/06/06	250 U	37 J	21 J	0.5 U	1.0 U	1.0 U	1.0 U
406R[c]	10/16/07	50 U	78 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/11/08	250 U	250 U	500 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/17/08	250 U	20 J	110 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/02/09	NA	110 U	110 U	NA	NA	NA	NA
	10/19/09	250 U	260 U	520 U	0.50 U	0.50 U	0.50 U	0.50 U
	10/20/10	250 U	120 U	120 U	0.50 U	0.23 J	0.50 U	1.0 U
	11/02/11	250 U	28 J	57 J	0.50 U	0.13 J	0.50 UJ	1.0 UJ
412	08/19/04	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	02/28/05	50 U	54 U	540 U	0.5 U	1 U	1 U	2 U
	10/17/05	250 U	250 U	500 U	0.5 U	1 U	1 U	2 U
	04/17/06	250 U	250 U	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/06/06	250 U	20 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/02/07	250 U	260 U	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/11/07	50 U	19 J	500 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/09/08	250 U	270 U	22 J	0.5 U	1.0 U	1.0 U	2.0 U
	10/15/08	NA	110 U	110 U	NA	NA	NA	NA
	10/22/09	NA	110 U	410 U	NA	NA	NA	NA
	10/14/10	NA	NA	NA	NA	NA	NA	NA

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
425	08/26/04	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	02/23/05	50 U	51 U	510 U	0.5 U	1 U	1 U	2 U
	10/20/05	250 U	21 J	40 J	0.5 U	1 U	1 U	2 U
	04/18/06	250 U	250 U	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/11/06	250 U	260 U	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/02/07	250 U	20 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/10/07	50 U	31 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/14/08	250 U	270 U	530 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/16/08	NA	110 U	110 U	NA	NA	NA	NA
	10/19/09	NA	260 U	520 U	NA	NA	NA	NA
	10/18/10	NA	NA	NA	0.50 U	0.070 J	0.50 U	1.0 U
	12/19/11	NA	NA	NA	0.50 U	0.50 U	0.50 U	1.0 U
428	08/23/04	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	02/24/05	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	10/21/05	250 U	250 U	500 U	0.5 U	1 U	1 U	2 U
	04/18/06	250 U	260 U	520 U	0.50 U	1.0 U	1.0 U	2 U
	10/5/06	NA	NA	NA	NA	NA	NA	NA
428R[d]	04/05/07	250 U	260 U	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/15/07	50 U	20 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/14/08	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/17/08	NA	12 J	110 U	NA	NA	NA	NA
	10/22/09	NA	NA	NA	NA	NA	NA	NA
	10/19/10	NA	110 U	110 U	0.50 U	0.50 U	0.50 U	1.0 U
704	08/19/04	50 U	50 U	500 U	0.5 U	1 U	1 U	2 U
	03/01/05	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	10/18/05	250 U	250 U	49 J	0.5 U	1 U	1 U	2 U
	04/14/06	250 U	9.2 J	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/09/06	250 U	250 U	500 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/04/07	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/10/07	50 U	52 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/11/08	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/16/08	NA	110 U	110 U	NA	NA	NA	NA
	10/20/09	NA	260 U	520 U	NA	NA	NA	NA
	10/20/10	NA	NA	NA	NA	NA	NA	NA
709	08/25/04	50 U	54 U	540 U	0.5 U	1 U	1 U	2 U
	03/01/05	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	10/18/05	250 U	65 J	97 J	0.5 U	1 U	1 U	2 U
	04/17/06	250 U	250 U	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/06/09	250 U	44 J	46 J	0.5 U	1.0 U	1.0 U	1.0 U
	04/02/07	250 U	32 J	500 U	0.5 U	1.0 U	1.0 U	1.0 U

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
709 (cont.)	10/11/07	50 U	54 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/09/08	250 U	36 J	53 J	0.5 U	0.42 J	1.0 U	2.0 U
	10/15/08	NA	110 U	110 U	NA	NA	NA	NA
	10/23/09	NA	110 U	410 U	NA	NA	NA	NA
	10/14/10	NA	NA	NA	NA	NA	NA	NA
713	08/26/04	50 U	52 U	520 U	0.5 U	1 U	1 U	2 U
	02/25/05	50 U	53 U	530 U	0.5 U	1 U	1 U	2 U
	10/19/05	250 U	250 U	500 U	0.5 U	0.51 J	1 U	2 U
	04/14/06	250 U	10 J	500 U	0.50 U	1.0 U	1.0 U	2 U
	10/05/06	250 U	18 J	21 J	0.5 U	1.0 U	1.0 U	1.0 U
	04/02/07	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/11/07	50 U	17 J	500 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/09/08	250 U	260 U	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/15/08	NA	110 U	110 U	NA	NA	NA	NA
	10/22/09	NA	100 J	400 J	NA	NA	NA	NA
	10/18/10	NA	NA	NA	NA	NA	NA	NA
715R[e]	04/03/07	26 J	160 J	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/10/07	20 J	130 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/08/08	19 J	160 J	120 J	0.5 U	1.0 U	1.0 U	2.0 U
	10/17/08	17 J	120 Y	130 U	0.5 U	1.0 U	1.0 U	2.0 U
	10/19/09	18 J	250 U	500 U	0.070 J	0.50 U	0.50 U	0.50 U
	10/13/10	NA	NA	NA	NA	NA	NA	NA
718	08/30/04	50 U	150	530 U	0.5 U	1 U	1 U	2 U
	03/03/05	50 U	150 J	530 U	0.5 U	1 U	1 U	2 U
	10/20/05	250 U	120 J	93 J	0.5 U	1 U	1 U	2 U
	04/19/06	250 U	120 J	520 U	0.50 U	1.0 U	1.0 U	2 U
	10/05/06	250 U	120 J	520 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/04/07	250 U	100 J	500 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/12/07	50 U	170 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/08/08	16 J	120 J	68 J	0.5 U	1.0 U	1.0 U	2.0 U
	10/14/08	NA	170 Y	110 U	NA	NA	NA	NA
	10/21/09	NA	260 U	520 U	NA	NA	NA	NA
	10/13/10	NA	NA	NA	NA	NA	NA	NA
PMP-1	10/17/05	83 J	250 U	500 U	0.89 J	1.0 U	1.0 U	1.0 U
	04/18/06	22 J	270 U	530 U	0.50 U	1.0 U	1.0 U	2 U
	10/05/06	24 J	19 J	530 U	0.5 U	1.0 U	1.0 U	1.0 U
	04/04/07	23 J	260 U	510 U	0.5 U	1.0 U	1.0 U	1.0 U
	10/10/07	34 J	15 J	520 U	0.5 U	1.0 U	1.0 U	2.0 U
	04/09/08	23 J	260 U	520 U	0.5 U	0.42 J	1.0 U	2.0 U
	10/14/08	NA	110 U	110 U	NA	NA	NA	NA

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

Sampling Location	Sample Date	TPH-G (µg/L)	TPH-D (µg/L)	TPH-Dx (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
PMP Compliance Criterion		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**
	10/21/09	NA	260 U	520 U	NA	NA	NA	NA
	10/13/10	NA	NA	NA	NA	NA	NA	NA
346	08/21/02	21 U	45 U	500 UJ	0.12 U	0.09 U	0.051 U	0.0007 U
	02/20/03	21 U	45 U	38 U	NA	NA	NA	NA
	08/13/03	12 U	36 U	54 U	NA	NA	NA	NA
	02/24/04	12 U	36 U	54 U	0.059 U	0.07 U	0.092 U	0.50034 U
	08/03/05	250 U	28 J	500 U	NA	NA	NA	NA
	01/17/06	250 U	260 U	510 U	NA	NA	NA	NA
	08/25/06	250 U	260 U	520 U	NA	NA	NA	NA
	02/05/07	250 U	270 U	530 U	NA	NA	NA	NA
	08/02/07	NA	250 U	500 U	NA	NA	NA	NA
	10/16/08	NA	110 U	110 U	NA	NA	NA	NA
	09/30/09	NA	NA	NA	NA	NA	NA	NA
	08/17/10	NA	110 U	110 U	NA	NA	NA	NA
	10/18/10	250 U	110 U	110 U	NA	NA	NA	NA
	03/28/11	NA	110 U	110 U	NA	NA	NA	NA
	11/01/11	250 U	110 U	110 U	0.50 U	0.11 J	0.50 U	1.0 U

[a]Well 208 was installed off Navy property at an upgradient location formerly occupied by Texaco as a groundwater monitoring point for OU A. Monitoring at this location was terminated in 2004, as recommended by the 2003 amended PMP.

[b]Well 266 was installed at the northern limit of Navy property downgradient from the former Texaco property as a groundwater monitoring point for OU A. Monitoring at this location was terminated in 2004, as recommended by the 2003 amended PMP.

[c]Wells 392R and 406R were observed to contain floating product. Replacement well 392R was installed in August 2008 and replacement well 406R was installed in October 2007 to provide dependable wells for groundwater monitoring, with the original wells retained for product thickness monitoring.

[d]Due to a failed well screen, well 428 could not be sampled during the fall 2006 event. A replacement well (428R) was sampled beginning in spring 2007.

[e]Sampling was attempted at well 715 during fall 2005 through fall 2006; however, it was subsequently determined that the well was decommissioned in March 2003 (TEC 2003). A replacement well (428R) was sampled beginning in spring 2007.

Notes:
Bold sampling value exceeds the PMP compliance criterion.
D - The reported result is from a dilution.
J - estimated value
L - Chromatographic fingerprint of the sample resembles a petroleum product with a lighter component than the calibration standard.
µg/L - microgram per liter
NA - not analyzed
NS - not sampled because of floating product

Table 6-6 (Continued)
Summary of Analytical Results for OU B Terrestrial Groundwater Sampling – Petroleum

OU B - Operable Unit B
PMP - petroleum management plan
TPH-D - total petroleum hydrocarbons—diesel
TPH-Dx - total petroleum hydrocarbons as diesel and heavy oil
TPH-G - total petroleum hydrocarbons—gasoline
U - not detected above method reporting limit
Y - Chromatographic fingerprint of the sample resembles a petroleum product but the elution patter does not match the calibration standard.
Z - The chromatographic fingerprint does not resemble a petroleum product.

Table 6-7
OU B Marine 500-Foot Grid Sediment Sampling

Grid Cell Number	% Fines (Clay + Silt)				Total Organic Carbon (%)				Total PCBs – Bulk (µg/kg)				Total PCBs – Normalized (mg/kgOC)				Mercury (mg/kg)			
	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010
2001	46	73	60	56	2.9	3.4	3.0	2.5	2,300	360	170	200	79	11	5.7	8.0	0.62	0.99	0.70	0.69
2002	87	96	96	89	3.1	3.4	3.3	5.5	36	98	76	92	1.2	2.9	2.3	1.7	0.84	0.64	0.66	0.77
2003	38	50	45	43	1.6	1.8	1.8	1.8	85	180	110	100	5.3	10	6.1	5.6	0.49	0.50	0.58	0.28
2004	81	97	94	83	2.8	3.3	2.9	2.8	43	140	79	92	1.5	4.2	2.7	3.3	0.71	0.61	0.78	0.68
2005	81	92	92	89	2.7	2.9	2.9	2.6	57	110	78	81	2.1	3.8	2.7	3.1	0.98	0.91	0.89	0.78
2006	81	90	91	82	2.5	2.8	2.9	2.6	71	160	98	100	2.8	5.7	3.4	3.8	0.75	0.72	0.87	0.76
2007	84	93	92	78	2.5	2.7	2.8	2.5	53	130	100	76	2.1	4.8	3.6	3.0	0.90	0.87	0.94	0.70
2008	85	90	90	71	2.4	2.6	2.6	2.5	110	160	100	120	4.6	6.2	3.8	4.8	0.91	0.89	0.88	1.1
2009	90	90	92	94	2.7	2.6	2.6	2.9	84	100	68	67 J	3.1	3.8	2.6	2.3 J	0.98	0.55	0.59	0.81
2010	46	60	52	53	1.2	1.7	1.3	1.4	53	82	53	45	4.4	4.8	4.1	3.2	0.42	0.48	0.41	0.40
2011	84	88	89	89	2.2	2.3	2.3	2.4	120	87	65	63 J	5.5	3.8	2.8	2.6 J	4.5	0.59	0.59	0.74
2012	89	90	90	97	3.1	2.4	2.4	2.6	79	60	59	54 J	2.5	2.5	2.5	2.1 J	0.45	0.52	0.73	0.92
2013	82	89	93	97	3.1	2.8	2.8	3.1	230	67	70	54 J	7.4	2.4	2.5	1.7 J	1.1	0.50	0.72	0.68
2014	38	29	30	23	1.3	0.8	0.90	0.78	110	52	31	30	8.5	6.3	3.4	3.8	0.37	0.35	0.39	0.24
2015	86	90	89	69	2.2	2.2	2.2	2.2	63	41	39	54	2.9	1.9	1.8	2.5	1.2	0.39	0.44	0.46
2016	88	92	89	75	2.3	2.4	2.7	2.6	110	54	66	68	4.8	2.3	2.4	2.6	0.74	0.51	0.67	0.61
2017	89	96	92	83	2.6	2.8	2.8	2.6	150	85	87	31	5.8	3.0	3.1	1.2	0.72	0.87	0.62	0.76
2018	45	37	46	29	2.5	1.1	1.3	1.2	86	48	41	35	3.4	4.4	3.2	2.9	0.35	0.32	1.3	0.49
2019	77	86	79	52	2.1	2.2	2.5	1.7	150	120	100	64	7.1	5.5	4.0	3.8	4.1	0.84	0.64	0.50
2020	94	93	91	85	2.5	2.8	2.8	2.9	100	97	74	73	4.0	3.5	2.6	2.5	0.66	0.81	0.54	0.72
2021	65	66	74	49	1.7	1.8	2.0	1.9	84	69	44	52	4.9	3.8	2.2	2.7	0.48	0.39	0.48	0.35
2022	98	98	94	96	2.8	3.1	3.2	3.3	110	94	65	89	3.9	3.0	2.0	2.7	0.80	0.66	0.72	0.68
2023	85	94	91	84	2.7	3.0	3.0	3.0	150	110	61	83	5.6	3.7	2.0	2.8	0.86	0.59	0.67	0.93
2024	92	88	85	78	2.7	3.2	3.4	3.4	250	160	110	84	9.3	5.0	3.2	2.5	0.84	0.71	0.52	0.52
2025	82	92	82	100[a]	2.8	2.9	3.4	7.2	380	240	270	230	14	8.3	7.9	3.2	1.1	0.76	0.82	0.82
2026	76	96	78	82	2.7	3.3	3.5	3.5	220	190	160	130 J	8.1	5.8	4.6	3.7 J	0.82	0.70	0.75	0.67
2027	89	83	85	83	2.9	3.6	3.4	3.0	250	160	240	120	8.6	4.4	7.1	4.0	0.69	0.67	0.65	0.68
2028	56	74	82	94	2.0	2.0	3.0	3.7	200	190	210	170	10	9.5	7.0	4.6	0.68	0.65	0.93	0.78
2029	71	92	86	94	3.4	3.4	3.6	3.8	290	270	190	180 J	8.5	7.9	5.3	4.7 J	1.0	0.83	0.97	0.79
2030	85	87	87	75	3.0	3.1	2.9	2.3	320	1,900	2,000	110 J	11	61	69	4.8 J	0.82	0.76	0.65	0.62
2031	93	94	91	79	2.9	2.9	3.0	2.7	230	340	110	73 J	7.9	12	3.7	2.7 J	0.75	1.1	0.71	0.53
2032	93	95	90	92	2.6	2.7	2.8	3.1	99	130	78	68	3.8	4.8	2.8	2.2	0.83	0.85	0.59	0.65
2033	86	90	87	80	3.1	3.0	3.5	3.3	370	340	190	160	12	11	5.4	4.8	1.4	1.2	0.90	0.75
2034	55	77	83	69	2.3	2.7	2.9	3.1	620	210	150	140 J	27	7.8	5.2	4.5 J	1.2	0.62	1.0	0.82
2035	79	73	76	84	2.7	2.2	2.5	2.6	170	380	7,300	160 J	6.3	17	290	6.2 J	0.58	0.56	1.4	0.53
2036	91	85	88	81	2.9	3.1	3.0	3.2	210	160	99	92 J	7.2	5.2	3.3	2.9 J	0.74	0.77	0.75	0.74
2037	89	87	84	67	2.8	3.3	2.9	2.6	160	150	110	61 J	5.7	4.5	3.8	2.3 J	0.30	0.58	0.85	0.55
2038	71	71	66	67	2.3	2.1	2.1	1.9	140	71	79	49	6.1	3.4	3.8	2.6	0.91	0.65	0.53	0.46
2039	34	45	34	33	1.8	3.0	1.6	3.8	200	420	340	360 J	11	14	21	9.5 J	1.2	1.4	2.0	4.3

Table 6-7 (Continued)
OU B Marine 500-Foot Grid Sediment Sampling

Grid Cell Number	% Fines (Clay + Silt)				Total Organic Carbon (%)				Total PCBs – Bulk (µg/kg)				Total PCBs – Normalized (mg/kgOC)				Mercury (mg/kg)			
	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010
2040	68	73	79	48	2.5	2.7	3.0	3.3	480	280	330	110	19	10	11	3.3	1.1	0.77	1.5	0.93
2041	65	71	85	65	2.6	3.8	2.8	3.6	240	180	180	130	9.2	4.7	6.4	3.6	0.82	0.65	0.76	0.56
2042	76	82	77	78	2.6	2.8	2.6	2.8	180	240	300	120	6.9	8.6	12	4.2	0.75	1.5	0.84	0.69
2043	65	77	75	53	3.5	2.7	2.6	2.2	140	170	76	110	4.0	6.3	2.9	5.0	0.50	1.3	0.87	0.51
2044	86	94	90	73	2.8	3.0	3.0	2.7	99	110	79	70 J	3.5	3.7	2.6	2.6 J	0.85	0.57	0.60	0.56
2045	52	55	91	76	3.0	2.3	3.7	3.2	220	180	170	220	7.3	7.8	4.6	6.9	0.61	0.54	0.82	0.95
2046	29	34	28	10	1.2	2.0	1.2	1.6	490	120	66	61	41	6.0	5.5	3.8	0.42	0.38	0.20	0.22
2047	77	80	84	73	2.2	2.3	2.6	2.9	110	2,700	81	75	5.0	120	3.1	2.6	0.53	0.55	0.61	0.57
2048	91	95	90	74	3.0	3.1	3.1	2.8	90	100	68	48 J	3.0	3.2	2.2	1.7 J	0.71	0.89	0.52	0.63
2049	81	43	49	76	2.6	1.6	1.5	3.2	740	160	310	120	28	10	21	3.8	0.59	0.42	0.36	0.66
2050	85	88	82	77	2.6	2.8	2.8	2.4	140	130	88	49 J	5.4	4.6	3.1	2.0 J	0.57	0.57	0.60	0.88
2051	80	97	90	87	3.3	3.1	2.9	2.9	100	99	95	57 J	3.0	3.2	3.3	2.0 J	0.57	0.80	0.67	0.76
2052	75	93	81	82	2.4	3.1	2.8	2.8	670	440	240	160	28	14	8.6	5.7	0.93	0.73	0.71	0.69
2053	81	83	87	83	2.6	2.6	2.7	2.4	300	130	90	140	12	5.0	3.3	5.8	0.68	0.42	0.48	0.62
2054	80	83	83	75	3.3	3.8	3.0	2.9	180	130	59	76	5.5	3.4	2.0	2.6	0.66	0.61	0.80	0.68
2055	49	63	74	79	2.1	4.5	3.3	3.8	340	320	140	120	16	7.1	4.2	3.2	0.53	0.76	0.80	1.0
2056	81	71	82	69	3.2	4.2	2.9	3.4	600	440	230	86 J	19	10	7.9	2.5 J	0.85	1.2	1.1	1.3
2057	69	88	84	80	5.1	3.1	3.5	3.0	280	270	150	86	5.5	8.7	4.3	2.9	2.1	1.9	1.0	0.76
2058	84	87	84	79	2.9	3.0	3.0	3.1	170	100	79	65 J	5.9	3.3	2.6	2.1 J	0.52	0.70	0.61	0.55
2059	77	79	75	88	3.6	3.6	2.6	3.2	320	170	190	110 J	8.9	4.7	7.3	3.4 J	1.2	1.9	1.2	0.69
2060	48	54	50	84	3.1	2.7	2.3	4.0	420	470	250	100 J	14	17	11	2.5 J	4.3	19	2.3	0.94
2061	41	32	34	46	1.8	2.2	1.7	5.0	180	120	120	280 J	10	5.5	7.1	5.6 J	0.35	0.31	0.49	0.42
2062	81	87	81	76	3.1	2.9	2.9	2.7	170	120	110	60 J	5.5	4.1	3.8	2.2 J	0.71	0.63	0.67	0.57
2063	71	56	59	84	5.0	2.6	3.2	3.5	860	440	340	140 J	17	17	11	4.0 J	6.1	3.3	2.3	1.1
2064	77	85	82	74	3.6	3.4	3.6	3.3	470	410	180	100 J	13	12	5.0	3.0 J	1.9	2.0	1.4	0.88
2065	76	72	52	48	2.7	2.8	2.4	2.8	250	320	240	130 J	9.3	11	10	4.6 J	1.1	0.67	0.69	0.79
2066	73	87	83	73	3.3	3.5	3.0	2.6	320	200	89	62 J	9.7	5.7	3.0	2.4 J	0.74	0.94	0.70	0.50
2067	56	58	42	53	4.5	3.3	2.1	7.2	400	340	180	57 J	8.9	10	8.6	0.79 J	1.9	5.7	2.6	0.64
2068	87	66	64	64	2.8	3.0	3.0	2.9	300	240	190	90 J	11	8.0	6.3	3.2 J	0.49	0.94	1.6	1.5
2069	38	36	33	36	2.4	1.7	2.4	1.5	86	82	53	62 J	3.6	4.8	2.2	4.1 J	0.56	0.57	0.49	0.58
2070	72	86	77	79	2.6	2.8	2.6	2.6	29	97	59	34 J	1.1	3.5	2.3	1.3 J	0.65	0.58	0.65	0.52
2071	17	18	20	34	0.85	0.71	0.89	1.2	30	26	16	14	3.5	3.7	1.8	1.2	0.16	0.25	2.0	0.19
Geometric Mean					-	-	-	-	170	160	120	90	6.7	6.1	4.6	3.2	0.81	0.76	0.77	0.66
Arithmetic Mean					2.7	2.7	2.7	2.9	250	240	260	99	9.4	8.9	9.9	3.5	1.0	1.1	0.86	0.73

[a]Adjusted from 105 percent reported by laboratory

Notes:
J - estimated value
µg/L - microgram per liter
mg/kg - milligram per kilogram
mg/kgOC - milligram per kilogram of organic carbon
PCBs - polychlorinated biphenyls

Table 6-8
OU B Marine 1,500-Foot Grid Sediment Sampling

Grid Cell Number	% Fines (Clay + Silt)				Total Organic Carbon (%)				Total PCBs – Bulk (µg/kg)				Total PCBs – Normalized (mg/kgOC)				Mercury (mg/kg)			
	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010	2003	2005	2007	2010
2301	29	55	61	63	1.3	2.0	2.0	2.1	170	42	30	35 J	13	2.1	1.5	1.7 J	0.081	0.10	0.093	0.064
2302	37	40	40	39	0.86	0.94	0.88	2.5	21	15	8.7	11	2.4	1.6	1.0	0.44	0.081	0.090	0.082	0.081
2303	29	26	22	35	1.6	1.5	1.1	1.3	68	17	13	13 J	4.3	1.1	1.2	1.0 J	0.084	0.080	0.070	0.067
2304	23	25	16	38	0.94	1.1	0.60	0.70	14	13	4.5	5.7 J	1.5	1.2	0.75	0.81 J	0.071	0.080	0.057	0.063
2305	64	71	71	63	2.8	3.8	3.4	3.3	78	100	77	62	2.8	2.6	2.3	1.9	0.44	0.45	0.47	0.50
2306	95	88	86	78	3.6	4.1	3.9	0.58	130	130	110	63	3.6	3.2	2.8	11	0.11	0.87	0.71	0.70
2307	96	95	86	70	4.1	4.3	4.1	4.2	81	200	100	61	2.0	4.7	2.4	1.5	0.83	0.62	0.62	0.64
2308	96	96	92	72	3.6	3.3	3.9	2.5	93	130	65	74	2.6	3.9	1.7	3.0	0.14	0.83	0.67	0.74
2309	97	85	88	78	3.8	4.0	4.0	4.0	110	130	89	62 J	2.9	3.3	2.2	1.6 J	0.81	0.63	0.67	0.65
2310	98	98	94	78	3.4	3.7	3.4	3.6	81	220	100	61	2.4	5.9	2.9	1.7	0.88	0.72	0.69	0.70
2311	92	87	90	85	3.5	3.5	3.6	3.8	74	120	88	92	2.1	3.4	2.4	2.4	0.82	0.74	0.70	0.77 J
2312	19	20	21	16	0.77	0.97	1.0	0.78	20	16	14	15	2.6	1.6	1.4	1.8	0.15	0.15	0.14	0.14
2313	91	95	92	88	3.0	3.2	3.2	3.1	65 U	130	87	89	2.2 U	4.1	2.7	2.9	0.72	0.78	0.75	0.82
2314	85	97	92	76	3.5	3.8	3.7	3.6	110	120	72	72 J	3.1	3.2	1.9	2.0 J	0.84	0.60	0.69	0.70
2315	98	98	87	67	3.3	4.0	4.0	3.8	120	100	77	49	3.6	2.5	1.9	1.3	0.84	0.56	0.78	0.63
2316	94	93	85	82	3.6	4.2	4.2	4.3	120	120	76	100	3.3	2.9	1.8	2.3	0.74	0.48	0.51	0.56
2317	90	96	89	92	3.2	2.9	3.4	3.4	120	100	65	93	3.8	3.4	1.9	2.7	0.81	0.70	0.69	0.72
2318	87	97	89	94	3.2	3.4	3.4	3.4	95	95	54	70	3.0	2.8	1.6	2.1	0.84	0.65	0.70	0.66
2319	97	96	84	96	3.0	3.7	3.6	3.4	77	100	48	51 J	2.6	2.7	1.3	1.5 J	0.71	0.52	0.56	0.56
2320	86	94	90	84	2.8	3.1	3.1	2.9	75	97	62	81	2.7	3.1	2.0	2.8	0.59	0.58	0.56	0.61
2321	83	94	90	77	2.6	3.3	3.3	2.8	130	150	63	64 J	5.0	4.5	1.9	2.3 J	0.98	1.3	0.86	0.65
2322	95	90	89	76	2.7	3.3	3.0	3.0	86	70	50	45	3.2	2.1	1.7	1.5	0.64	0.53	0.59	0.51
2323	63	67	64	53	2.4	2.6	3.2	2.1	65	50	48	32	2.7	1.9	1.5	1.5	0.46	0.42	0.46	0.34
2324	80	82	84	76	2.7	2.9	2.9	2.7	79	80	61	44	2.9	2.8	2.1	1.6	0.59	0.62	0.69	0.51 J
2325	56	51	55	41	1.6	1.7	2.6	1.7	47	38	26	18	2.9	2.2	1.0	1.1	0.39	0.42	0.34	0.28
2326	13	13	12	12	0.54	0.42	0.37	0.36	5.6	2.5 U	1.7 U	1.3 U	1.0	0.60 U	0.46 U	0.36 U	0.025	0.020	0.029	0.026
2327	80	84	84	75	3.5	2.9	2.9	3.0	69	91	54	44	2.0	3.1	1.9	1.5	0.60	0.58	0.61	0.55
2328	75	82	81	63	2.5	2.8	3.3	2.8	61	63	39	33	2.4	2.3	1.2	1.2	0.60	0.60	0.55	0.36
2329	49	49	53	48	1.5	1.8	1.7	2.0	37	39	29	16 J	2.5	2.2	1.7	0.80 J	0.31	0.24	0.28	0.24
2330	9	16	15	21	0.35	0.41	0.39	0.39	2.5 U	2.6 U	2.9	4.7 J	0.71 U	0.63 U	0.74	1.2 J	0.022	0.060	0.055	0.050
2331	81	83	78	60	2.4	2.6	2.6	1.0	57	72	43	33 J	2.4	2.8	1.7	3.3 J	0.55	0.52	0.64	0.39
2332	39	32	37	28	1.4	1.1	1.4	0.76	52	30	38	27	3.7	2.7	2.7	3.6	0.39	0.36	0.46	0.35
Geometric Mean[a]					-	-	-	-	57	58	38	35	2.6	2.4	1.6	1.7	0.36	0.37	0.37	0.34
Arithmetic Mean[a]					2.5	2.7	2.8	2.5	72	84	53	48	2.7	2.7	1.8	2.1	0.52	0.50	0.49	0.46

[a]Results for cell 2301 excluded from mean values for 2003

Notes:
U - analyte not detected
J - estimated value
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
mg/kgOC - milligram per kilogram organic carbon
PCBs - polychlorinated biphenyls

Table 6-9
Results of Chemical Analyses on Post-Construction Sediment Samples Collected in Association with Military Construction Projects

Location	Mercury (mg/kg)	PCBs (mg/kgOC)	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
CSL	**0.59**	**65**	**93**	**6.7**	**270**	**390**	**530**	**6.1**	**960**
SQS	**0.41**	**12**	**57**	**5.1**	**260**	**390**	**450**	**6.1**	**410**
Pier 8									
P8-01	**0.88**	6.3	20	0.86	18	**710**	210	0.9	**500**
P8-02	0.22	9.3	5.7	0.48	11	47	22	0.13	110
P8-03	**2.4**	7	7.8	0.87	22	170	120	0.34	**620**
P8-03 FD	**0.54**	4.8	6.6	0.75	23	**460**	93	0.26	**500**
P8-04	0.37	2.8	9.4	1.1	29	120	44	0.4	**500**
P8-05	0.37	6.1	10	0.95	50	**730**	89	0.42	390
P8-06	**2.3**	3.4	7.2	0.81	23	120	87	0.19	**650**
P8-07	0.37	3.8	7.5	1.1	33	120	180	0.15	390
P8U-01	**0.5**	9.1	12	0.78	24	170	140	0.94	260
P8U-02	0.34	1.7	6	1.2	16	71	43	1.4	140
P8U-03	0.18	2.3	3.9	0.41	14	46	36	0.22	100
P8U-04	**0.89**	12	16	1.5	74	210	360	1.5	**490**
P8U-04 FD	**0.82**	**16**	14	2.3	49	180	190	1.2	**490**
P8U-05	0.25	2.8	5	0.62	15	45	34	0.17	120
P8U-06	0.25	0.65	2.8	0.37	9.5	24	12	0.079	170
P8U-07	0.18	1.5	4.2	0.42	12	48	21	0.14	83
P8U-08	0.19	0.79	3.9	0.51	9.8	33	21	0.15	81
Pier 7									
P7-01	**0.89**	7.6	11	1.6 J	30	130	61 J	0.55	200 J
P7-02	**0.53**	1.3	11	1.8 J	36	130	62 J	0.53	200 J
P7-02 FD1	**0.72**	1.6	10	1.6 J	32	130	55 J	0.56	180 J
P7-03	**1**	5.4 J	12	1.5	38	**420**	77	0.5	390
P7-04	**0.54**	**14**	11	0.65	34	**16,000**	380	0.55	**1,400**
P7-04A	0.27	5.9	3.3	0.39	15	55	16	0.13	90
P7-04B	**0.58**	2.7	8	1.4	34	120	52	0.46	200
P7-04C	**0.52**	11	7.4	0.79	22	140	77	0.57	**770**
P7-04D	**0.63**	**24**	8.4	0.69	30	170	200	0.46	**1,300**
P7-04E	0.39	9.1	4.4	0.62	17	93	46	0.22	220
P7-04F	0.29	4.2	4.3	0.85	18	63	45	0.21	200
P7-04G	**1.4**	**31 J**	8.6	1.2	46	110	84	0.4	**690**
P7-05	0.34	**48**	10	1	25	300	150	1.2	**440**
P7-05 FD2	**0.43**	**140**	17	1.3	24	220	120	1.1	**550**
P7-05A	**0.43**	**16**	7.4	1.3	28	95	52	0.35	160
P7-05A FD1	**0.42**	11	7.5	1.2	29	87	47	0.35	170
P7-05B	0.23	1.8	4.6	0.47	67	270	20	0.2	93
P7-05C	0.21	7	5.1	0.85	13	46	46	0.2	200
P7-05D	**0.56**	11 J	14	0.94	110	**680**	200	0.65	**640**
P7-05E	**0.55**	5.4	7.6	1.2	25	94	46	0.36	140
P7-05F	0.14	**67**	2	0.22	8.8	18	8.8	0.086	56
P7-05G	**0.82**	**80**	9.9	0.8	20	86	150	0.28	**550**
P7-06	0.37	1.4	4.4	0.52 J	16	33	53 J	0.15	100 J

Table 6-9 (Continued)
Results of Chemical Analyses on Post-Construction Sediment Samples Collected in Association with Military Construction Projects

Location	Mercury (mg/kg)	PCBs (mg/kgOC)	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
P7-06 FD2	0.16	1.9 U	4.9	0.64 J	17	37	26 J	0.16	100 J
P7-06A	0.31	0.94	7.9	1.1 J	28	94	46 J	0.51	220 J
P7-06B	0.28	1.2	6.6	1.5 J	25	76	37 J	0.35	130 J
P7-06C	0.23	1.5	6	0.74 J	20	45	26 J	0.17	130 J
P7-06D	**0.75**	3.7	6.1	0.82 J	23	54	32 J	0.18	180 J
P7-06E	**0.6**	5.3	11	0.93 J	34	270	200 J	0.44	390 J
P7-06F	**0.88**	7.5	11	0.87 J	40	160	130 J	0.29	270 J
P7-06G	0.29	1.9	6	0.83 J	22	64	30 J	0.35	130 J
P7-06H	0.21	0.46 U	5	0.56 J	110	51	46 J	0.17	110 J
P7-07	**0.46**	1	21	1.2 J	29	300	220 J	0.63	**600 J**
P7-08	**0.65**	2.8	14	1.1 J	35	190	83 J	0.57	360 J
Drydock 3									
DD3-1	**1.39 J**	**12.8 J**	13.3	1.29	35.7	195	63	0.8 J	252
DD3-2	0.142 J	9.02 J	6.7	0.51	22.8	87.4	27	0.3 J	108
Pier 6									
P6-1	**4.4 J**	7.1 J	11	1.7	50	190 J	140	0.6	410 J
P6-2	**0.80 J**	2.2	11	1.4	41	260 J	99	0.5	280 J
P6-3	**0.90 J**	1.3	19	1.9	41	**540 J**	120	0.6	**680 J**
P6-4	**1.6 J**	**290 J**	**130**	2	72	**460 J**	**510**	0.6	**2,780 J**
Drydock 1									
DD1-1	**0.546 J**	**17.8 J**	9.7	1.3	60.8	161	106	0.9 J	261
DD1-2	**0.425 J**	4.91 J	9.9	1.08	39.5	161	49	0.7 J	168
DD1-3	**0.477 J**	1.89	6.5	0.82	20.4	97.1 J	42	0.5 J	181 J
DD1-3 FD	**0.422 J**	2.41	6.5	0.71	20.8	124 J	39	0.2 J	162 J
DD1-4	0.144 J	1.93	7.2	0.79	19.7	**907 J**	39	0.2 J	**631 J**
DD1-5	**1.53 J**	2.38	12.4	1.27	42.8	203 J	191	0.9 J	334 J
DD1-6	**2.16 J**	1.39	9.6	0.93	23.6	184 J	**699**	0.6 J	**468 J**
Pier 5									
P5-1	**1.7 J**	9.8 J	15	1.4	35	200 J	130	0.5	380 J
P5-1 FD	**12 J**	4.6 J	13	1.5	47	210 J	150	0.4	370 J
P5-2	**1.2 J**	7.6 J	14	1	30	150 J	180	0.4	**580 J**
P5-3	**1.6 J**	3.9 J	18	1.4	26	310 J	220	0.4	**630 J**
P5-4	**0.50 J**	**17 J**	4.6	1.2	36	150 J	86	0.5	370 J
P5-5	**4.0 J**	3.1 J	9.1	1.4	31	140 J	57	0.4	250 J
P5-6	**0.54 J**	2.8	14	1.5	46	190 J	140	0.6	**650 J**
P5-7	**0.62 J**	1.4 J	9	1.3	27	**740 J**	74	0.5	**440 J**
P5-8	**0.58 J**	2	9.9	1.6	40	150 J	74	0.5	250 J
P5-9	0.34 J	1.0 J	8.8	0.88	22	150 J	54	2.7	210 J
Drydock 4									
DD4-1	0.364 J	**25.3 J**	50	0.94	34.8	271 J	113	0.4 J	**564**
DD4-2	0.394 J	**17.2 J**	8.4	0.8	21.1	138 J	38	0.4 J	165
DD4-3	**0.771 J**	**15.2**	21	1.93	38.5	**1,120 J**	105	1.1	**693**
DD4-4	**0.739 J**	**28.2 J**	15.4	1.87	33.2	**411 J**	72	1.8	379 J
DD4-4 FD	**0.490 J**	**21.6 J**	13	1.78	30.2	**1,780 J**	96	2	**875 J**

Table 6-9 (Continued)
Results of Chemical Analyses on Post-Construction Sediment Samples Collected in Association with Military Construction Projects

Location	Mercury (mg/kg)	PCBs (mg/kgOC)	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Drydock 5									
DD5-1	0.331 J	9.68	11.1	1.09	30.7	121 J	46	0.2 U	361
DD5-2	0.127 J	4.07	4.7	0.4	10.7	71.3 J	21	0.1 U	119
Drydock 6									
DD6-1	0.163 J	**12.9 J**	38.4	0.45	42.7	**635**	186	0.6 J	**809**
DD6-1 FD	0.159 J	**37.5 J**	27.9	0.43	35	**618**	132	0.8 J	**638**
DD6-2	0.097 J	0.488	4.4 J	3.36 J	14.1	136 J	14	0.2 U	**586**
DD6-3	0.244 J	6.28	32.3	4.5	24.4	240 J	112	0.3 J	**1,370**
DD6-4	0.168 J	5.08 J	**489 J**	3.10 J	67.4 J	**1,200 J**	**563 J**	2.6	**2,440 J**
DD6-4 FD	0.078 J	4.70 J	**252 J**	1.14 J	31.9 J	**523 J**	244 J	0.6 J	**1,190 J**
DD6-5	0.082 J	3.7	**155**	1.25 J	51.1	**1,160 J**	150	0.2 U	**1,390**
DD6-6	0.100 J	4.23	**164**	2.13 J	53.9	**1,390 J**	195	0.2 U	**1,450**
DD6-7	**0.429 J**	4.33 J	48.1	0.67 J	47.2	**855 J**	159	0.6 J	**647**
Pier B									
PB-01	0.26	3.9	4.1 J	0.10 J	18	49 J	41	0.20 J	120
PB-02	**0.59**	4.1	8.3	0.87	34	130 J	54	0.40 J	160
PB-03	**0.64**	5.2	9.8	1.1	40	130 J	63	0.60 J	180
PB-04	**0.66**	3.5	10	1.1	41	140 J	62	0.40 J	190
PB-05	**0.67**	3.2	12	1.1	44	140 J	59	0.50 J	180
PB-06	**0.68**	3.6	9.7	1	38	150 J	52	0.50 J	170
PB-07	**0.56**	5.5	9.1	0.97	39	120 J	55	0.50 J	170
PB-09	**0.44**	4.5	18	1.2	92 J	140 J	100	0.50 J	350
PB-09 FD	**0.57**	5.5	20	1.1	**270 J**	140 J	120	0.60 J	330
PB-10	**1**	3.3	8.5	0.54	34	80 J	56	0.30 J	150
PBU-1-Lower	**1.4**	**21 J**	17	1.7 J	56	260	190	2.3	310
PBU-1-Upper	**0.65**	6.2	8.9	1.0 J	30	140	70	0.88	180
PBU-2-Lower	**0.81**	4.8	11	1.7 J	45	220	100	1.2	300
PBU-2-Upper	**0.66**	2.4	8.3	1.4 J	39	190	70	0.74	200
PBU-3-Lower	**0.64**	**15**	12	0.91 J	39	130	88	1.2	170
PBU-3-Upper	**0.6**	2.9	11	1.4 J	38	160	72	0.73	180
PBU-4-Lower	**1**	10	17	1.6 J	53	200	140	1.5	290
PBU-4-Upper	**0.55**	4	10	1.2 J	34	160	67	0.79	230

Notes:
Shaded value exceeds CSL
Bolded value exceeds SQS.
J - estimated value
mg/kg - milligram per kilogram
mg/kg OC - milligram per kilogram as organic carbon
PCBs - polychlorinated biphenyls
CSL - Washington State cleanup screening level
SQS - Washington State sediment quality standard

Table 6-10
OU C Trigger Well Cumulative Results for Four Recent Rounds Through Fall 2011

Well ID	Date	TPH-G (mg/L)	TPH-D (mg/L)	TPH-Dx (mg/L)
Trigger Level		**1**	**0.5**	**0.5**
GMWT-9	10/21/2008		0.27 Y (0.28 Y)	0.087 J (0.091 J)
	10/21/2009	NA	**1.3 Y**	0.240 J
	4/5/2010	NA	0.098 J (0.100 J)	0.036 J (0.037 J)
	8/16/2010	NA	0.440 Y (0.430 Y)	0.140 UJ (0.190 UJ)
	10/14/2010	NA	0.270 Y	0.140 Z
	3/28/2011	NA	0.11 J	0.11 U
	10/13/2011	NA	**0.82 Y** **(0.87 Y)**	0.26 J (0.32 L)
	10/31/2011	NA	**1.2 Y**	**0.56 L**
GMWT-22	10/12/2007	NA	0.25 U	0.50 U
	10/21/2008	NA	0.20 Y	0.097 J
	10/20/2009	NA	0.310 Y	0.130 J
	10/15/2010	NA	0.240 Y	0.170 ZJ
	11/03/2011	NA	0.43 Y	0.37 J
GMWT-23	10/17/2007	NA	0.25 U	0.52 U
	10/21/2008	NA	0.047 J	0.042 J
	10/20/2009	NA	0.100 U	0.400 U
	10/14/2010	NA	0.068 J	0.100 J
	10/31/2011	NA	0.1 J	0.19 J
GMWT-24	10/17/2007	NA	0.25 U (0.25 U)	0.50 U (0.50 U)
	10/21/2008	NA	0.031 J	0.021 J
	10/19/2009	NA	0.110 U	0.410 U
	10/14/2010	NA	0.110 J	0.078 J
	11/03/2011	NA	0.079 J	0.1 J
GMWT-25	10/12/2007	NA	0.26 U	0.52 U
	10/21/2008	NA	0.019 J	0.11 U
	10/19/2009	NA	0.110 U	0.410 U
	10/15/2010	NA	0.065 J (0.057 J)	0.110 Z (0.091 J)
	11/03/2011	NA	0.05 J (0.052 J)	0.074 J (0.083 J)
GMWT-26	4/19/2006	0.25 U (0.25 U)	0.26 U (0.25 U)	0.52 U (0.50 U)

Notes:
Bold value exceeds the trigger level
B - analyte also detected in blank.

Table 6-10 (Continued)
OU C Trigger Well Cumulative Results for Four Recent Rounds Through Fall 2011

J - The result is an estimated concentration that is less than the reporting limit but greater than or equal to the method detection limit.
L - The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
mg/L - milligram per liter
NA - not analyzed
TPH-G - total petroleum hydrocarbons—gasoline
TPH-D - total petroleum hydrocarbons—diesel
TPH-Dx - total petroleum hydrocarbons—diesel extended (heavy oil)
U - not detected above reporting limit
Y - Chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern does not match the calibration standard.
Z - The chromatographic fingerprint does not resemble a petroleum product.

Table 6-11
OU C Product Thickness Measurements – Spring 2009 Through Fall 2011

Well ID	Product Thickness (foot)						
	4/3/2009	10/19/2009 - 10/26/2009	4/6/2010	10/14/2010 - 10/21/2010	3/28/2011- 3/29/2011	10/13/2011	10/31/2011- 11/15/2011
GMW-1	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-2	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-3	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-4	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-5	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMWT-2	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMWT-6	NM	NM	NM	NM	NM	NM	NM
GMWT-7	0	0	0	0	0	NM	0
GMWT-9	NM	0	0	0	0	0	0
GMWT-10	0.02	0.01	0	0.01	0	NM	0
GMWT-14	0	0	0	Sheen	0	NM	0
GMWT-15	0.06	0.07	Sheen	0	0	NM	0
GMWT-16	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMWT-17	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMWT-18	>0.61	0.76	1.53	0.36	0.71	NM	0.05
GMWT-19	0	0	0	6.62	0.12	NM	0.01
GMWT-20	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMWT-21	NM	NM	NM	NM	NM	NM	NM
GMWT-22	NM	0	NM	0	NM	NM	0
GMWT-23	NM	0	NM	0	NM	NM	0
GMWT-24	NM	0	NM	0	NM	NM	0
GMWT–25	NM	0	NM	0	NM	NM	0
GMWT–26	NM	NM	NM	NM	NM	NM	NM
PS11-MW05	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-26	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-27	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned
GMW-28	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned	Abandoned

Note:
NM - not measured

7.0 TECHNICAL ASSESSMENT

7.1 QUESTION A – IS THE REMEDY FUNCTIONING AS INTENDED BY THE ROD?

This section summarizes the current state of functionality for each OU based on the findings of the 5-year review process. Each component of the remedy for each OU is discussed in the sections that follow, generally in the order that the components were described in Section 4.

7.1.1 Functionality of Remedy for OU A

Is the remedy functioning as intended by the ROD? No, the OU A remedy is not currently functioning as intended by the ROD. Bank erosion at Charleston Beach is causing the release of potentially contaminated fill material into the marine environment. However, the Navy has recently completed extensive analyses of site conditions and beach dynamics and is in the process of identifying a long-term solution to the erosion problem.

The physical construction components of the OU A remedy were implemented prior to the first 5-year review. These include paving, shoreline erosion protection, and habitat enhancements. The requirement for groundwater monitoring was implemented upon execution of the ROD and has been ongoing. The remedy components that required management plans (ICs, soil management, petroleum management, and O&M) have been implemented and were in use during this 5-year review period. Inspection and maintenance of the physical remedy components and ICs have been ongoing since execution of the ROD. However, as noted below, improvements are needed in some elements of the inspection and monitoring program to ensure the continued functionality of these aspects of the remedy.

The inspections of the pavement and erosion protection remedy components conducted during this 5-year review period have identified and documented needed repairs, and this inspection process is therefore generally functioning as intended by the ROD. The site paving remains intact, interrupting the exposure pathways. However, improvements are needed to the IC process, both to ensure the ongoing correction in a timely manner of deficiencies identified during inspections and in documenting whether corrective actions have been implemented and are effective.

Periodic groundwater monitoring has been conducted under plans approved by the regulatory agencies, as intended by the ROD. The groundwater data (Section 6.4.1) indicate that the low-risk conditions present at the time of the ROD remain present or have improved. A substantial body of data now exists (1994 to present) documenting COC trends and current concentrations, compared to concentrations at the time of the ROD. The expectation in the ROD for the existing

mature LTM program would be to collect sufficient monitoring data to assess the ongoing functionality of the remedy (e.g., is erosion or damage to the asphalt cap resulting in increased COC migration?). Depending on the nature of the remedy repair at Charleston Beach, however, the LTM program may need to be modified, at least temporarily, to assess the effects of the remedy repair.

7.1.2 Functionality of Remedy for OU NSC

Is the remedy functioning as intended by the ROD? Yes, the OU NSC remedy continues to function as intended by the ROD.

The physical construction components of the OU NSC remedy were implemented prior to the first-5 year review. These include paving upgrades and stormwater system cleaning and repair. The requirement for groundwater monitoring was implemented upon execution of the ROD and has been ongoing. The remedy components that required management plans (ICs, excavation management, and storm drain maintenance) have been implemented and were in use during this 5 year review period. Inspections and maintenance of the physical remedy components and ICs have been ongoing since execution of the ROD. However, as noted below, improvements are needed in some elements of the inspection and monitoring program to ensure the continued functionality of these aspects of the remedy.

The inspections of the pavement and storm drain remedy components conducted during this 5-year review period have identified and documented needed repairs, and this inspection process is therefore generally functioning as intended by the ROD. The site paving remains intact, interrupting the exposure pathways. Storm drain repairs have been made based on the inspections. However, improvements are needed to the IC process, both to ensure the ongoing correction in a timely manner of deficiencies identified during inspections and in documenting whether corrective actions have been implemented and are effective.

Periodic groundwater monitoring has been conducted under plans approved by the regulatory agencies, as intended by the ROD. The monitoring data (Section 6.4.2) indicate that the low-risk conditions present at the time of the ROD remain present or have improved. A substantial body of data now exists (1994 to present) documenting COC trends and current concentrations compared to concentrations at the time of the ROD. In accordance with the intent of LTM under the ROD, future monitoring data are necessary only to assess the ongoing functionality of the remedy (e.g., is damage to the asphalt cap or storm drain system resulting in increased COC migration?).

7.1.3 Functionality of Remedy for OU B Terrestrial

Is the remedy functioning as intended by the ROD? No, the OU B Terrestrial remedy is not functioning as intended by the ROD. There is evidence that mercury is being released to Sinclair Inlet via groundwater and intruding seawater entering a primary storm drain line in the western portion of the OU and possibly also via direct groundwater discharge in this area in quantities that may represent one of the more significant loadings of this element to the inlet. Mercury has recently been found to be a COC at OU B Marine, based on risks associated with human consumption of marine species collected in the inlet. The Navy is actively investigating the mechanisms of release of mercury from OU B Terrestrial as well as alternative approaches to source control. In addition to the mercury transport issue, the process of implementing repairs to the pavement cap on an ongoing basis is not functioning as intended by the ROD, as discussed further in the next paragraph.

The physical construction components of the OU B Terrestrial remedy include paving upgrades, stormwater system cleaning and repair, and shoreline stabilization measures. The requirement for groundwater monitoring was implemented upon execution of the ROD in 2004 and has been ongoing. The remedy components that required management plans (ICs and remedy maintenance) have been implemented and were in use during this 5-year review period. Inspections of the physical remedy components and ICs continued to be implemented during this 5-year review. However, as documented in Section 6.5, many of the same pavement cap deficiencies are identified year after year during annual inspections. This indicates that the process for timely correction of deficiencies is not fully functioning as intended. Process improvements are therefore needed, both to ensure the ongoing correction in a timely manner of deficiencies identified during inspections and in documenting whether corrective actions have been implemented and are effective.

The monitoring data (Section 6.4.3) indicate that, overall, with the exception of the issue of mercury, the comparatively low-risk conditions present at the time the ROD was executed have persisted. In accordance with the ROD, the groundwater monitoring program continues to be a subject of discussion between the Navy, EPA, and Ecology, including potential changes in the analyte lists and monitoring frequency.

7.1.4 Functionality of Remedy for OU B Marine

Is the remedy functioning as intended by the ROD? Yes, the OU B Marine remedy is currently functioning as intended by the ROD.

The physical construction components of the OU B Marine remedy were initiated prior to the first 5-year review, but the active remedy components were not completed until March 2004. The primary remedy components include dredging and disposal of contaminated sediments,

placement of a clean cap over other contaminated sediments, and placement of a thin layer of clean sediments in one area for ENR. The dredged sediments were disposed of in an excavated seafloor confined disposal pit and capped with clean materials. The remedy also included shoreline stabilization measures at a location in the center of the BNC shoreline where slumping is believed to have occurred. The remedy also relies on ongoing processes of natural sediment recovery.

Post-remedy monitoring of OU B Marine was initiated in 2003, and subsequent monitoring rounds were conducted in 2005, 2007, and 2010. Marine sediments were sampled in all rounds, and English sole were sampled in 2003, 2007, and 2010. The most recent monitoring also included bathymetric surveys and sub-bottom profiling to verify the persistence and condition of the sediment disposal pit and cap/ENR remedy components.

The 2010 marine surveys showed that portions of the upper sediment layer of the cap at the sediment disposal pit may be only about 2 feet thick, and the cover layer may be gradually thinning in a few areas. Sand potentially representing the underlying sand cap layer was encountered during the 2010 sediment coring at a depth of 2 to 3 feet in one core and 3 to 4 feet in another. There had been previous observations of sand at depths of approximately 2 feet in both the 2005 and 2007 monitoring. The 2010 sub-bottom profiling survey also suggested that an area of less than 50 square feet may have less than 2 feet of sediment over the sand layer. This sediment cover layer was reported to average 5.5 feet in thickness in 2001, immediately after the original placement (U.S. Navy 2002f). However, the remedy closure report also noted that the sediment cover layer originally ranged from 0.5 to 10 feet in thickness, and the recent observations may coincide with the thinner areas of the original placement. (There is inherent uncertainty in interpreting both sub-bottom profiling data and sediment cores.) The Navy will continue to monitor this situation closely.

Trend analyses performed with the OU B Marine sediment data collected to date show decreasing levels of PCBs and predict that the PCB cleanup goal for OU B Marine is likely to have been met in 2011. The Navy is planning another round of sampling for 2012 to confirm this prediction. However, pre- and post-construction PCB, mercury, and metals data collected in connection with recent in-water construction work at BNC have included a limited number of PCB and mercury results that are considerably higher than most of the findings from the ongoing OU B Marine monitoring. These findings, together with recent evidence of the release of mercury from OU B Terrestrial, may represent a threat to the long-term functionality of the OU B Marine remedy. The Navy and agencies are presently considering how the construction sediment data will be integrated with the existing OU B Marine data set and what analyses and additional investigation could be useful in assessing whether additional action is needed.

The habitat restoration, shoreline stabilization, maintenance, monitoring, and IC components of the remedy have all been implemented and are functioning as intended by the ROD.

7.1.5 Functionality of Cleanup Action for OU C

Is the cleanup action functioning as intended by the CAP? Yes, the cleanup action is functioning as intended by the CAP. ICs are in place, and both groundwater and free-product monitoring are being conducted as required under the CAP. Exceedances of the trigger level in one of the sentinel wells have resulted in an increased sampling frequency for that well, as expected by the CAP.

7.1.6 Functionality of Remedy for OU D

Is the remedy functioning as intended by the ROD? No, the OU D remedy is not functioning as intended by the ROD. The IC component of the remedy for OU D has not functioned to ensure that potentially damaging activities do not occur to the low-permeability cap at OU D. Though restrictive covenants were included in the property deed during the land transfer, City of Bremerton redevelopment activities may have compromised the integrity of the cap. Property development activities after transfer of OU D to the City had the potential to create infiltration pathways through the low-permeability cap material that could allow increased leaching of soil COCs by precipitation. Increased leaching could result in transport of COCs to the marine environment. Navy efforts have made only limited progress over the last 5 years to engage the City on this issue and fully evaluate the impact of the redevelopment on the remedy functionality.

The second 5-year review (U.S. Navy 2007d) concluded that there was insufficient information regarding OU D to assess the long-term protectiveness of site conditions and recommended that the Navy seek additional information from the City regarding park construction. In a letter transmitting the second 5-year review report to the City, the Navy again expressed concern regarding the City's actions and requested additional information (U.S. Navy 2007e). As a result, a remedy evaluation was performed to evaluate engineering modifications made to the OU D remedy by the City.

The OU D remedy evaluation report (U.S. Navy 2010d) documented the degree to which the remedy conditions were being met per the requirements of the ROD. The remedy evaluation concluded that the potential for infiltration into subsurface soils has nearly doubled since the property was transferred to the City because of the removal of cap materials and replacement with paving stones. Therefore, the potential has increased for leaching of contaminants into groundwater and migration through the site to Sinclair Inlet. The increase in infiltration may indicate that the site no longer meets the remedy requirements for site-wide capping. However, the ROD did not establish specific infiltration limits or cap permeability requirements. The data

available at the time of the remedy evaluation were not sufficient to establish whether infiltration or contaminant migration from the site has increased since the time of remedy completion.

Other potential contaminant exposure could result from leaks within the park fountain design including underground water supply and return piping routed underneath the remedy cover materials, as well as potential leaks within the irrigation system. These potential sources could cause significant quantities of water to be released to the subsurface, which in turn could cause migration of contaminants to groundwater and even potential flow into Sinclair Inlet. Preferential groundwater migration is also likely to occur through the backfill materials used to surround the fountain piping. It is unclear how much material was hauled off site or imported during construction activities. Unfortunately, it is not known whether low-permeability cap soils placed for the remedy were stockpiled by the combined sewer overflow contractor and reused. It is also unknown what sub-base material the paving stones were placed on or what the raised landscaping planters were created with. If the planter areas were constructed with contaminated materials, they may also present an exposure risk to park visitors, or an increased opportunity for mobilization of COCs (see also discussion on this topic in Section 7.2).

Although it is possible that the concrete slab failure along the shoreline (see Section 6.5.3) was caused, or at least exacerbated, by the park construction changes in groundwater or surface water flow resulting from park construction are unlikely to have been the primary cause of the shoreline failure.

Because of the uncertainties of the remedy evaluation and the potential for increased contaminant exposures, recommendations were made for additional investigation to assess functionality (see Section 6.5.4).

The storm drain cleaning and repair components of the OU D remedy were implemented together with the similar remedy component for OU B Terrestrial. No Navy storm drain remains within OU D. If property redevelopment has resulted in the installation of new storm drains, the functionality of ongoing storm drain maintenance, cleaning, and repair should be evaluated in future 5-year reviews.

Groundwater monitoring, which is combined with the monitoring program for OU B Terrestrial and provides data from well LTMP-5, is functioning in accordance with the ROD requirements. Monitoring data from this well indicate mercury concentrations consistently exceeding the compliance criterion and nickel and dieldrin concentrations occasionally exceeding the compliance criteria. However, an upward trend is not apparent in the concentrations of these COCs in groundwater.

7.1.7 Operation and Maintenance Costs

Annual operation, maintenance, and monitoring (OM&M) costs for all OUs were estimated in the RODs to total approximately $810,000 per year. Actual annual OM&M costs for fiscal years 2007 through 2011 for all OUs were approximately $2,870,000 per year. The additional costs beyond the ROD estimate are primarily related to the ongoing evaluation of mercury in Sinclair Inlet and the investigations regarding revising the remedy at Charleston Beach. The difference between projected and actual costs is not indicative of any additional issues regarding remedy functionality.

7.2 QUESTION B – ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS, AND RAOS USED AT THE TIME OF REMEDY SELECTION STILL VALID?

This section reviews any changes to ARARs used to establish RGs in the RODs and reviews any changes to risk assessment assumptions (exposure and toxicity) to evaluate the protectiveness of the remedy.

The findings documented in this section are the changes in the exposure and toxicity assumptions of ARARs that have occurred since the RODs were signed that may affect the protectiveness of the remedies at OU A, OU NSC, OU B Marine, OU B Terrestrial, OU C, and OU D. No change has affected the remedies for OU A, OU NSC, OU C, or OU D since the last 5-year review. However, because of uncertainties, more information is needed regarding OU D to assess the protectiveness of the remedy. A new exposure pathway, vapor intrusion, was evaluated based on the second 5-year review recommendation, and no risk above target risk goals was found for the vapor inhalation pathway of OU B Terrestrial. This work is summarized in Section 7.2.2. For OU B Marine, studies have been initiated to address the data gaps that need to be filled before the protectiveness of the remedy can be assessed with respect to mercury in sediment. The 2011 addendum to the second 5-year review report (U.S. Navy 2011i) identified data gaps in regards to current mercury contamination in Sinclair Inlet and uncertainties associated with data of the technical memorandum. The preliminary health evaluation conducted constitutes the beginning of the additional effort needed to address mercury is also summarized in Section 7.2.2.

Concentrations of chemicals in groundwater remain above the RGs at many locations in OU A, OU NSC, and OU B Terrestrial, resulting in the need for continued ICs to prevent exposure and the need for ongoing monitoring. Although some of the RGs might be lower if calculated today, the remedy components continue to protect against exposures, just as they did at the time the ROD was signed. ICs preventing exposure and ongoing monitoring will need to continue until COC concentrations in groundwater and surface water are below the RGs.

7.2.1 Review of Applicable or Relevant and Appropriate Requirements

In the preamble to the NCP, EPA states that ARARs are generally "frozen" at the time of ROD signature, unless new or modified requirements call into question the protectiveness of the selected remedy. Five-year review guidance (USEPA 2001) indicates that the question of interest in developing the 5-year review is not whether a standard identified as an ARAR in the ROD has changed in the intervening period, but whether such a change to a regulation calls into question the protectiveness of the remedy. If the change in the standard would be more stringent, the next stage is to evaluate and compare the old and the new standards and their associated risk. This comparison is done to assess whether the currently calculated risk associated with the standard identified in the ROD is still within EPA's acceptable excess cancer risk range of 10^{-4} to 10^{-6}, or below a hazard index of 1 for noncancer effects. If the old standard is not considered protective, a new cleanup standard may need to be adopted after the 5-year review through CERCLA's processes for modifying a remedy.

This is the first 5-year review for OU C and the second for OU B Terrestrial, OU B Marine, and OU D. This is the third 5-year review for OU NSC and OU A. During the first 5-year review for OU NSC and OU A, no substantive changes were found to ARARs that would call into question the protectiveness of the remedy. For this third 5-year review, all the ARARs identified in the RODs for OU A , OU NSC, OU B Terrestrial, OU B Marine, and OU D were again reviewed for changes that could affect the assessment of whether the remedy is protective.

Some ARARs that were used in the determination of cleanup levels have been amended since publication of one or more of the RODs. These regulations are the following:

- Washington State MTCA regulations
- Washington State marine surface water quality standards for protection of aquatic life

The result of the amendments to the regulations is sometimes the lowering of a numeric ARAR. In these instances, the revised ARAR must be evaluated to determine whether there is a negative effect on the protectiveness of the remedy. In other instances, the ARAR remains unchanged or has been raised. In these instances, no further discussion is provided, because the protectiveness of the remedy is not affected.

Operable Unit A

For OU A, soil cleanup levels were based on industrial site usage, and groundwater cleanup levels were based on the protection of adjacent surface waters of Sinclair Inlet. For the COCs in soil

and groundwater listed in the OU A ROD, no revision to the ARARs was found that would affect the protectiveness of the remedy.

Soil. Table 7-1 compares current ARAR values for soil with those provided in the OU A ROD (Table 8-1 of U.S. Navy, USEPA, and Ecology 1997). Since the time of the second 5-year review, there has been no ARAR revision for soil that would affect the protectiveness of the remedy.

As discussed in the first and second 5-year reviews, the MTCA Method C industrial soil cleanup level for total PCBs increased from 17 to 66 mg/kg for "high risk and persistent PCBs" (as defined by EPA guidance). The lower cleanup level selected in the ROD (17 mg/kg) remains protective of human health and the environment.

As discussed in the first 5-year review, the MTCA Method C industrial soil cleanup level for arsenic decreased from 219 to 88.5 mg/kg. Although the arsenic value has again decreased slightly from 88.5 to 87.5 mg/kg, no change to the ROD RG for arsenic is considered necessary. As stated in the second 5-year review, if the cleanup level were changed at OU A, the effect would be minimal, because the areas with the greatest arsenic concentrations have been paved, thereby effectively interrupting the direct contact exposure route.

At the time of the OU A ROD, individual carcinogenic PAHs (cPAHs) were assessed based on the MTCA Method C industrial soil cleanup level for benzo(a)pyrene. The RG for cPAHs in soil required adjusting the concentrations of individual cPAHs based on their relative toxicity to benzo(a)pyrene, then summing up the individual adjusted concentrations and comparing the result to the RG for benzo(a)pyrene. This resulted in a total "toxicity equivalent" concentration (TTEC) based on the toxicity of benzo(a)pyrene (Ecology 2001). However, new MTCA Method C industrial values are now available for the individual cPAHs, such that the summing step may no longer be required if only one cPAH present. However, this does not constitute a change in the assessment of the toxicity of these compounds, and, in general, the TTEC approach is still required. Therefore, the ROD RG has not substantively changed and remains protective.

Groundwater. Table 7-2 compares current groundwater ARAR values for the protection of surface water with those presented in the OU A ROD (Table 8-1 of U.S. Navy, Ecology, and USEPA 1997). Since the time of the first and second 5-year reviews, there has been no ARAR revision for groundwater that would affect the protectiveness of the remedy. However, for many of the COCs listed in the OU A ROD, the RG is based on the laboratory PQL. MTCA allows for use of the PQL when the MTCA cleanup level is below the PQL. Based on new analytical techniques, laboratories are now able to readily achieve lower PQLs for some of these COCs.

When RGs are established as PQLs and the PQLs decrease with improved technology, the 5-year review process does not typically recommend revising the RGs during every 5-year review. Instead, the 5-year review includes an assessment of whether the latest PQLs are being used for monitoring and decision making. At OU A, monitoring is no longer required for the COCs that had PQLs identified as the RGs, in accordance with the recommendations of the first 5-year review. However, changes are listed for completeness. Although PQLs for copper, lead, nickel, and zinc have changed, they are not discussed in detail because the ROD RGs were based on the marine ambient water quality criteria at the time of the ROD, which have remained the same. It should also be noted that some PQL changes on Table 7-2 may reflect rounding differences rather than actual changes. For example, the achievable PQL for aldrin decreased from 0.01 to 0.005 µg/L. Although lower PQLs are currently achievable for more chemicals than those listed, only those with significant changes are listed below:

- **PAHs:** The ROD RG for PAHs in groundwater is based on the PQL achievable at the time the ROD was prepared, 5 µg/L. However, most laboratories now routinely run a selected ion monitoring (SIM) analysis, which typically provides a PQL of 0.1 µg/L for all PAHs listed: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd) pyrene. The MTCA B surface water criteria increased for several of the PAHs. However, because the ROD RG was based on the PQLs, the changes have no effect on the ROD RGs. Note that although PAHs are no longer being monitored at OU A, the MTCA B surface water criteria for chrysene and benzo(k)flouranthene have now increased (become less conservative) and are therefore now achievable. Because the MTCA B surface water value is now achievable because of new laboratory technologies, cleanup levels for chrysene and benzo(a)pyrene no longer need to be compared to PQLs. It is recommended that PQLs no longer be tracked for these chemicals.

- **Bis(2-ethylhexyl)phthalate:** The ROD RG selected for bis(2-ethylhexyl) phthalate in groundwater is also based on the PQL achievable at the time the ROD was written, 5 µg/L. As with PAHs, most laboratories routinely run a SIM analysis, which typically now provides a PQL of 0.1 µg/L for bis(2-ethylhexyl) phthalate.

Operable Unit NSC

For OU NSC, soil cleanup levels were based on industrial site use, and groundwater cleanup levels were based on the protection of adjacent surface waters of Sinclair Inlet. For the COCs in soil and groundwater listed in the OU NSC ROD, no revision to the ARARs was found that

would affect the protectiveness of the remedy. However, TPH groundwater monitoring reports should be updated to include comparisons to new MTCA A criteria for TPH fractions.

Soil. Table 7-3 compares current ARAR values for the soil with those documented in the OU NSC ROD (Table 8-2 of U.S. Navy, Ecology, and USEPA 1996). As described for OU A, the MTCA Method C industrial soil cleanup level for total PCBs has increased from 17 to 66 mg/kg. The lower cleanup level selected in the ROD (17 mg/kg) remains protective of human health and the environment.

As discussed above for OU A, the cPAHs of the OU NSC ROD were adjusted based on their toxicity equivalency to benzo(a)pyrene. While MTCA C industrial values are now available for individual cPAHs using the same TTEC methodology, in the majority of cases (i.e., more than one cPAH present), there is no real difference in the cPAH RG, and the remedies remain protective.

As described in the second 5-year review for TPH in soil, the ROD selected an RG of 200 mg/kg based on the MTCA Method A cleanup levels for TPH in soil. Current MTCA Method A values have been available since the last review for each of the specific fuel type fraction ranges of diesel, heavy oil, mineral oil, gasoline with benzene, and gasoline without benzene. As shown in Table 7-3, the ROD-selected RG of 200 mg/kg is protective for all of the newer individual TPH compounds, except gasoline. However, the residual TPH in soil is more likely attributable to the diesel range rather than the gasoline range, and the new lower TPH-G levels do not apply to the site. Benzene was not identified as a COC in the risk assessment, indicating that the TPH-G "with benzene" MTCA A value of 30 mg/kg is not relevant. TPH-G was detected at low concentrations at depth (from 8 to 15 feet below ground surface), with a maximum detection of only 160 mg/kg and a frequency of detection of only 8 out of 39 samples. In contrast, TPH-D was detected in 30 of 39 samples, with a maximum concentration of 1,800 mg/kg. While the maximum historical TPH-G concentration is above the current TPH-G MTCA A unrestricted level of 100 mg/kg (without benzene), the low frequency of detection in soil combined with the lack of detections of TPH-G in groundwater (see Table 6-2) appear to confirm that the heavier petroleum products are the source of TPH at OU NSC. In addition, the MTCA Method A values are intended to be protective of unrestricted land use, and ICs are in place that will prevent residential use of the site. Therefore, the ROD-selected RG for TPH remains protective.

Groundwater. Table 7-4 compares current ARARs values for the protection of surface water with those presented in the OU NSC ROD (Table 8-1 of U.S. Navy, Ecology, and USEPA 1996). Since the time of the first and second 5-year reviews, no ARAR revision that has been made for groundwater protection of surface water would affect the protectiveness of the remedy. As listed above for OU A, the RGs listed for many of the COCs in the OU NSC ROD are based on the laboratory PQL. For OU NSC, most of the COCs for which PQLs were used are still currently being monitored. The PQL changes are discussed below.

For copper, lead, and nickel in groundwater, the PQLs have decreased since the second 5-year review. However, because the ROD RG was based on the marine ambient water quality criterion, and, therefore, the RG is still protective. The ROD RG selected for alpha BHC in groundwater is based on the PQL achievable at the time the ROD was written, 0.01 µg/L. The current PQL for alpha-benzene hexachloride (alpha-BHC) is also slightly lower at 0.005 µg/L. The PQL for total PCBs has also slightly lowered from 0.2 to 0.1 µg/L. These slight changes of the PQLs for alpha-BHC and total PCBs may also reflect rounding differences rather than actual changes. These changes are insignificant and do not affect the protectiveness of the remedy. It should also be noted that alpha-BHC and total PCBs are no longer being monitored for at OU NSC. PCB and pesticides are no longer being monitored at OU NSC, based on the February 2002 monitoring results (which had no detections), as recommended in the first 5-year review (U.S. Navy 2002e).

In addition, for TPH in groundwater, the ROD selected an RG of 1,000 µg/L based on the MTCA Method A values for TPH. This value was intended to be compared to the total concentration of all TPH compounds, which was the common approach to reporting and assessing petroleum concentrations at the time the ROD was signed. However, petroleum is now commonly analyzed for the individual carbon-fraction ranges for specific fuel types. MTCA Method A values have been available since the second 5-year review for each of the specific fuel-type fraction ranges of diesel, heavy oil, mineral oil, gasoline with benzene, and gasoline without benzene. Because current MTCA A values are no longer available for total TPH, a straight comparison of present and past MTCA Method A levels cannot be made for TPH. The ROD-selected RG of 1,000 µg/L is equal to the current MTCA Method A level for gasoline without benzene, but is less protective than the current MTCA Method A values for the other individual fractions. Because benzene was not selected as a COC in groundwater, it is unlikely to be present. Therefore, use of the ROD RG value of 1,000 µg/L remains appropriate for gasoline monitoring based on current MTCA standards. However, a value of 500 µg/L is more appropriate when monitoring for diesel than the ROD RG of 1,000 µg/L. The current MTCA Method A value for mineral oil has also recently decreased from 1,000 to 500 µg/L. However, there has been no monitoring for mineral oil at OU NSC. The changes in the MTCA Method A groundwater cleanup values for the TPH compounds do not affect the protectiveness of the remedy as long as the results of monitoring are compared to the revised MTCA A values. Currently, only wells 392/392R have groundwater concentrations exceeding both current and past MTCA A values for TPH diesel. Therefore, it is recommended that future groundwater monitoring results be compared to the revised MTCA A values when monitoring for diesel and other individual fractions of TPH.

Vapor Intrusion. The 2001 MTCA revisions included language for the evaluation of the vapor intrusion pathway at sites where the maximum diesel-range organic concentration in soil exceeds 10,000 mg/kg. As discussed in the second 5-year review, OU NSC fits this criterion. Therefore,

in 2003 (at the request of Ecology), a vapor intrusion evaluation was conducted for OU NSC (U.S. Navy 2003c). This evaluation used modeling to predict air concentrations from soil and groundwater and included an evaluation of the potential health risks to industrial workers associated with inhalation of indoor and outdoor air at OU NSC. Modeled air concentrations were compared to MTCA Method C air cleanup levels. The vapor intrusion evaluation concluded that the vapor intrusion pathway is not a health concern to industrial workers at OU NSC. Therefore, this revision to MTCA does not affect the protectiveness of the remedy selected for OU NSC.

Operable Unit B Marine

The ARARs and RGs for OU B Marine are defined for sediment and are also assumed to result in reduction of COC concentrations in marine tissues. The term COC is generally used to identify those chemicals that trigger the need for remedial action, because they result in an exceedance of target health goals. However, Section 8 of the OU B Marine ROD used the term COC to identify the primary contributors to human and ecological health risk, whether or not they resulted in an exceedance of target health goals (U.S. Navy, Ecology, and USEPA 2000a). As described in Section 9 of the OU B Marine ROD, only two chemicals were identified as COCs in sediment and subsequently had RGs developed. These two COCs, PCBs and mercury, are the focus of this discussion.

PCBs. The ROD defined an MCUL of 3 mg/kgOC for PCBs in OU B Marine sediments. Achievement of the MCUL would lead to the site being removed from the National Priorities List. The ROD ultimate long-term PCB cleanup goal for sediment throughout Sinclair Inlet is based on the reference area concentration of 1.2 mg/kgOC. MTCA allows for use of background values when the MTCA risk-based cleanup goal is below natural background for persistent organic compounds (e.g., PCBs) and naturally occurring metals. No risk-based cleanup goal was calculated for PCBs in sediment in the ROD. According to the ROD, the sediment cleanup goal is expected to result in achievement of the fish tissue cleanup goal of 0.023 mg/kg, which is also based on reference area background fish tissue concentrations.

The ROD MCUL for PCBs of 3 mg/kgOC was selected based on modeling results for natural recovery. The MCUL is defined in the ROD as the primary measurable objective for cleanup of PCBs in OU B Marine sediments. To achieve the MCUL, the ROD selected an action level of 12 mg/kgOC to identify areas of sediment to be dredged. The ROD also selected an action level of 6 mg/kgOC to identify areas of sediment in which ENR through addition of a thin layer of clean sediment would be considered.

The remedial construction activities conducted at OU B Marine to achieve the RAOs resulted in the unplanned release of contaminated materials on SOAL near the CAD pit. In response to the unplanned release, the Navy completed an ESD, in which the Navy established an action level

for the SOAL portion of the OU B Marine ROD to address the sediment contamination on SOAL (U.S. Navy, Ecology and USEPA 2004b). The Navy selected a response action of ENR for SOAL sediments containing greater than or equal to 9 mg/kgOC PCBs.

The MCUL, the cleanup goal, and the action levels defined in the ROD, as well as the selected action level for SOAL sediments, are all equal to or more protective than the Washington State SMS SQS of 12 mg/kgOC and MCUL of 65 mg/kgOC. The SQS is the "sediment cleanup objective" for cleanup activities under the SMS, whereas the MCUL is the maximum allowed chemical concentration to be achieved by year 10 after completion of the active cleanup action. There has been no change in background concentration data or ARARs used to establish the OU B Marine cleanup goals for PCBs in sediment that would affect the protectiveness of the selected remedy.

Mercury. The ROD did not select a cleanup goal specific to mercury in sediment. Rather, the ROD selected a combined action level of 6 mg/kgOC PCBs and 3 mg/kg mercury in sediment to achieve the RAO for mercury. The Washington State SMS SQS for mercury at the time the ROD was signed was 0.41 mg/kg and the MCUL was 0.59 mg/kg, both of which are below the action level for mercury of 3 mg/kg and have not changed since signing of the ROD. There has been no change in ARARs for mercury in sediment since the signing of the ROD that would affect the selected remedy. Currently, the health hazards of mercury in Sinclair Inlet are being further evaluated, and a number of mercury studies have been initiated. The stakeholder group is assessing additional data gaps and developing a plan to fill the gaps, and the Navy plans to conduct a focused FS for mercury once applicable data have been collected. The FS may include development of site-specific RGs for mercury in sediment and/or tissue to address human health risks from the consumption of mercury in Sinclair Inlet seafood. See also discussion in Section 7.2.2.

Operable Unit B Terrestrial

The ROD for OU B Terrestrial concluded that under current conditions, with contaminated soil effectively capped by pavement and buildings and groundwater not being used, no action other than ICs was required to ensure protectiveness (U.S. Navy, Ecology and USEPA 2004a). Therefore, no cleanup levels were established for the site. However, the potential for movement of contaminants off site was identified as a concern. The RAOs were based on the need to prevent exposure to contaminated terrestrial media (i.e., accumulated stormwater system sediment and debris, soil, and groundwater) and to limit transport to the adjacent marine environment (OU B Marine).

To achieve the RAOs for OU B Terrestrial, in addition to ICs, a conditional point of compliance for groundwater was selected at OU B Terrestrial near the shoreline to monitor groundwater discharge from OU B Terrestrial to Sinclair Inlet. Twelve target analytes were selected to be

monitored in groundwater and compared against the conditional points of compliance groundwater criteria. Table 7-5 compares current ARAR values for the protection of surface water with those presented in the OU B Terrestrial ROD. TCE, which is one of the chemicals selected for groundwater monitoring at the conditional point of compliance, has had a significant change in toxicity criterion (as discussed in Section 7.2.2). However, the change does not affect the protectiveness of the remedy selected for OU B Terrestrial.

The RG for TCE is based on the MTCA Method B surface water value, which has lowered because of the latest toxicity changes. The MTCA Method B surface water value has decreased from 55.6 to 12.8 µg/L. Although, the current RG is now more conservative, the change does not affect the protectiveness of the remedy. There is currently no detection of TCE in any of the bordering groundwater wells adjacent to the shoreline of Sinclair Inlet and, therefore, no evidence of TCE being transported into the adjacent surface water body (U.S. Navy 2011b). The changes in the MTCA Method B surface water value for TCE do not affect the protectiveness of the remedy as long as the results of monitoring are compared to the revised MTCA value (see Sections 4.3.4 and 6.4.3 for further discussion). It is recommended that future monitoring results be compared to the revised MTCA Method B surface water value for TCE.

Operable Unit C

OU C is a petroleum-contaminated site. CERCLA does not address petroleum as a contaminant. Petroleum releases are addressed in Washington State under Subchapter IX of RCRA and the state's MTCA. This CERCLA 5-year review includes an assessment of the OU C remedy protectiveness to address the parallel MTCA review requirements. Therefore, no ROD RG was established. Compliance levels of OU C are referred to as trigger levels, which were based on MTCA Method A regulatory levels. No soil cleanup value was established for OU C because the contaminant depth was approximately 80 to 120 feet below ground surface.

Groundwater. Table 7-6 compares current ARAR values for the protection of surface water with those presented in the quarterly groundwater monitoring reports of OU C. There has been no ARAR revision for groundwater protective of surface water that would affect the protectiveness of the remedy. For OU C, based on discussions between the Navy and Ecology, and in accordance with MTCA 173-340, MTCA Method A values were used as trigger cleanup levels (U.S. Navy 2007i). No change in MTCA Method A values was found since the trigger values were established.

Operable Unit D

The ROD for OU D concluded that as long as contaminated soil was contained in place, no action other than ICs and periodic groundwater monitoring was required to ensure protectiveness (U.S. Navy, Ecology and USEPA 2005). The ROD-selected RGs for soil were based on the

protection of adjacent surface waters of Sinclair Inlet. Ten chemicals were identified as COCs in soil at OU D. The cleanup levels for these 10 COCs are based on MTCA Method B soil values for the protection of surface water, except in cases where background concentrations were higher. Table 7-7 compares current ARAR values for soil based on the protection of surface water with those presented in the OU D ROD. Five of the 10 COCs in soil have changes in toxicity criteria that have changed the MTCA Method B soil cleanup levels protective of surface water. For four of the five COCs with changes, cPAHs, 4,4-DDT, dieldrin, and endrin, the changes are insignificant. For the fifth COC, PCE, the changes are significant based on the new toxicity criteria recently entered into EPA's Integrated Risk Information System (IRIS) database (USEPA 2012a). The new value, however, is higher (chemical is less toxic than previously thought) than the previous value. The MTCA Method B soil cleanup level protective of surface water for PCE has increased from 0.0552 to 3 mg/kg. Note that today's soil cleanup level protective of surface water for PCE of 3 mg/kg is higher than any level of PCE detected in soil during the RI (maximum detected value during the RI was 0.17 mg/kg).

Although the ROD RGs would be slightly lower today for four COCs, the original capping remedy prevents chemical transport to the adjacent marine environment. If this cap is still functioning as anticipated by the ROD, the remedy for OU D would still be protective. However, there is still some question as to whether the cap is functioning (see Sections 7.1.6 and 7.2.2 for additional discussion).

No cleanup level was established for any other site media at OU D. However, periodic groundwater monitoring was selected as part of the remedial alternative. One monitoring well was selected as the conditional point of compliance for groundwater monitoring of COCs in groundwater near the point of discharge to the marine environment. The groundwater criteria selected for monitoring of the COCs in groundwater were established as the higher of the regulatory level or the PQL and were based on protection of adjacent surface waters of Sinclair Inlet. Table 7-8 compares current ARAR values for the protection of surface water with the "preliminary cleanup levels" presented in the OU D ROD. Since the first 5-year review, no change in ARARs has been identified that would affect the protectiveness of the selected remedy. The ROD monitoring criteria for mercury was based on the PQL at the time of the ROD. As stated above for OU NSC, MTCA allows for use of the PQL when the MTCA cleanup level is below the PQL. The current PQL for mercury has decreased slightly from 0.2 to 0.1 μg/L. The change is insignificant and therefore has no effect on the protectiveness of the remedy.

In addition, the marine ambient water quality criterion for cadmium has increased from 8.8 to 9.3 μg/L, becoming slightly less conservative. The lower ROD monitoring level for cadmium remains protective. The ROD-selected groundwater monitoring criterion for copper of 3.1 μg/L is based on the state and federal water quality criteria. However, the National Toxics Rule

criterion of 2.4 µg/L is slightly lower (i.e., more conservative) than the state and federal water quality criteria. The difference between the ROD-selected RG and the state and federal water quality criteria is insignificant, and the use of 3.1 µg/L in monitoring for copper does not affect the protectiveness of the remedy.

7.2.2 Review of Risk Assessment Assumptions

Risk assessment assumptions were also reviewed as part of the requirement to assess protectiveness of the remedy. For human health, there are potentially two areas where changes could have occurred since the signing of the RODs: toxicity values for select chemicals and assumptions regarding human activity (i.e., exposure assumptions). How these changes to toxicity and exposure parameters might affect the protectiveness of the remedy is discussed below.

Toxicity Criteria

Changes to toxicity criteria since the signing of the five RODs discussed in this 5-year review potentially impact only the soil RGs at OU D and the groundwater RGs at OU B Terrestrial. As per communication with Martha Hankins of Ecology (Hankins 2012), the most updated IRIS values per Washington Administrative Code 173-340-708(8)(a) for TCE and PCE should be used. Ecology's CLARC database does not reflect the updated toxicity criteria for TCE and PCE as of March 2012 (toxicity criteria were updated in IRIS in September 2011 and February 2012 for TCE and PCE, respectively). Ecology is planning to update their database to reflect these changes (Hankins 2012). Consequently, the latest IRIS toxicity criteria were used in the standard MTCA cleanup level calculations and are shown in the Section 7 tables. None of the toxicity criteria for the COCs identified in sediment and fish tissue at OU B Marine have changed since the signing of the ROD. No toxicity criteria changes were found for COCs identified in OU A or OU NSC.

Operable Unit D. The ROD RG for PCE in soil is 0.055 mg/kg, based on the MTCA Method B soil cleanup level for the protection of surface water and the toxicity criteria available at the time the ROD was executed. The toxicity criterion for PCE has been revised. The EPA has published new cancer toxicity values for PCE in EPA's IRIS (USEPA 2012a). The new oral slope factor for PCE is 0.0021 $(mg/kg\text{-}day)^{-1}$. Using the new oral slope factor for PCE to calculate the MTCA Method B soil cleanup value for surface water protection, results in a value of 3 mg/kg, several orders of magnitude higher than the ROD-selected RG of 0.055 mg/kg. Because the soil RG for PCE is now higher than the value established in the ROD, the protectiveness of the selected remedy is not affected. The new soil RG for PCE is higher than any value detected in soil during the RI. Therefore, PCE would not be considered a COC at OU D if the site were evaluated today.

Operable Unit B Terrestrial. The conditional point of compliance groundwater criterion for TCE is 55.6 µg/L, based on MTCA Method B surface water formulas and the toxicity criteria available at the time the ROD was executed. As discussed above, there has been revisions to the toxicity criteria for TCE. The EPA has published new cancer toxicity values for TCE in EPA's IRIS (USEPA 2012a). The new oral slope factor for TCE is 0.046 $(mg/kg\text{-}day)^{-1}$. Using the new oral slope factor for TCE to calculate the MTCA Method B groundwater cleanup value for surface water protection results in a value of 12.8 µg/L. While the groundwater RG for TCE is now lower than the value established in the ROD, the protectiveness of the selected remedy is not affected. Currently, there is no detection of TCE in the groundwater wells adjacent to the Sinclair Inlet at OU B Terrestrial.

The RG of 55.6 µg/L for TCE was based on a noncancer hazard quotient of 1 and older toxicity criteria. As such, the old number and the new cancer-based number have different toxicological endpoints, and their risk levels are not directly comparable. However, using the new cancer slope factor, the cancer risk level of 55.6 µg/L is approximately 4×10^{-6}. Therefore, the cancer risk level of the ROD RG it is still below the target health goal of 1×10^{-5} in the OU B Terrestrial ROD and within the EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}. Therefore, the remedy is still protective.

Exposure Parameters

The new exposure pathways that have been identified since the ROD was signed are potential exposures to contaminants previously capped at OU D, vapor intrusion in selected locations of OU B Terrestrial, and exposures to mercury in seafood consumed by subsistence fishers for OU B Marine. These new exposures are discussed below.

Operable Unit D: The original risk assessment conducted as part of the RI for OU D found no unacceptable human health risk based on chemical concentrations in the upper 2 feet of soil at OU D (U.S. Navy, Ecology, and USEPA 2005). Four metals (arsenic, chromium, mercury, and thallium) and cPAHs were evaluated for direct-contact health risks during future use of the site as a park. Risks for site visitors were driven by benzo(a)pyrene concentrations and were 1×10^{-6}. However, based on interview responses from Navy personnel and correspondence between EPA and the City of Bremerton (USEPA 2006) prior to the second 5-year review and the findings of the draft OU D remedy evaluation report (U.S. Navy 2010d), the exposure assumptions related to chemicals in soil beneath OU D may have changed since the time of the ROD. Grading activities by the City of Bremerton may have brought deeper soils to the surface, which may have different concentrations than the soil evaluated in the original risk assessment. In addition, these grading activities have resulted in removal of cap material, increasing the potential for leaching of contaminants into groundwater and migration through the site to Sinclair Inlet. The original risk assessment did not quantify future risks to the marine environment because of groundwater, but

noted that ongoing monitoring was intended to ensure that possible contaminants reaching the Inlet were below surface water criteria.

At the time of the second 5-year review, a review of chemical concentrations measured in deeper soil at OU D (up to 15 feet below grade at the time of sampling) indicated that the presence of chemicals in formerly deep soil that is now near ground surface is unlikely to change the conclusions of the risk assessment. Chemical concentrations in soil depths greater than 2 feet (at the time the ROD was executed) were generally lower than those in shallow soil. Therefore, the potential health risks related to park visitors coming into direct contact (via ingestion, dust inhalation, or dermal exposures) with previously deep soils because of increased soil concentrations are considered to be quite low, and exposure to deeper soils is unlikely to increase the low risks identified in the original baseline risk assessment.

The chemicals driving risk (cPAHs) in OU D soil are now considered mutagens by EPA. If child exposures are a potential, EPA is now recommending a different formula to evaluate mutagen risks (USEPA 2012b) than the cancer risk formula used in the original baseline risk assessment. In addition, hexavalent chromium is also now considered a mutagen. Total chromium was selected as a chemical of potential concern and evaluated as 100 percent hexavalent chromium in the original risk assessment[2]. As stated above, the site has been redeveloped as a park. Therefore, child exposures to surface soil via the recreational exposure pathway could occur, and EPA's new exposure quantifications and methodologies would apply if a risk assessment were to be conducted today. If risks were calculated today for the park scenario, they would be higher than risks calculated in the original baseline risk assessment, assuming other exposure inputs were the same. The original risk assessment calculated a risk of 1×10^{-6}, equal to the target goal for an unrestricted land use scenario under MTCA. Therefore, any increases in risk could potentially result in risks greater than 1×10^{-6} in the park, if other assumptions used in the baseline risk calculations (e.g., soil concentrations and number of days per year of park visits) were the same. Depending on the actual soil concentrations (currently unknown) and the exposure assumptions used to assess the frequency of park visits, there is some possibility that a 1×10^{-6} risk level could be exceeded. Current surface soil concentrations and information on park conditions (e.g., amount of uncovered surface soil) would be required to assess current risks. If surface soil concentrations are lower than the risk assessment (this is likely because of mixing with lower concentration soils), risks may still not exceed a target risk goal for unrestricted land use. However, if additional assessment is planned (see discussion in

[2]Note that hexavalent chromium also has new toxicity criteria in IRIS since the original baseline risk assessment was conducted, and risks from hexavalent chromium would be higher if evaluated today. However, there was no known source of hexavalent chromium at OU D, and, therefore, the assumption of 100 percent hexavalent chromium is likely a significant overestimation of health risks.

Section 7.1.6), the Navy recommends that surface soil samples be collected and analyzed for PAHs and metals to assess current surface soil concentrations.

The mutagen issues for cPAHs and hexavalent chromium do not affect the construction worker risks assessed in the baseline risk assessment, because the adult-only risk equations have not changed.

Operable Unit B Terrestrial. At the time the OU B Terrestrial ROD was executed, the vapor inhalation pathway was not routinely evaluated at sites. However, in recent years, EPA and many state agencies have published guidance documents aimed to specifically address potential health risks associated with the vapor inhalation pathway. In the previous second 5-year review, the vapor intrusion pathway for VOCs of OU B Terrestrial was identified as a complete pathway that needed to be evaluated. In the last 5 years, a number of investigations of the vapor intrusion pathway were conducted that comprehensively reviewed all VOC data from BNC, conducted site-specific building inspections, modeled health risks using Johnson-Ettinger modeling techniques (US EPA 2004), and ultimately selected three locations, shown on Figure 7-1, where additional vapor intrusion investigative work was warranted (U.S. Navy 2009b):

- TCE northern plume
- TCE southern plume
- HWSA

The additional investigative work was conducted following the development of a sampling and analysis plan early in 2010 to address the data gaps identified on a site-specific basis for the three areas of concern (U.S. Navy 2010h). For the TCE southern plume and HWSA areas, additional investigation consisted of collection of new groundwater data and assessing whether current concentrations were acceptable for the vapor intrusion pathway. Additional data collection in the TCE northern plume area consisted of additional groundwater sampling and the collection of two rounds of sub-slab soil gas and indoor air data from Buildings 427 and 435 (Figure 7-2). The results of the 2010 data collection efforts were evaluated in a vapor intrusion follow-up report (U.S. Navy 2012b). The 2012 report determined that no vapor intrusion health risk was associated with any of the three areas of potential concern. However, for the TCE northern plume area, the draft report identified a possible data gap. The TCE concentrations between wells 425 and 432 and the northern property boundary were not known (see Figure 7-2), and there was the possibility of an off-site upgradient source (U.S. Navy 2012b). Consequently, between the draft and the final follow-up reports during summer 2011, the Navy drilled three new wells between 425 and 432 and the northern property boundary (see Figure 7-3).

As shown on Figure 7-3, concentrations of TCE measured in new wells 904, 905, and 907 fully delineate the groundwater plume with respect to TCE and confirm that maximum concentrations of TCE in groundwater are between Buildings 427 and 435. Therefore, no additional building

was identified for potential vapor intrusion concerns for TCE, and the conclusions regarding TCE (no indoor air health risk) were confirmed by the new data (U.S. Navy 2012b). Only one chemical in one of the three new wells (well 905) had a concentration in groundwater above a vapor screening level. PCE in well 905 was detected at a concentration slightly above the vapor screening level and significantly higher than current concentrations detected in any other wells. The concentration was 76 µg/L (the screening level is 62 µg/L). The risk analysis presented in the follow-up report concluded that this concentration in groundwater is very unlikely to result in an indoor air health risk above a target health goal (U.S. Navy 2012). Both the new and the existing data indicate the area of groundwater with concentrations exceeding a vapor screening level is very localized. Consequently, it does not appear that PCE is present at concentration levels associated with an actionable health risk. However, PCE concentration trends in the well need to be established and assessed over multiple sampling events.

The follow-up report recommended that wells 425, 432, and 704 and the three new wells (904, 905, and 907) continue to be monitored for TCE as part of the regular LTM program at BNC (U.S. Navy 2012b). In addition, analysis for PCE, chloroform, 1,2-dichloroethane and TCE daughter products should be conducted to confirm that concentrations remain low and that concentrations of all chemicals are stable or decreasing. Based on the results of the vapor intrusion studies described above, the Navy also plans to perform further TCE and PCE plume characterization in the TCE northern plume area of OU B Terrestrial area (see Section 4.3.4).

Operable Unit B Marine. The second 5-year review of the BNC cleanup efforts recommended a supplemental risk evaluation of mercury for Sinclair Inlet sediment and fish tissue (U.S. Navy 2007d). This recommendation was based on elevated mercury concentrations measured in rockfish and higher Suquamish Tribe seafood ingestion rates than were used in the original risk assessment, both of which could affect the protectiveness of the remedy for OU B Marine. This evaluation has been performed (U.S. Navy 2010i), and the results are summarized below.

The purpose of the risk evaluation was to conduct a screening-level (i.e., health protective) analysis of BNC-related mercury hazards to Suquamish Tribe members. EPA tribal seafood consumption risk assessment framework concepts (USEPA 2007b) were used in the risk assessment methodology and were agreed on in consultation with the Suquamish Tribe. Suquamish Tribe-specific seafood ingestion rates were used in the evaluation.

Post-remediation sediment data collected in 2003, 2005, and 2007 were included for analysis. Included in the risk evaluation were tissue data collected from the Navy, WDFW, ENVVEST Project, and Ecology Environmental Information Management database from Sinclair Inlet. The available Sinclair Inlet tissue data were organized into four broad seafood groups: salmon, pelagic fish, bottom fish, and shellfish. Representative species were selected for each seafood group based on their occurrence in Sinclair Inlet and/or Puget Sound and the availability of existing data. The selected species and their seafood groups are as follows:

- **Salmon:** Chinook and coho
- **Pelagic fish:** surfperch (surrogate for Pacific herring) and rockfish
- **Bottom fish:** English sole
- **Shellfish:** littleneck clams, butter clams, mussels, graceful crab (surrogate for Dungeness crab) and sea cucumber

Mercury data from the above species were used in risk calculations to assess health risks. Because some of the mercury present in Sinclair Inlet is from sources unrelated to BNC (e.g., mercury emitted from coal-fired power plants), health risks from eating seafood obtained from Sinclair Inlet were also compared with those from ingesting mercury in seafood from nonurban areas of Puget Sound that have no known local point sources.

Hazard quotients (HQs) exceeded the target goal of 1 for seafood consumption in both Sinclair Inlet and nonurban reference areas of Puget Sound at 95th percentile tribal consumption rates derived from Suquamish Tribe data. Incremental HQs for a sport fishing population met target health goals for all areas. Table 7-9 presents the Suquamish Tribe HQs for each seafood group for Sinclair Inlet and nonurban reference areas, and Table 7-10 presents the incremental hazards above reference areas. Total Sinclair Inlet and reference area seafood ingestion hazards for both adults and children are driven by rockfish in the pelagic fish seafood group, with shellfish and salmon also contributing to the overall hazards. Hazards associated with mercury concentrations in English sole were insignificant. Likewise, hazards associated with direct exposure to mercury in Sinclair Inlet sediment represent insignificant mercury exposures. Hazards from sediment exposures were not estimated for reference areas, because they would be lower than Sinclair Inlet sediment hazards.

Because mercury is present in seafood throughout Puget Sound, the HQs most relevant to cleanup activities at BNC are the incremental hazards above the reference areas, shown in Table 7-10. Incremental hazards shown in Table 7-10 are presented in two ways for rockfish (pelagic group): one using an age-adjusted approach that accounts for the older fish in Sinclair Inlet and the other using unadjusted values. Mercury concentrations are higher in older fish, irrespective of location. Sinclair Inlet appears to have an unusually large percentage of older fish in the population, likely because of, with limited exceptions, the long-standing advisory against seafood harvesting from the inlet. The incremental HQ above nonurban reference areas for tribal subsistence consumption is approximately 4 for adults and 3 for children (using age-adjusted rockfish values). The incremental hazards are driven by shellfish for adults (HQ of 1.6) and the pelagic fish group (i.e., rockfish) for children (HQ of 1.9). Shellfish hazards are driven by clams and crab, with mussel and sea cucumber HQs below 1. If rockfish concentrations are not

adjusted for age, incremental HQs above nonurban reference areas are approximately 5 for both adults and children.

If seafood is consumed at 95th percentile Suquamish consumption rates, all collected from Sinclair Inlet, the incremental mercury HQ is 4, above the target health goal of 1 (incremental HQ is 5 if rockfish concentrations are not age adjusted). The greatest concerns appear to be the consumption of rockfish and the potential increased hazards of children consuming seafood containing both mercury and PCBs (PCBs were identified as the primary health concern in seafood in the OU B Marine ROD).

Based on the risk evaluation, mercury has been identified as a COC for OU B Marine. The Navy is presently working with stakeholders to identify marine sampling needed to address limitations in the historical data used to predict risks from mercury in marine tissues. Information on current marine tissue mercury levels will be used to refine the risk calculations as input to a planned focused FS that will assess potential approaches to reducing risks from mercury in seafood collected in Sinclair Inlet.

7.3 HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?

No additional information has been identified. However, Ecology is in the process of reviewing the SMS to clarify cleanup requirements for contaminated sediments, and the new cleanup requirements will be evaluated, once they are established, for the sediments of OU B Marine in the next 5-year review. It should also be noted that the fish ingestion rate used to calculate MTCA Method B surface water cleanup levels will be partially changed in the revised SMS. The current ingestion rate used in the MTCA surface water calculations is 54 g/day. This ingestion rate is not based on subsistence levels of seafood consumption, and it is likely to be increased. An increase in ingestion rate results in decreases in MTCA Method B surface water cleanup levels.

7.4 TECHNICAL ASSESSMENT SUMMARY

The monitoring data indicate that, overall, the low-risk conditions present at the time of the ROD remain or have improved at OU A and OU NSC. However, at OU A, the work to develop a permanent solution to ongoing erosion at Charleston Beach must be completed to ensure the future functionality of the OU A remedy.

There is evidence that mercury is being released via storm drain and groundwater discharges from the western portion of OU B Terrestrial into Sinclair Inlet in quantities that may represent one of the more significant loadings of this element to the inlet. Total mercury concentrations in groundwater at wells LTMP-1, LTMP-3, and LTMP-5 continue to consistently exceed the compliance criterion. However, mercury concentration trends are not increasing. With the exception of the issue of mercury, the comparatively low-risk conditions have persisted that were present at OU B Terrestrial at the time the ROD was executed.

The OU C CAP was completed during this 5-year review period, and the IC and groundwater monitoring are functioning as intended by the CAP.

The BNC-wide remedy inspection process is not fully functional, because of the challenging logistical and funding issues associated with ensuring regular maintenance of paving and storm drains. The deed restrictions and IC inspections at OU D have not functioned to ensure the integrity of the low-permeability cap, to document the continued prohibition on the use of groundwater, or to document the land use because no mechanism has been established to ensure inspection and correction of deficiencies.

No ARAR change has affected the remedy for OUA, OU NSC, OU B Terrestrial, OU D, or OU C since the last 5-year review. However, because of uncertainties, more information is needed regarding OU D to assess the protectiveness of the remedy. For OU B Marine, studies have been initiated to address the data gaps to be filled before the protectiveness of the remedy can be assessed with respect to mercury in sediment. The 2011 addendum to the second 5-year review report (U.S. Navy 2011i) identified data gaps for assessing current mercury impacts to Sinclair Inlet and uncertainties associated with the technical memorandum data. The preliminary health evaluation conducted to address mercury that constitutes the beginning of the additional effort to address mercury is also summarized in Section 7.2.2.

Concentrations of chemicals in groundwater remain above the RGs at many locations in OU A, OU NSC, and OU B Terrestrial, resulting in the need for continued ICs to prevent exposure and the need for ongoing monitoring. Although some of the RGs might be lower if calculated today, the remedy components continue to protect against exposures, just as they did at the time the ROD was signed. ICs preventing exposure and ongoing monitoring will need to continue until COC concentrations in groundwater and surface water are below the RGs.

7.5 ISSUES

Table 7-11 lists the issues identified as a result of this 5-year review that have the potential to affect the protectiveness of the remedies at BNC. The following additional issues that do not

have the potential to affect protectiveness will be addressed by the Navy as part of overall program optimization:

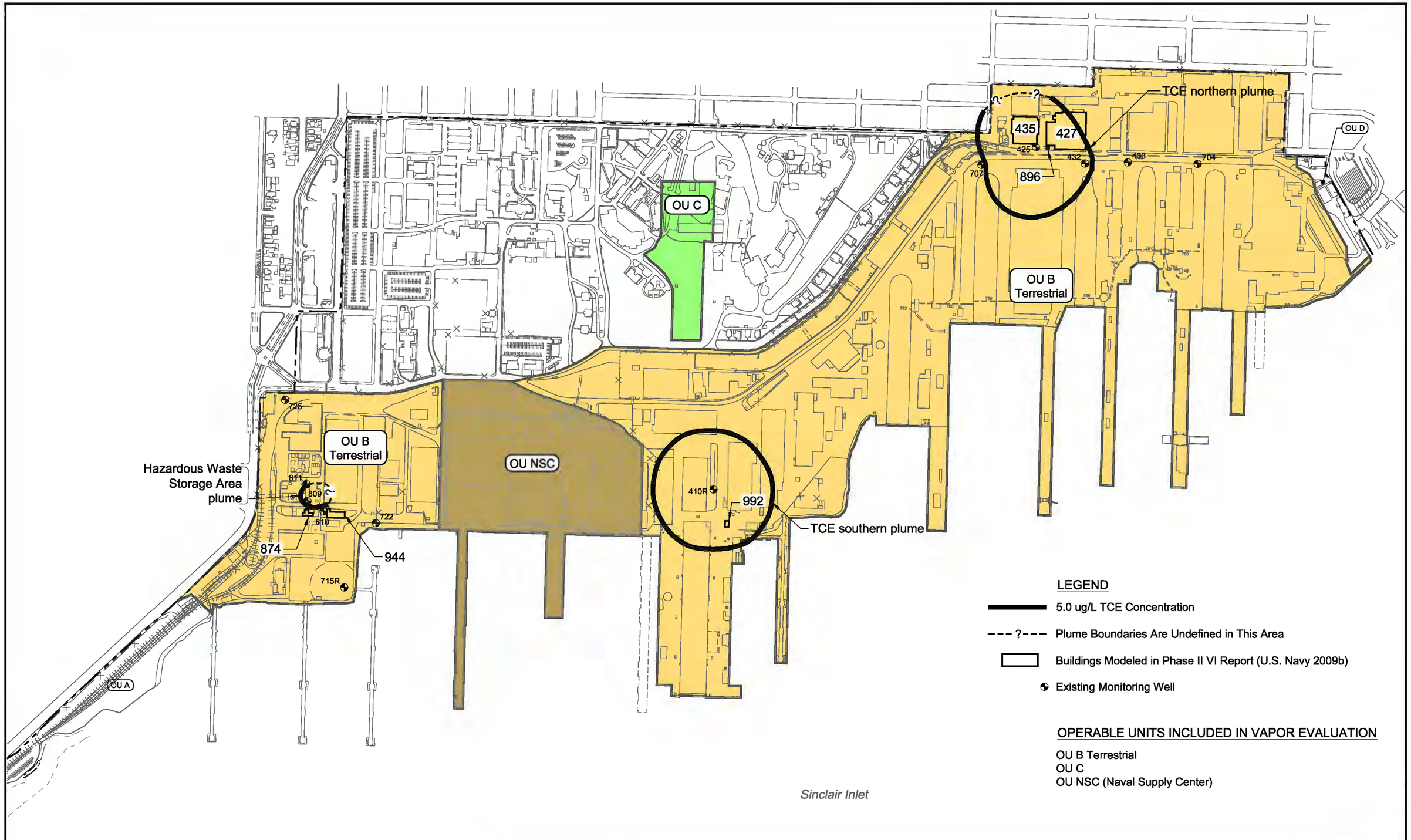
- Some changes to the monitoring program are warranted, as recommended in the most recent monitoring report and reiterated in Section 6.4 of this review.

- At OU NSC, future TPH monitoring results should be compared to current MTCA Method A criteria for TPH fractions. At OU B Terrestrial, future TCE monitoring results should be compared to current MTCA Method B surface water criteria for TCE.

- The 2011 LTM plan does not include VOC analysis of groundwater samples from some of the wells located within all areas where vapor intrusion was recent assessed, although VOC analysis for groundwater from these wells will be included in the 2012 LTM plan.

- The 2011 LTM plan appears not to include TCE analysis of groundwater samples collected from well 410R.

- Community involvement through the RAB process has been comparatively limited in recent years. The EPA has encouraged the Navy to explore alternative web-based approaches to disseminating information on site cleanups and encouraging public participation.



U.S. NAVY	Bremerton Naval Complex THIRD FIVE-YEAR REVIEW	0 300 600 SCALE IN FEET	**Figure 7-1** **Areas of Potential Concern for** **Vapor Intrusion Identified in the Phase II Report**

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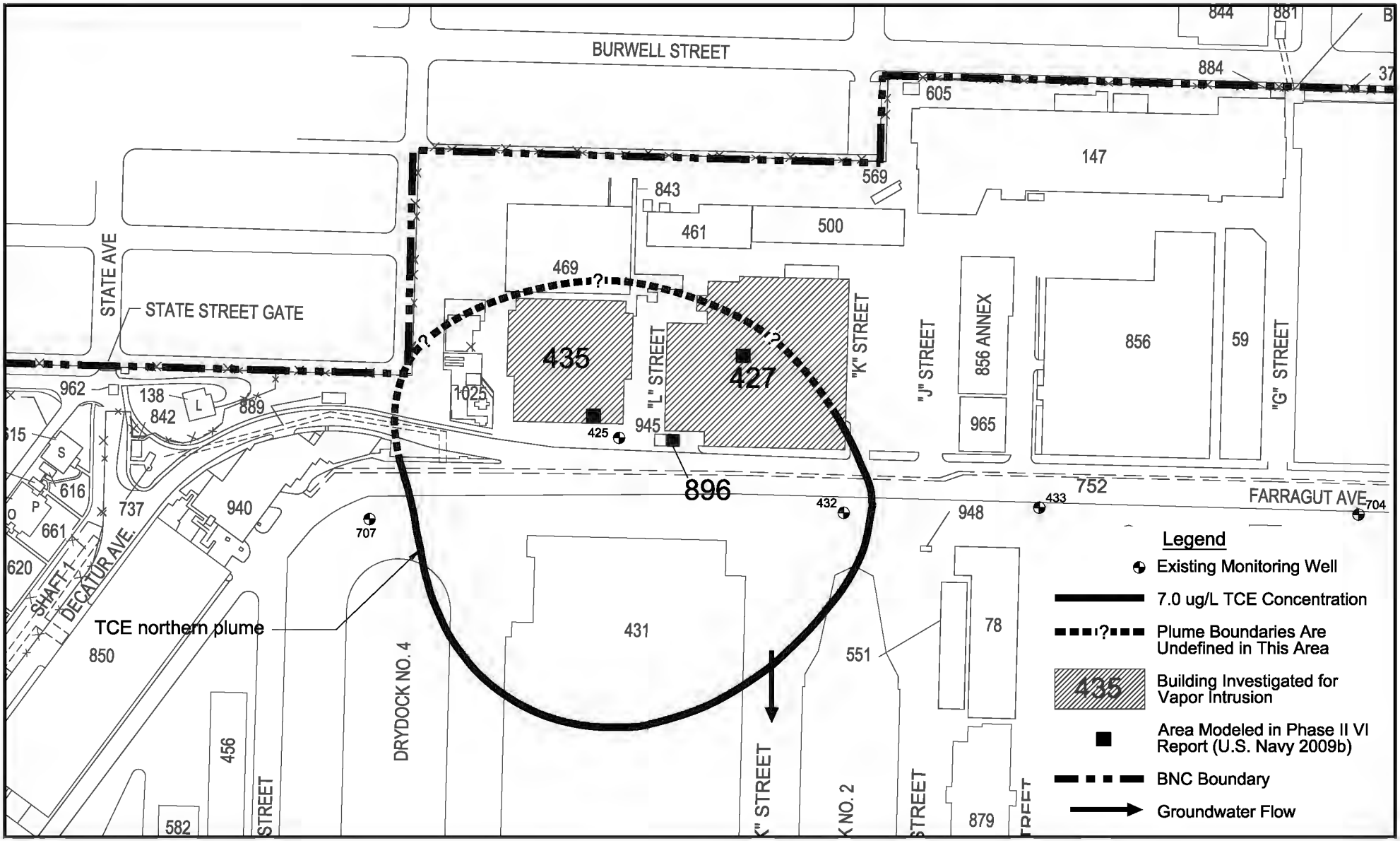

U.S. NAVY

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SCALE IN FEET

Figure 7-2
TCE Northern Plume

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

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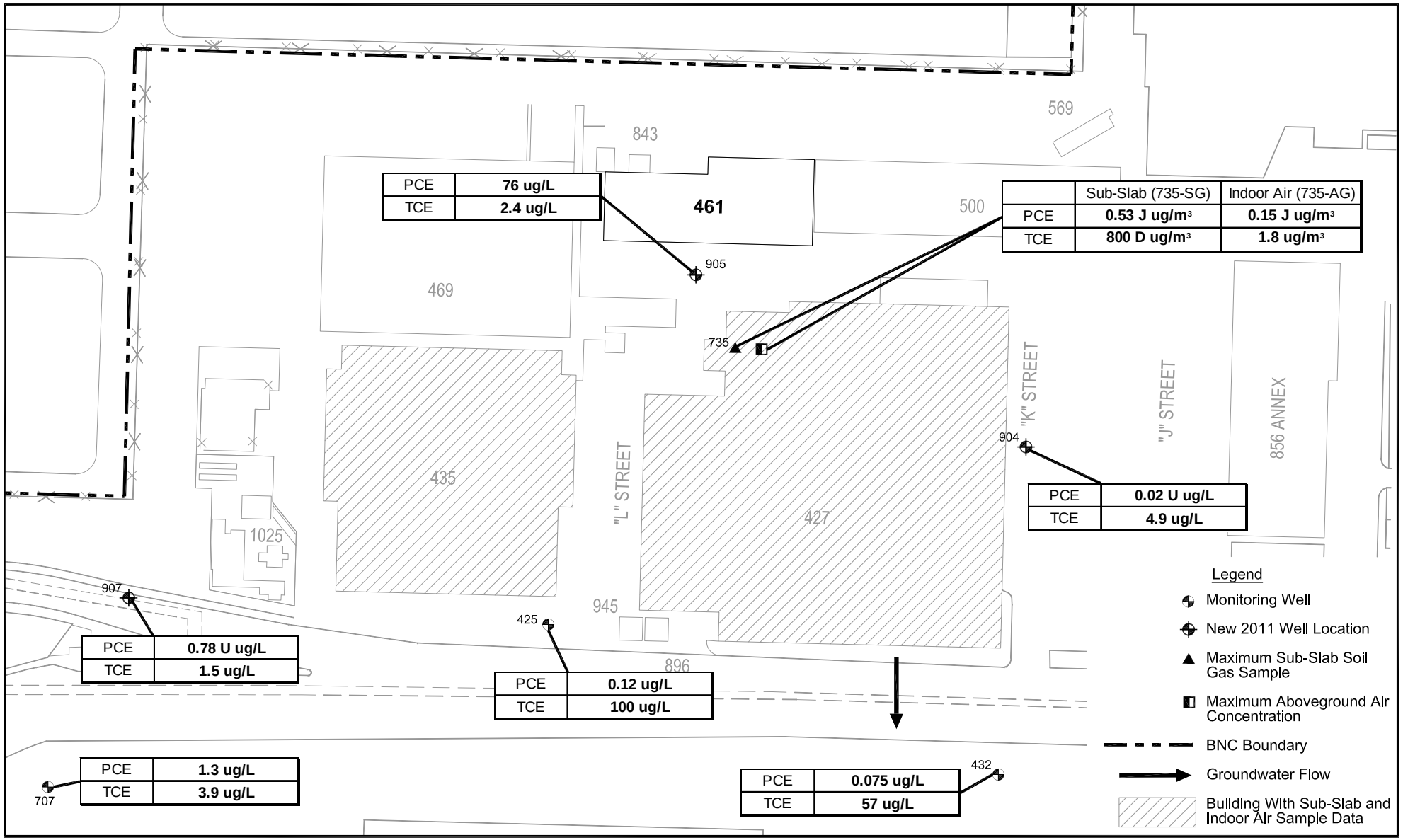

U.S. NAVY

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Figure 7-3
PCE and TCE Concentrations in the Northern Plume - Operable Unit B Terrestrial New Monitoring Well Locations

Bremerton Naval Complex
THIRD FIVE-YEAR REVIEW

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Table 7-1
Soil Cleanup Levels for OU A

Chemical	ROD Remediation Goal (mg/kg)	Current Regulatory Level (mg/kg)	ROD Basis
Arsenic	219	87.5	MTCA C Industrial
Lead	1,000	1,000	
cPAHs[a]	18	NA	
Benzo(a)anthracene	-	180	
Benzo(a)pyrene	-	18	
Benzo(b)fluoranthene	-	180	
Benzo(k)fluoranthene	-	1,800	
Chrysene	-	18,000	
Dibenz(ah)anthracene	-	18	
Indeno(1,2,3-cd)pyrene	-	180	
Total PCBs	17	66	

[a]The remediation goal (RG) in the ROD for cPAHs (total) is based on the MTCA Method C industrial soil cleanup level for benz(a)pyrene. The RG for cPAHs in soil requires comparing the total toxicity equivalency concentration (TTEC) for the seven cPAHs relative to benzo(a)pyrene to the cleanup level derived for benzo(a)pyrene. However, new MTCA Method C industrial values are now available for individual cPAHs. The values may be used if only one cPAH is detected. If multiple cPAHs are present, the TTEC approach must be used.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cells indicates a regulatory value that has changed since the time of the ROD.
- - An individual cleanup goal was not provided in the ROD. Rather, concentrations of these individual cPAHs were normalized to benzo(a)pyrene values using the TTEC approach.
cPAHs - carcinogenic polycylic aromatic hydrocarbons
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
OU A - Operable Unit A
NA - not applicable
PCBs - polychlorinated biphenyls
ROD - Record of Decision

Source: ROD Table 8-1 (U.S. Navy, Ecology, and USEPA 1997)

Table 7-2
Groundwater Cleanup Levels for Protection of Surface Water for OU A

Chemical	ROD Regulatory Level (µg/L)	Current Regulatory Level (µg/L)	ROD Basis	Previous PQL[a] (µg/L)	Current PQL (µg/L)	ROD Remediation Goal (µg/L)
Arsenic	0.0982	0.0982	MTCA B SW	0.5	0.5	0.5
Copper	2.5	3.1	State WQC	2.5	0.5	2.5
Lead	5.8	8.1	State WQC	5	0.1	5.8
Nickel	7.9	8.2	State WQC	5	0.5	7.9
Zinc	76.6	81	State WQC	5	2	76.6
Benzo(a)anthracene	0.0296	0.296	MTCA B SW	5	0.1	5[b]
Benzo(a)pyrene	0.0296	0.0296	MTCA B SW	5	0.1	5[b]
Benzo(b)fluoranthene	0.0296	0.296	MTCA B SW	5	0.1	5[b]
Benzo(k)fluoranthene	0.0296	2.96	MTCA B SW	5	0.1	5[b]
Chrysene	0.0296	29.6	MTCA B SW	5	0.1	5[b]
Indeno(1,2,3-cd)pyrene	0.0296	0.296	MTCA B SW	5	0.1	5[b]
Bis(2-ethylhexyl) phthalate (BEHP)	3.56	3.56	MTCA B SW	5	0.1	5[b]
Aldrin	0.0000816	0.0000816	MTCA B SW	0.01	0.005	0.01[b]
Dieldrin	0.0000867	0.0000867	MTCA B SW	0.02	0.01	0.02[b]
Endrin	0.0023	0.0023	State WQC	0.02	0.01	0.02[b]
Alpha-chlordane	0.000354	0.0013[c]	MTCA B SW	0.01	0.005	0.01[b]
Gamma-chlordane	0.000354	0.0013[c]	MTCA B SW	0.01	0.005	0.01[b]
4,4'-DDD	0.000504	0.000504	MTCA B SW	0.02	0.01	0.02[b]
4,4'-DDE	0.000356	0.000356	MTCA B SW	0.02	0.01	0.02[b]
4,4'-DDT	0.000356	0.000356	MTCA B SW	0.02	0.01	0.02[b]
Aroclor 1260	0.000027	NA	MTCA B SW	0.02	0.1	0.02[b]

[a]PQLS at the time of the ROD
[b]The ROD states that the goal is based on the PQL, which is allowed by Washington Administrative Code 173-340 if cleanup levels are below the PQL. The PQLs have changed since the ROD was published. However, in accordance with the recommendations of the first 5-year review, these chemicals of concern are no longer part of the monitoring program. See discussion in Section 7.2.
[c]Though the current regulatory level has changed, the remediation goal would still be based on the PQL if a ROD were being signed today.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
µg/L - microgram per liter
MTCA - Model Toxics Control Act
OU A - Operable Unit A
NA - not available in Washington State Department of Ecology's online cleanup level and risk calculation (CLARC) database
PQL - practical quantitation limit
WQC - water quality criteria

Source: ROD Table 8-1 (U.S. Navy, Ecology, and USEPA 1997)

Table 7-3
Soil Cleanup Levels for OU NSC

Chemical	ROD Remediation Goal (mg/kg)	Current Regulatory Level (mg/kg)	ROD Basis
Lead	1,000	1,000	MTCA A Industrial
cPAHs[a]	18	NA	
Benzo(a)anthracene	-	180	
Benzo(a)pyrene	-	18	
Benzo(b)fluoranthene	-	180	
Benzo(k)fluoranthene	-	1,800	
Chrysene	-	18,000	
Dibenz(a,h)anthracene	-	18	
Indeno(1,2,3-cd)pyrene	-	180	
Total PCBs	17	66	
Total petroleum hydrocarbons	200	NA	MTCA A
Diesel	-	2,000	-
Heavy oil	-	2,000	-
Mineral oil	-	4,000	-
Gasoline with benzene	-	30	-
Gasoline without benzene	-	100	-

[a]The RG in the ROD for cPAHs (total) is based on the MTCA Method C industrial soil cleanup level for benz(a)pyrene. The RG for cPAHs in soil requires comparing the total toxicity equivalency concentration (TTEC) for the seven cPAHs relative to benzo(a)pyrene to the cleanup level derived for benzo(a)pyrene. However, new MTCA Method C industrial values are now available for individual cPAHs. The values may be used if only one cPAH is detected. If multiple cPAHs are present, the TTEC approach must be used.

Notes:
Blue highlighted cell indicates the ROD RG.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
- - An individual cleanup goal was not provided in the ROD. Rather, concentrations of these individual cPAHs were normalized to benzo(a)pyrene values using the TTEC approach.
cPAHs - carcinogenic polycyclic aromatic hydrocarbons
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
NA - not applicable
OU NSC - Operable Unit Naval Supply Center
PCBs - polychlorinated biphenyls
RG - remediation goal
ROD - Record of Decision

Source: ROD Table 8-2 (U.S. Navy, Ecology, and USEPA 1996)

Table 7-4
Groundwater Cleanup Levels for Protection of Surface Water for OU NSC

Chemical	ROD Regulatory Level (µg/L)	Current Regulatory Level (µg/L)	ROD Basis	Previous PQL (µg/L)	Current PQL (µg/L)	ROD Remediation Goal (µg/L)
Arsenic	0.0982	0.0982	MTCA B SW	0.5	0.5	0.5 [a]
Copper	2.5	3.1	State WQC	2.5	0.5	2.5
Lead	5.8	8.1	State WQC	5	0.1	5.8
Nickel	7.9	8.2	State WQC	5	0.5	7.9
Alpha-BHC	0.0079	0.0079	MTCA B SW	0.01	0.005	0.01[a]
Alpha-chlordane	0.000354	0.0013[b]	MTCA B SW	0.01	0.005	0.01[a]
Gamma-chlordane	0.000354	0.0013[b]	MTCA B SW	0.01	0.005	0.01[a]
4,4'-DDT	0.000356	0.000356	MTCA B SW	0.02	0.01	0.02[a]
Total PCBs	0.000027	0.0001[b]	MTCA B SW	0.2	0.1	0.2[a]
Total petroleum hydrocarbons	1,000		MTCA A	250	250	1,000
Diesel	-	500	-	-	-	-
Heavy oil	-	500	-	-	-	-
Mineral oil	-	500	-	-	-	-
GRO with benzene	-	800	-	-	-	-
GRO without benzene	-	1,000	-	-	-	

[a]The ROD states that the goal is based on the PQL, which is allowed by Washington Administrative Code 173-340 if cleanup levels are below the PQL. The PQLs have changed since the ROD was published. However, in accordance with the recommendations of the first 5-year review, these chemicals of concern are no longer part of the monitoring program.

[b]Though the current regulatory level has changed, the remediation goal would still be based on the PQL if a ROD were being signed today.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
BHC - benzene hexachloride
GRO - gasoline-range organics
µg/L - microgram per liter
MTCA - Model Toxics Control Act
OU NSC - Operable Unit Naval Supply Center
PQL - practical quantitation limit
ROD - Record of Decision
WQC - water quality criteria

Source: ROD Table 8-1 (U.S. Navy, Ecology, and USEPA 1996)

Table 7-5
Groundwater Cleanup Levels for Protection of Surface Water for OU B Terrestrial

Chemical	ROD Regulatory Level (µg/L)	Current Regulatory Level (µg/L)	ROD Basis	ROD Remediation Goal (µg/L)
Trichlorethene	55.6	12.8[a]	MTCA B SW	55.6
4,4'-DDT	0.000356	0.000356	MTCA B SW	0.000356
4,4'-DDE	0.000356	0.000356	MTCA B SW	0.000356
Aldrin	0.0000816	0.0000816	MTCA B SW	0.0000816
Dieldrin	0.0000867	0.0000867	MTCA B SW	0.0000867
Heptachlor epoxide	0.0000636	0.0000636	MTCA B SW	0.0000636
Arsenic	0.0982	0.0982	Background	5.0
Copper	3.1	3.1	State WQC	3.1
Lead	8.1	8.1	State WQC	8.1
Mercury	0.025	0.025	State WQC	0.025
Nickel	8.2	8.2	State WQC	8.2
Zinc	81	81	State WQC	81

[a]The MTCA Method B surface water value was calculated using MTCA's Washington Administrative Code 173-340-730-2 equation for carcinogens.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
µg/L - microgram per liter
MTCA - Model Toxics Control Act
OU B - Operable Unit B
ROD - Record of Decision
WQC - water quality criteria

Table 7-6
Groundwater Trigger Levels for Protection of Surface Water for OU C

Chemical	Trigger Level (µg/L)	Current Regulatory Level (µg/L)	Basis[a]	Remediation Goal (µg/L)
Diesel (DRO)	500	500	MTCA Method A	500
Heavy oil (RRO)	500	500		500
Gasoline (GRO without benzene)	1,000	1,000		1,000

[a]Based on Ecology policy in similar waterfront situations (e.g., Harbor Island and the Seattle waterfront) in the RI/FS report (U.S. Navy 2002g) and ongoing discussions between the Navy and Ecology (U.S. Navy 2007i).

Notes:
DRO - diesel-range organics
Ecology - Washington State Department of Ecology
GRO - gasoline-range organics
µg/L - microgram per liter
RRO - residual-range organics
MTCA - Model Toxics Control Act

Table 7-7
Soil Cleanup Levels for Protection of Surface Water for OU D

Chemical	ROD Regulatory Level (mg/kg)	Current Regulatory Level (mg/kg)	ROD Basis[a]	ROD Remediation Goal (mg/kg)
Tetrachloroethene	0.0552	3	MTCA B	0.0552
cPAHs[b]	0.866	0.574		0.866
4,4'-DDT	0.00729	0.00483		0.00729
Dieldrin	0.0000672	0.000045		0.0000672
Endrin	0.00076	0.00051		0.00076
Arsenic	0.057	0.057		2.64[c]
Cadmium	1.214	1.283		2.3[c]
Copper	1.066	1.066		21.7[c]
Mercury	0.06	0.03		0.06[c]
Zinc	101	101		101

[a]MTCA Method B soil levels protective of surface water were calculated using the equation in Washington State Department of Ecology worksheet MTCASGL10.xls.
[b]The preliminary RG in the ROD for cPAHs (total) is based on the MTCA Method B soil cleanup level for protection of surface water for benz(a)pyrene. The RG for cPAHs in soil requires comparing the total toxicity equivalency concentration (TTEC) for the seven cPAHs relative to benzo(a)pyrene to the cleanup level derived for benzo(a)pyrene. Note that individual cancer values for cPAHs are now available because of different chemical property values that been established.
[c]The ROD remediation goal is based on area background concentrations.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
cPAHs - carcinogenic polycyclic aromatic hydrocarbons
mg/kg - milligram per kilogram
OU D - Operable Unit D
MTCA - Model Toxics Control Act
RG - remediation goal
ROD - Record of Decision

Table 7-8
Groundwater Monitoring Levels for Protection of Surface Water for OU D

Chemical	ROD Regulatory Level (µg/L)	Current Regulatory Level (µg/L)	ROD Basis	Previous PQL (µg/L)	Current PQL (µg/L)	ROD Preliminary Remediation Goal (µg/L)
4,4'-DDT	0.000356	0.000356	MTCA B SW	0.01	0.01	0.01[a]
Dieldrin	0.0000867	0.0000867	MTCA B SW	0.01	0.01	0.01[a]
Endrin	0.0023	0.0023	State WQC	0.01	0.01	0.01[a]
Arsenic	0.0982	0.0982	MTCA B SW	0.5	0.5	5[b]
Cadmium	8.8	9.3	State/federal WQC	1	0.1	8.8
Copper	2.4	2.4	National Toxics Rule	0.5	0.5	3.1
Mercury	0.025	0.025	State WQC	0.2	0.1	0.2[a]
Zinc	81	81	State WQC	1.8	1.8	81

[a]The ROD states that the goal is based on the PQL, which is allowed by Washington Administrative Code 173-340 if cleanup levels are below the PQL. Note, however, that the PQLs have changed since the ROD was published. See discussion in Section 7.2

[b]The ROD remediation goal for arsenic is based on the area background concentration established in the OU B remedial investigation report.

Notes:
Blue highlighted cell indicates the ROD remediation goal.
Yellow highlighted cell indicates a regulatory value that has changed since the time of the ROD.
µg/L - microgram per liter
MTCA - Model Toxics Control Act
OU D - Operable Unit D
PQL - practical quantitation limit
WQC - water quality criteria

Table 7-9
Suquamish Tribe Mercury Hazards From Sinclair Inlet and Reference Areas

Exposure Pathway	Sinclair Inlet Mercury Hazard Quotient		Reference Areas Mercury Hazard Quotient	
	Adult	Child	Adult	Child
Salmon	2.1	1.9	1.3	1.2
Pelagic fish	4.5	5.5	1.5	1.9
Bottom fish	0.17	0.090	0.15	0.077
Shellfish	2.8	1.5	1.2	0.67
Total Seafood Consumption	9.5	9.0	4.2	3.8
Shellfish harvesting sediment	0.0029	0.028	--	--
Net fishing sediment	0.0017	NA	--	NA

Notes:
The reference areas are non-urban embayments of Puget Sound where contamination is expected to be very low and to reflect regional and global background levels of mercury. The source document describes the process used to select appropriate reference areas for each species.
-- - Hazards from exposure to sediments were not quantified for the reference areas and are assumed to be less than those calculated for Sinclair Inlet.
NA - not applicable

Table 7-10
Suquamish Tribe Incremental Mercury Hazards From Sinclair Inlet Above Reference Areas

Exposure Pathway	Incremental Mercury Hazard Quotient	
	Adult	Child
Salmon	0.76	0.67
Pelagic fish	1.5 (3.0)[a]	1.9 (3.6)[a]
Bottom fish	0.023	0.012
Shellfish	1.6	0.89
Total Seafood Consumption	3.9 (5.4)[a]	3.4 (5.2)[a]

[a]The pelagic fish incremental hazard above the reference area was calculated by using age-adjusted concentrations for rockfish. The rockfish in Sinclair Inlet were older than those in the reference areas. Therefore, Sinclair Inlet rockfish concentrations were adjusted to match the age of the reference population to assess the contribution of mercury from Sinclair Inlet. The value in parentheses represents the incremental hazard above nonurban reference areas assuming no age adjustment of rockfish between Sinclair Inlet and the reference areas. This value was calculated by subtracting the reference area hazard for the pelagic fish from the Sinclair Inlet hazard for pelagic fish.

Table 7-11
Issues

Item No.	Issue	Affects Protectiveness	
		Current	**Future**
General			
1	A more responsive program is needed to address and document pavement and storm drain repair and maintenance work identified during annual inspections.	No	Yes
2	The current IC plan does not include a provision for assessing the potential for vapor intrusion resulting from future remodeling in the TCE northern plume area.	No	Yes
3	During this 5-year review period, contamination was discovered at a construction site located outside the established OU boundaries. Because this discovery was outside of any OU footprint, there was no clear process for notification of the U.S. Environmental Protection Agency when contamination was discovered.	No	Yes
OU A			
4	The Navy is redesigning Charleston Beach solely to address the potential release indicated by the erosion of material from the landfill and restore the protectiveness of the OU A remedy. A 90 percent design will be completed in September 2012 with the understanding that there are data gaps related to the possibility that the erosion of upland material has impacted the remedy for adjacent OU B Marine.	Yes	Yes
OU B Terrestrial			
5	Analysis is not complete of the ongoing transport of mercury and other metals via a primary storm drain line in the western portion of the OU to the marine environment.	Yes	Yes
OU B Marine			
6	Based on a technical memorandum that evaluated human health risks related to mercury in Sinclair Inlet seafood, mercury has been identified as a COC. Additional data are needed to fill data gaps related to source control, sediment quality, and seafood quality. No clear process has been established for addressing source control issues identified through the ongoing contaminant transport studies.	Yes	Yes
7	Observations of a relatively thin upper sediment cover in some limited portions of the CAD pit suggest the possibility of thinning of the cover material, possibly through a combination of cover sediments mixing with the underlying sand layer and actual loss of the covering sediment material. Thinning of the CAD pit cover could result in eventual impacts to the protectiveness of the remedy. However, the historical record also shows that the original sediment cover was not uniform in thickness, and the small areas with thin cover observed recently may be an artifact of the original cover placement.	No	Yes
8	No decision process has been established for evaluating data generated outside the long-term monitoring program (such as data related to in-water construction projects) relative to the protectiveness of the OU B Marine remedy.	Yes	Yes
OU D			
9	The Navy and City of Bremerton have not been able to establish a working relationship that allows effective IC inspections or assessment of the long-term protectiveness of site conditions.	No	Yes
10	Changes in the method of risk calculation for some COCs could mean that current conditions are less protective than previously thought, if park visitors are currently exposed to soil containing COCs.	No	Yes

Table 7-11 (Continued)
Issues

Notes:
CAD - confined aquatic disposal
COC - chemical of concern
IC - institutional control
OU - operable unit
TCE - trichloroethene

8.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section presents the recommendations and follow-up actions identified as a result of the 5-year review process. Table 8-1 summarizes the recommendations that have the potential to affect current or future protectiveness of human health or the environment. The following recommendations that do not have the potential to affect protectiveness will be addressed by the Navy as part of overall program optimization:

- Update the monitoring program with the recommendations from the latest monitoring report and Section 6.4 of this review.
- Compare monitoring data to the latest ARAR values as these values change.
- As planned, update the LTM plan in 2012 to include ongoing analysis of groundwater samples from wells currently selected for VOC analysis in the following vapor intrusion areas: TCE northern plume, TCE southern plume, and HWSA.
- Include TCE analysis in the 2012 LTM plan for well 410R.
- Consider using electronic communications, such as websites and social media, to engage the public.

Table 8-1
Recommendations and Follow-Up Actions

Item No.	Recommendation/ Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness	
					Current	Future
General						
1	Develop and implement a reliable BNC-wide program for executing repair work for pavement and storm drains in a timely manner after maintenance requirements are identified. Clearly document completed repairs and catch basin cleaning.	Navy	EPA, Ecology	December 2013	No	Yes
2	Revise the IC plan to include a provision for assessing the potential for vapor intrusion resulting from future remodeling in the TCE northern plume area.	Navy	EPA, Ecology	December 2013	No	Yes
3	Update the IC plan to ensure that new discoveries are promptly reported to EPA. Improve the administrative processes for implementing the plan.	Navy	EPA, Ecology	December 2013	No	Yes
OU A						
4	Complete the 90 percent design of the remedy repair. Sample and analyze intertidal sediments as part of OU B Marine monitoring. Depending on the results of the sampling, consider the need for upland sampling or design modifications.	Navy	EPA, Ecology	90% design in September 2012; sediment sampling prior to 2015	Yes	Yes
OU B Terrestrial						
5	Complete the analysis of ongoing transport of metals COCs from the terrestrial to marine environment, as well as potential remedies.	Navy, USGS	EPA, Ecology	December 2013	Yes	Yes
OU B Marine						
6a	Collect additional data to reflect current conditions in Sinclair Inlet and reduce uncertainties associated with the data that were used for the human health risk evaluation technical memorandum.	Navy	EPA, Ecology	October 2013	Yes	Yes

Table 8-1 (Continued)
Recommendations and Follow-Up Actions

Item No.	Recommendation/ Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness	
					Current	Future
6b	Perform a focused feasibility study to document and collate studies related to mercury in sediments, and identify and evaluate potential approaches for reducing human health risks from mercury in Sinclair Inlet. The study will include an evaluation of source control (contaminant transport from the uplands to the marine waters and sediment).	Navy	EPA, Ecology	October 2014	Yes	Yes
6c	If data support, develop a Record of Decision amendment or Explanation of Significant Differences to address mercury as a contaminant of concern, select cleanup levels and select the preferred alternative of the focused feasibility study.	Navy	EPA, Ecology	January 2015	Yes	Yes
7	The Navy will make a detailed comparison between historical records regarding the CAD pit sediment cover placement and recent reports of possible thinning of the cover material.	Navy	EPA, Ecology	December 2012	No	Yes
8	Establish a process for evaluating the data generated from recent in-water construction projects relative to the protectiveness of the OU B Marine remedy. Consider the potential application of this process to other future data generated from outside of the OU B Marine long-term monitoring program.	Navy	EPA, Ecology	December 2012	Yes	Yes
OU D						
9	Transition to EPA and Ecology the lead regarding engagement with the City of Bremerton and initiate a meaningful dialog that allows additional assessment and effective IC inspections.	Navy	EPA, Navy	December 2013	No	Yes
10	Finalize the existing remedy evaluation report prepared by the Navy without City input.	Navy	EPA, Navy	October 2013	No	Yes

Table 8-1 (Continued)
Recommendations and Follow-Up Actions

Notes:
BNC - Bremerton naval complex
CAD - confined aquatic disposal
COCs - chemicals of concern
Ecology - Washington State Department of Ecology
EPA - U.S. Environmental Protection Agency
IC - institutional control
OU - operable unit

9.0 CERTIFICATION OF PROTECTIVENESS

An overall protectiveness determination of the remedies for the BNC site cannot be made at this time and will be deferred until further information for three OUs is obtained, as described below. Following collection and evaluation of the necessary additional information, protectiveness determinations will be made for the site as a whole and the individual OUs no later than December 31, 2015.

A protectiveness determination of the remedies for OU A, OU B Marine, and OU B Terrestrial cannot be made until further information is obtained. The protectiveness of the OU B Marine remedy has come into question based on evidence of releases through the groundwater and a primary storm drain line in the western portion of OU B Terrestrial and the potential release of fill materials from Charleston Beach at OU A. OU B Marine and OU B Terrestrial are inextricably linked. The future protectiveness of the OU B Marine remedy will depend on the accurate assessment of potential ongoing sources to the marine environment from OU B Terrestrial and implementing successful source control measures at OU B Terrestrial. Information needed to assess the protectiveness of the remedies for OU B Marine, OU B Terrestrial, and OU A will be developed through ongoing Navy investigations. These investigations include studies of terrestrial sources, mercury movement through the marine food web, and the nature of intertidal sediments at Charleston Beach. In addition, elevated PCB and mercury levels have been reported in some sediment samples collected during pre- and post-construction sampling for in-water construction projects at BNC. The implications of these findings for the remedy are still being evaluated. The results of these investigations are presently projected to be available by approximately 2015, at which time the protectiveness of the remedies for OU A, OU B Marine, and OU B Terrestrial will be reevaluated. In the interim, the pathways for human exposure are being controlled.

The cleanup action at OU C, selected under the state MTCA regulation, remains protective of human health and the environment.

The remedies implemented at OU NSC and OU D currently protect human health and the environment. Exposure pathways and infiltration pathways that could increase contaminant migration and result in unacceptable risks are being controlled and monitored. The conditions and COC concentrations found today in groundwater are similar to those at the time the RODs were executed. Conditions at the time of ROD execution were found not to pose unacceptable risks to human health and the environment as long as exposures and contaminant migration were controlled. In order for the remedies to be considered protective for the long term, the recommendations and follow-up actions listed in Table 8-1 need to be addressed in a timely manner. Future protectiveness will continue to be assessed during and after implementation of these actions based on monitoring of COC concentrations, trend analyses, and completion of follow-up actions.

10.0 NEXT REVIEW

The next 5-year review is scheduled for 2017.

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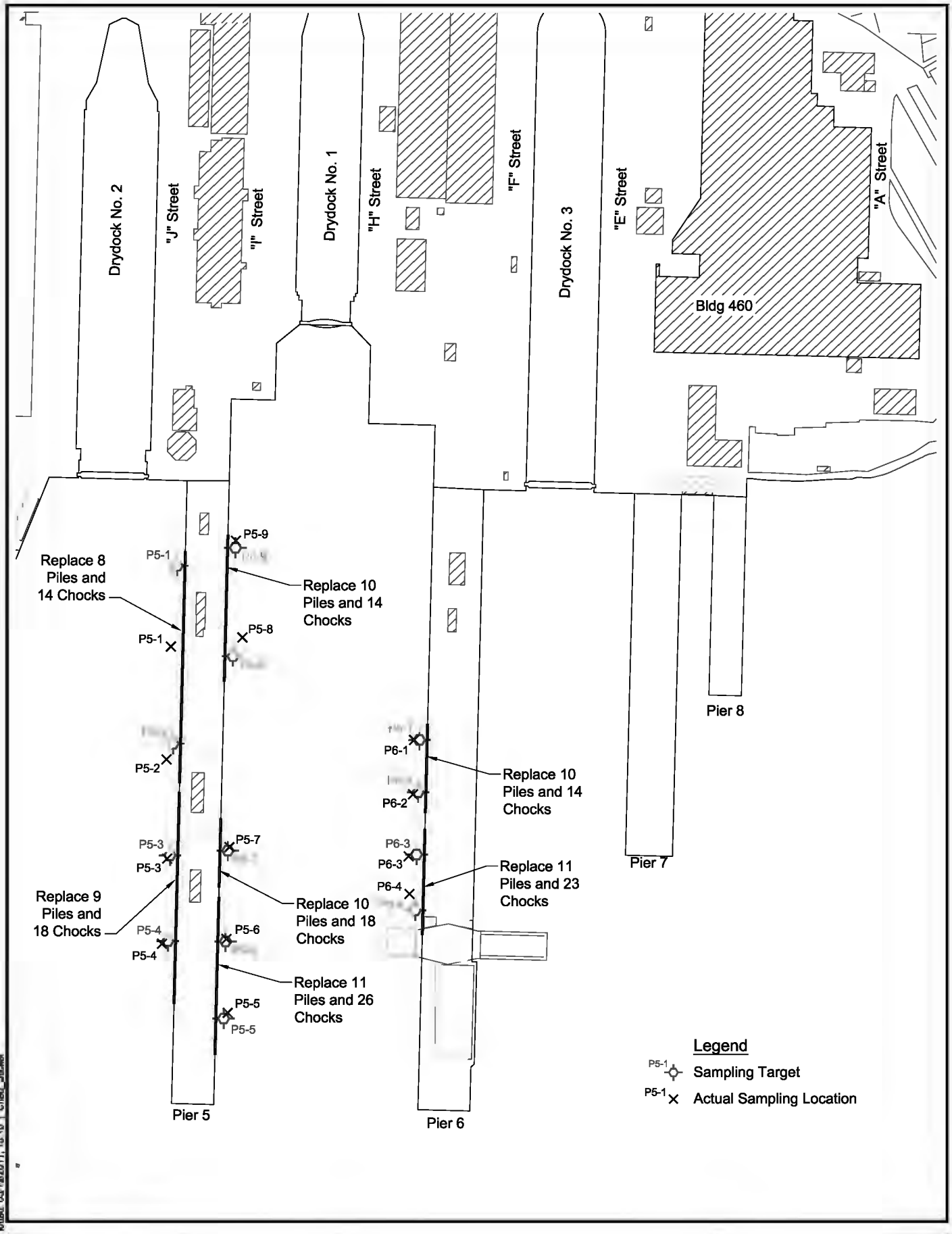
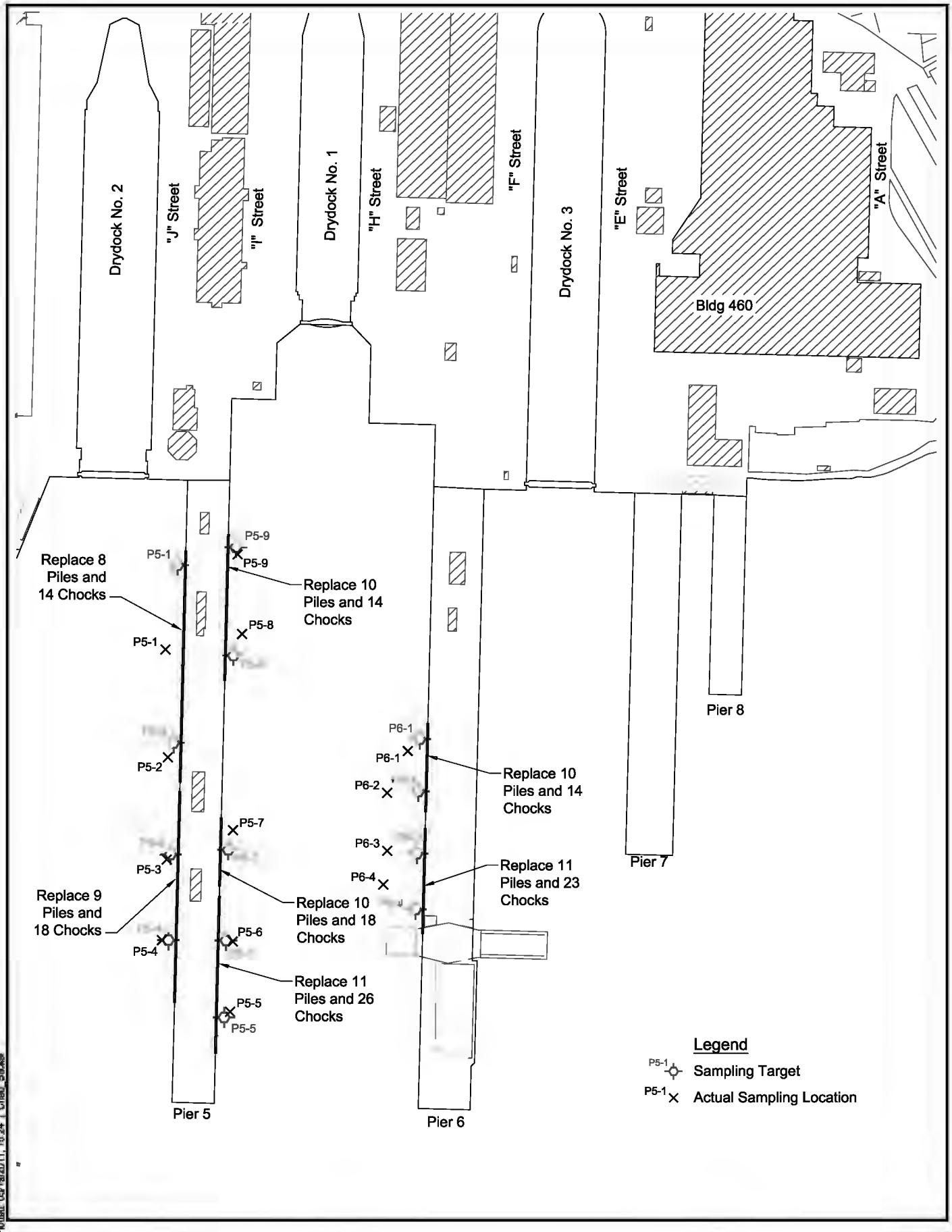
APPENDIX A

Tabulated Marine Sediment Data for In-Water Construction Projects



T:\PSNS\IDIQ\DO 25\Sed Mon Report\Figure 3-1 (Piers 5_6 - Pre Const).dwg
Mod: 05/16/2011, 15:43 | Plotted: 05/16/2011, 18:16 | Chad_Stickel

U.S. NAVY	0 125 250 SCALE IN FEET	**Figure 3-1** **Pre-Construction Sediment Sampling at Piers 5 and 6**	Delivery Order 0025 Bremerton Naval Complex PIERS 5 AND 6 FENDER SYSTEM REPAIR SEDIMENT MONITORING REPORT



T:\PSNS\IDIQ\DO 25\Sed Mon Report\Figure 3-2 (Piers 5_6 - Post Const).dwg
Mod: 05/16/2011, 15:54 | Plotted: 05/18/2011, 16:24 | Chad_Stoke

U.S. NAVY

0 125 250
SCALE IN FEET

Figure 3-2
Post-Construction Sediment Sampling at Piers 5 and 6

Delivery Order 0025
Bremerton Naval Complex
PIERS 5 AND 6 FENDER SYSTEM REPAIR
SEDIMENT MONITORING REPORT

Table 3-1
Results of PCBs and Mercury Analyses

Sample ID	Mercury (mg/kg)		Pre-Construction			Post-Construction		
	Pre-Con	Post-Con	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)
SQS/CSL	**0.41/0.59**		---	---	**12/65**	---	---	**12/65**
P5-1	1.4	1.7 J	3.1	100 J	3.2 J	2.9	280 J	9.8 J
P5-2	4.9	1.2 J	19[b]	310 J	1.6 J[b]	2.1	160 J	7.6 J
P5-3	1.1	1.6 J	2.8	93 J	3.3 J	3.3	130 J	3.9 J
P5-4	0.71 J	**0.50 J**	4.3	87 J	2.0 J	3.7	610 J	**17 J**
P5-5	0.41	4.0 J	2.5	32	1.3	3.1	95 J	3.1 J
P5-6	0.40	**0.54 J**	3.3	130 J	3.9 J	4.6	130	2.8
P5-7	0.31	0.62 J	1.9	46	2.4	3.4	46 J	1.4 J
P5-8	0.88	**0.58 J**	3.5	120	3.4	3.6	72	2.0
P5-9	0.41	0.34 J	1.3	120	9.2	5.4	57 J	1.0 J
P5-FD[a]	**0.47 J**	12 J	3.2	150 J	4.7 J	3.1	140 J	4.6 J
P6-1	**0.45**	4.4 J	2.7	54 J	2.0 J	4.0	280 J	7.1 J
P6-2	0.41	0.80 J	2.0	170 J	8.5 J	3.2	71	2.2
P6-3	3.3	0.90 J	3.9	50 J	1.3 J	6.8[b]	88	1.3
P6-4	**0.57**	1.6 J	2.8	41 J	1.5 J	2.5	7,300 J	290 J

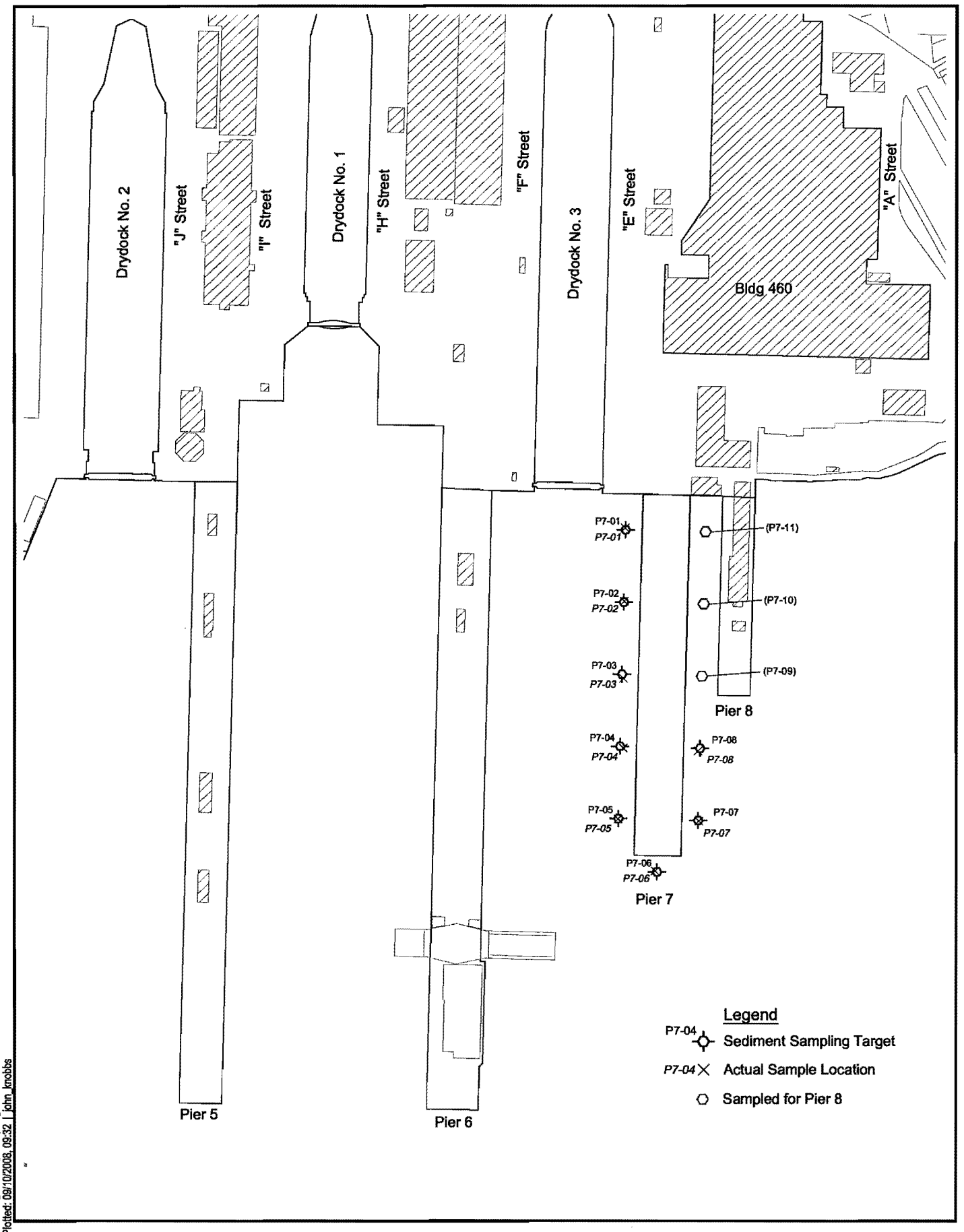
Notes
a - Field duplicate for pre-construction was collected from location P5-4. Post-construction field duplicate was collected from location P5-1.
b - TOC value outside range normally accepted for use in carbon normalization
Pre-Con - Pre-construction sample
Post-Con - Post-construction sample
SQS/CSL - Washington State Sediment Quality Standard/Cleanup Screening Level
Bold - Exceedance of SQS
Shaded - Exceedance of CSL
J - Estimated value
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
mg/kgOC - milligrams per kilogram as organic carbon

Table 3-2
Results of Metals Analyses

Sample ID	Arsenic (mg/kg)		Cadmium (mg/kg)		Chromium (mg/kg)		Copper (mg/kg)		Lead (mg/kg)		Silver (mg/kg)		Zinc (mg/kg)	
	Pre-con	**Post-con**	**Pre-con**	**Post-con**	**Pre-con**	**Post-con**	**Pre-con**	**Post-con**	**Pre-con**	**Post-con**	**Pre-con**	**Post-con**	**Pre-con**	**Post-con**
SQS/CSL	**57/93**		**5.1/6.7**		**260/270**		**390/390**		**450/530**		**6.1/6.1**		**410/960**	
P5-1	15	15	1.1	1.4	48 J	35	170	200 J	80	130	2.1	0.50	290 J	380 J
P5-2	24	14	1.9	1.0	54 J	30	350	150 J	350	180	0.30	0.40	**950 J**	**580 J**
P5-3	13	18	1.6	1.4	43 J	26	160	310 J	220	220	2.9	0.40	**870 J**	**630 J**
P5-4	20	4.6	2	1.2	60 J	36	290 J	150 J	180	86	6.5	0.50	**630 J**	370 J
P5-5	10	9.1	**6.1**	1.4	41 J	31	150	140 J	54	57	0.30	0.40	330 J	250 J
P5-6	9.1	14	1.1	1.5	38 J	46	110	190 J	45	140	2.9	0.60	320 J	**650 J**
P5-7	8.2	9.0	1.2	1.3	30 J	27	240	740 J	52	74	1.9	0.50	340 J	**440 J**
P5-8	16	9.9	2.1	1.6	62 J	40	230	150 J	97	74	3.7	0.50	340 J	250 J
P5-9	15	8.8	1.1	0.88	56 J	22	200	150 J	60	54	21	2.7	320 J	210 J
P5-FD[a]	10	13	1.3	1.5	34 J	47	140 J	210 J	69	150	0.40	0.40	300 J	370 J
P6-1	9.8	11	1.0	1.7	28 J	50	130	190 J	55	140	2.2	0.60	260 J	410 J
P6-2	15	11	1.3	1.4	62 J	41	130	260 J	97	99	4.2	0.50	**450 J**	280 J
P6-3	11	19	2.2	1.9	43 J	41	150	540 J	140	120	0.30	0.60	**450 J**	**680 J**
P6-4	11	130	1.1	2.0	38 J	72	140	460 J	61	**510**	0.20	0.60	340 J	2,780 J

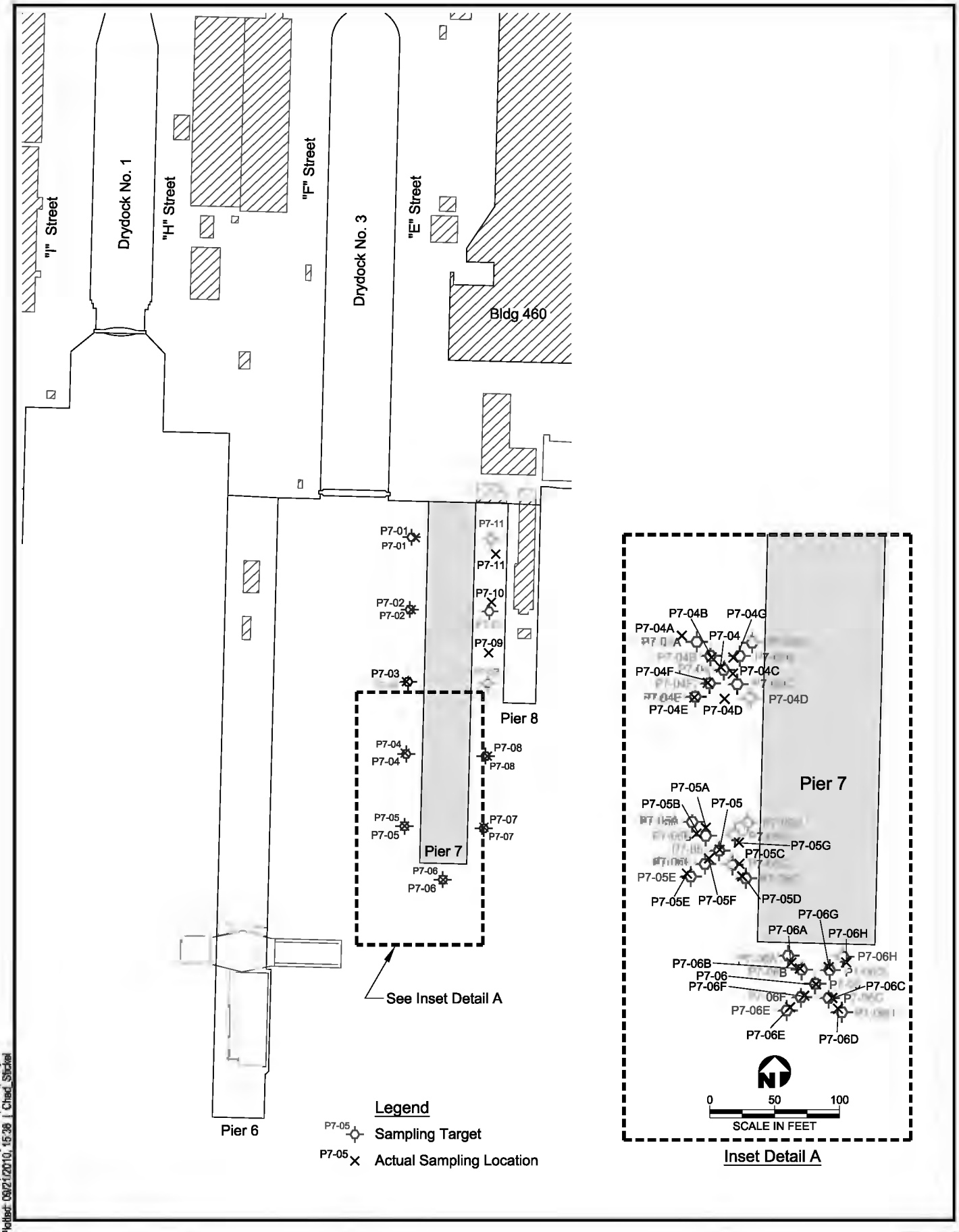
a - Field duplicate for pre-construction was collected from location P5-4. Post-construction field duplicate was collected from location P5-1.

Notes:
Pre-Con - Pre-construction sample
Post-Con - Post-construction sample
SQS/CSL - Washington State Sediment Quality Standard/Cleanup Screening Level
Bold - Exceedance of SQS; Shaded - Exceedance of CSL
mg/kg - milligrams per kilogram



T:\PSNS\DIQ\DO 50\Samp Plan\Figure A-1 (Pier 7).dwg
Mod: 09/10/2008, 09:32 | Plotted: 09/10/2008, 09:32 | john_knobbs

U.S. NAVY	0 125 250 SCALE IN FEET	**Figure 3-1** **Pre-Construction Sampling at Pier 7**	Delivery Order 0050 Bremerton Naval Complex PIER 7 FENDER PILE REPLACEMENT SEDIMENT MONITORING REPORT



T:\PSNS\IDIQ\DO 50\Sediment Mon Report\Figure 3-2 (Pier 7).dwg
Mod: 09/06/2010, 14:46 | Plotted: 09/21/2010, 15:39 | Chad_Stickel

U.S. NAVY	0 125 250 SCALE IN FEET	**Figure 3-2 Post-Construction Sediment Sampling at Pier 7**	Delivery Order 0050 Bremerton Naval Complex PIER 7 FENDER PILE REPLACEMENT SEDIMENT MONITORING REPORT

Table 3-1
Results of PCBs and Mercury Analyses

Sample ID	Mercury		Pre-Construction			Pre-Construction Reanalysis			Post-Construction		
	Pre-Con	Post-Con	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)
SQS/CSL	**0.41/0.59**		---	---	**12/65**	---	---	**12/65**	---	---	**12/65**
P7-01	0.83	0.89	3.2	350	11	---	---	---	3.4	260	7.6
P7-02	**0.56**	**0.53**	3.8	320	8.4	---	---	---	3.5	44	1.3
P7-02 FD	0.69	---	3.5	180	5.1	---	---	---	---	---	---
P7-02 FD1	---	0.72	---	---	---	---	---	---	3.1	49	1.6
P7-03	**0.42**	1.0	3.6	300	8.3	---	---	---	2.8	150 J	5.4 J
P7-04	5.9	**0.54**	1.9	1,400	74	1.8	1,600	89	1.3	180	**14**
P7-04A	---	0.27	---	---	---	---	---	---	0.71	42	5.9
P7-04B	---	**0.58**	---	---	---	---	---	---	3.1	83	2.7
P7-04C	---	**0.52**	---	---	---	---	---	---	2.1	240	11
P7-04D	---	0.63	---	---	---	---	---	---	1.1	260	**24**
P7-04E	---	0.39	---	---	---	---	---	---	1.1	100	9.1
P7-04F	---	0.29	---	---	---	---	---	---	1.4	59	4.2
P7-04G	---	1.4	---	---	---	---	---	---	0.85	260 J	**31 J**
P7-04H **	---	---	---	---	---	---	---	---	---	---	---
P7-05	0.63	0.34	3.1	35,000	1,100	4.1	16,000	390	1.5	720	**48**
P7-05 FD2	---	**0.43**	---	---	---	---	---	---	1.2	1,700	140
P7-05A	---	**0.43**	---	---	---	---	---	---	3.0	490	**16**
P7-05A FD1	---	**0.42**	---	---	---	---	---	---	3.6	380	11
P7-05B	---	0.23	---	---	---	---	---	---	1.6	28	1.8
P7-05C	---	0.21	---	---	---	---	---	---	2.0	140	7.0

Table 3-1 (Continued)
Results of PCBs and Mercury Analyses

Sample ID	Mercury		Pre-Construction			Pre-Construction Reanalysis			Post-Construction		
	Pre-Con	Post-Con	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)
P7-05D	---	**0.56**	---	---	---	---	---	---	2.1	240 J	11 J
P7-05E	---	**0.55**	---	---	---	---	---	---	2.6	140	5.4
P7-05F	---	0.14	---	---	---	---	---	---	0.33	220	67
P7-05G	---	0.82	---	---	---	---	---	---	2.5	2,000	80
P7-05H **	---	---	---	---	---	---	---	---	---	---	---
P7-06	5.0	0.37	5.0	120	2.4	---	---	---	1.7	24	1.4
P7-06 FD2	---	0.16	---	---	---	---	---	---	1.6	30 U	1.9 U
P7-06A	---	0.31	---	---	---	---	---	---	3.5	33	0.94
P7-06B	---	0.28	---	---	---	---	---	---	3.0	37	1.2
P7-06C	---	0.23	---	---	---	---	---	---	1.9	28	1.5
P7-06D	---	0.75	---	---	---	---	---	---	1.5	55	3.7
P7-06E	---	0.60	---	---	---	---	---	---	3.2	170	5.3
P7-06F	---	0.88	---	---	---	---	---	---	1.3	97	7.5
P7-06G	---	0.29	---	---	---	---	---	---	3.6	69	1.9
P7-06H	---	0.21	---	---	---	---	---	---	3.7	17 U	0.46 U
P7-07	**0.48**	**0.46**	3.7	140	3.8	---	---	---	3.3	33	1.0
P7-08	0.81	0.65	3.3	160	4.8	---	---	---	4.6	130	2.8
P7-09 *	0.65	2.4	5.7	260	4.6 J	---	---	---	2.4	170	7.1
P7-09 FD1*	---	**0.54**	---	---	---				2.7	130	4.8
P7-10 *	0.24	0.22	7.0	140	2.0 J	---	---	---	0.97	90	9.3
P7-11 *	0.32	0.88	4.1	180	4.4	---	---	---	0.84	53	6.3

Table 3-1 (Continued)
Results of PCBs and Mercury Analyses

Notes:
Pre-Con - Pre-construction sample
Post-Con - Post-construction sample
SQS/CSL - Washington State Sediment Quality Standard/Cleanup Screening Level
--- Sample not analyzed for this constituent in this round
* Sample collected as part of Pier 8 sampling
** Sample could not be collected due to restricted access
Bold - Exceedance of SQS
Shaded - Exceedance of CSL

Table 3-2
Results of Metals Analyses

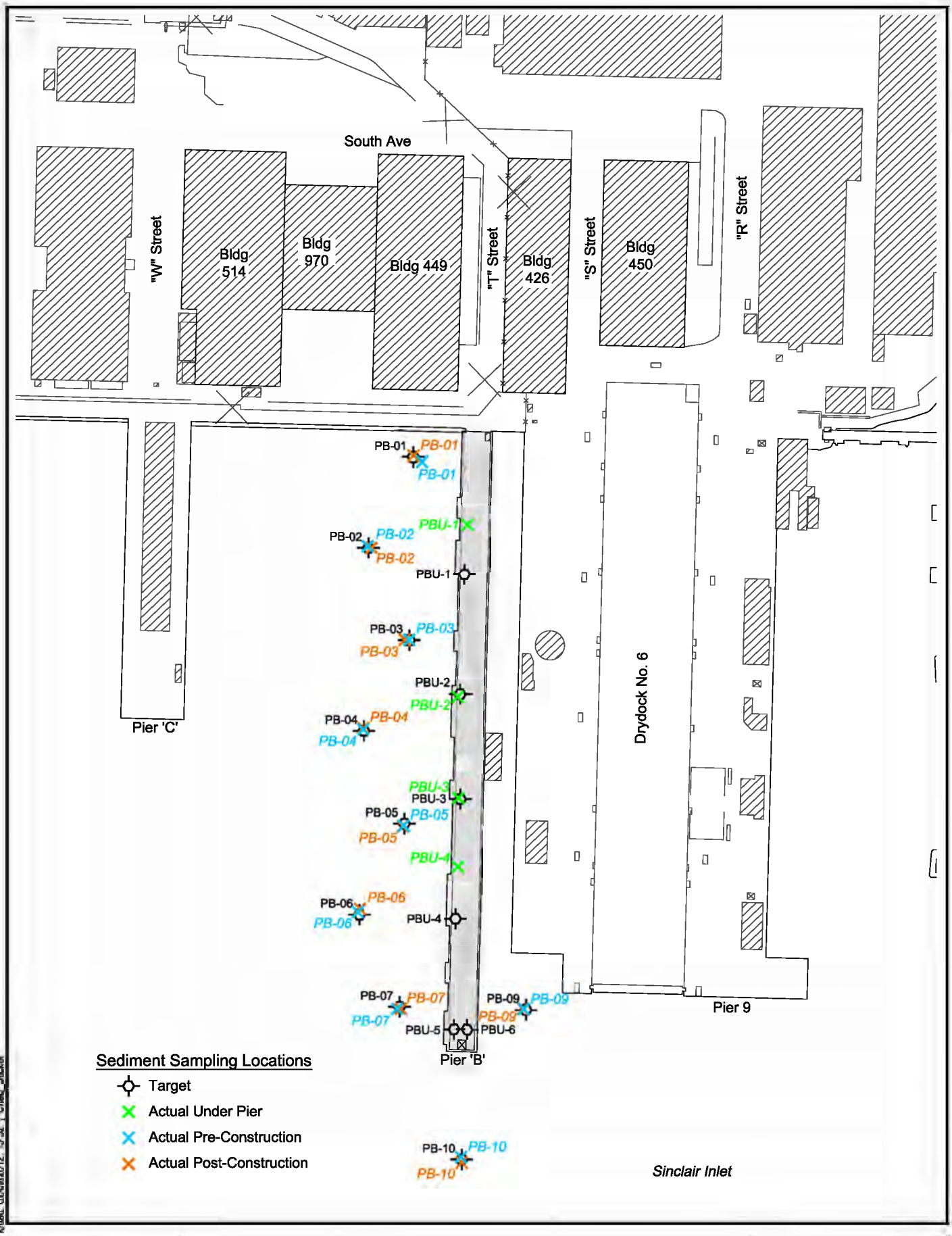
Sample ID	Arsenic		Cadmium		Chromium		Copper		Lead		Silver		Zinc	
	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con
SQS/CSL	**57/93**		**5.1/6.7**		**260/270**		**390/390**		**450/530**		**6.1/6.1**		**410/960**	
P7-01	17 J	11	1.4 J	1.6 J	36	30	270	130	120	61 J	0.64	0.55	1,600 J	200 J
P7-02	8.9 J	11	1.6 J	1.8 J	29	36	230	130	57	62 J	0.51	0.53	200 J	200 J
P7-02 FD	9.0 J	---	1.4 J	---	30	---	150	---	57	---	0.50	---	200 J	---
P7-02 FD1	---	10	---	1.6 J	---	32	---	130	---	55 J	---	0.56	---	180 J
P7-03	11 J	12	2.4	1.5	25	38	160	420	110	77	0.43	0.50	**940 J**	390
P7-04	19 J	11	1.7 J	0.65	51	34	450	16,000	340	380	1.3	0.55	2,400 J	1,400
P7-04A	---	3.3	---	0.39	---	15	---	55	---	16	---	0.13	---	90
P7-04B	---	8.0	---	1.4	---	34	---	120	---	52	---	0.46	---	200
P7-04C	---	7.4	---	0.79	---	22	---	140	---	77	---	0.57	---	**770**
P7-04D	---	8.4	---	0.69	---	30	---	170	---	200	---	0.46	---	1,300
P7-04E	---	4.4	---	0.62	---	17	---	93	---	46	---	0.22	---	220
P7-04F	---	4.3	---	0.85	---	18	---	63	---	45	---	0.21	---	200
P7-04G	---	8.6	---	1.2	---	46	---	110	---	84	---	0.40	---	**690**
P7-04H **	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P7-05	9.8 J	10	1.3	1.0	34	25	150	300	100	150	0.52	1.2	320 J	**440**
P7-05 FD2	---	17	---	1.3	---	24	---	220	---	120	---	1.1	---	**550**
P7-05A	---	7.4	---	1.3	---	28	---	95	---	52	---	0.35	---	160
P7-05A FD1	---	7.5	---	1.2	---	29	---	87	---	47	---	0.35	---	170
P7-05B	---	4.6	---	0.47	---	67	---	270	---	20	---	0.20	---	93
P7-05C	---	5.1	---	0.85	---	13	---	46	---	46	---	0.20	---	200
P7-05D	---	14	---	0.94	---	110	---	680	---	200	---	0.65	---	**640**

Table 3-2 (Continued)
Results of Metals Analyses

Sample ID	Arsenic		Cadmium		Chromium		Copper		Lead		Silver		Zinc	
	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con
P7-05E	---	7.6	---	1.2	---	25	---	94	---	46	---	0.36	---	140
P7-05F	---	2.0	---	0.22	---	8.8	---	18	---	8.8	---	0.086	---	56
P7-05G	---	9.9	---	0.80	---	20	---	86	---	150	---	0.28	---	**550**
P7-05H **	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P7-06	6.9 J	4.4	0.77 J	0.52 J	23	16	77	33	61	53 J	0.23	0.15	190 J	100 J
P7-06 FD2	---	4.9	---	0.64 J	---	17	---	37	---	26 J	---	0.16	---	100 J
P7-06A	---	7.9	---	1.1 J	---	28	---	94	---	46 J	---	0.51	---	220 J
P7-06B	---	6.6	---	1.5 J	---	25	---	76	---	37 J	---	0.35	---	130 J
P7-06C	---	6.0	---	0.74 J	---	20	---	45	---	26 J	---	0.17	---	130 J
P7-06D	---	6.1	---	0.82 J	---	23	---	54	---	32 J	---	0.18	---	180 J
P7-06E	---	11	---	0.93 J	---	34	---	270	---	200 J	---	0.44	---	390 J
P7-06F	---	11	---	0.87 J	---	40	---	160	---	130 J	---	0.29	---	270 J
P7-06G	---	6.0	---	0.83 J	---	22	---	64	---	30 J	---	0.35	---	130 J
P7-06H	---	5.0	---	0.56 J	---	110	---	51	---	46 J	---	0.17	---	110 J
P7-07	27 J	21	1.2 J	1.2 J	35	29	180	300	270	220 J	0.86	0.63	**500 J**	**600 J**
P7-08	9.8 J	14	1.1 J	1.1 J	32	35	1,200	190	49	83 J	0.53	0.57	210 J	360 J
P7-09 *	5.6	7.8	0.68	0.87	16	22	110	170	51	120	0.23	0.34	190	**620**
P7-09 FD1*	---	6.6	---	0.75	---	23	---	460	---	93	---	0.26	---	**500**
P7-10 *	5.3	5.7	0.80	0.48	18	11	48	47	42	22	0.15	0.13	120	110
P7-11 *	12	20	0.74	0.86	63	18	120	710	59	210	0.31	0.90	230	**500**

Table 3-2 (Continued)
Results of Metals Analyses

Notes:
Pre-Con - Pre-construction sample
Post-Con - Post-construction sample
SQS/CSL - Washington State Sediment Quality Standard/Cleanup Screening Level
--- Sample not analyzed for this constituent in this round
* Sample collected as part of Pier 8 sampling
** Sample could not be collected due to restricted access
Bold - Exceedance of SQS
Shaded - Exceedance of CSL



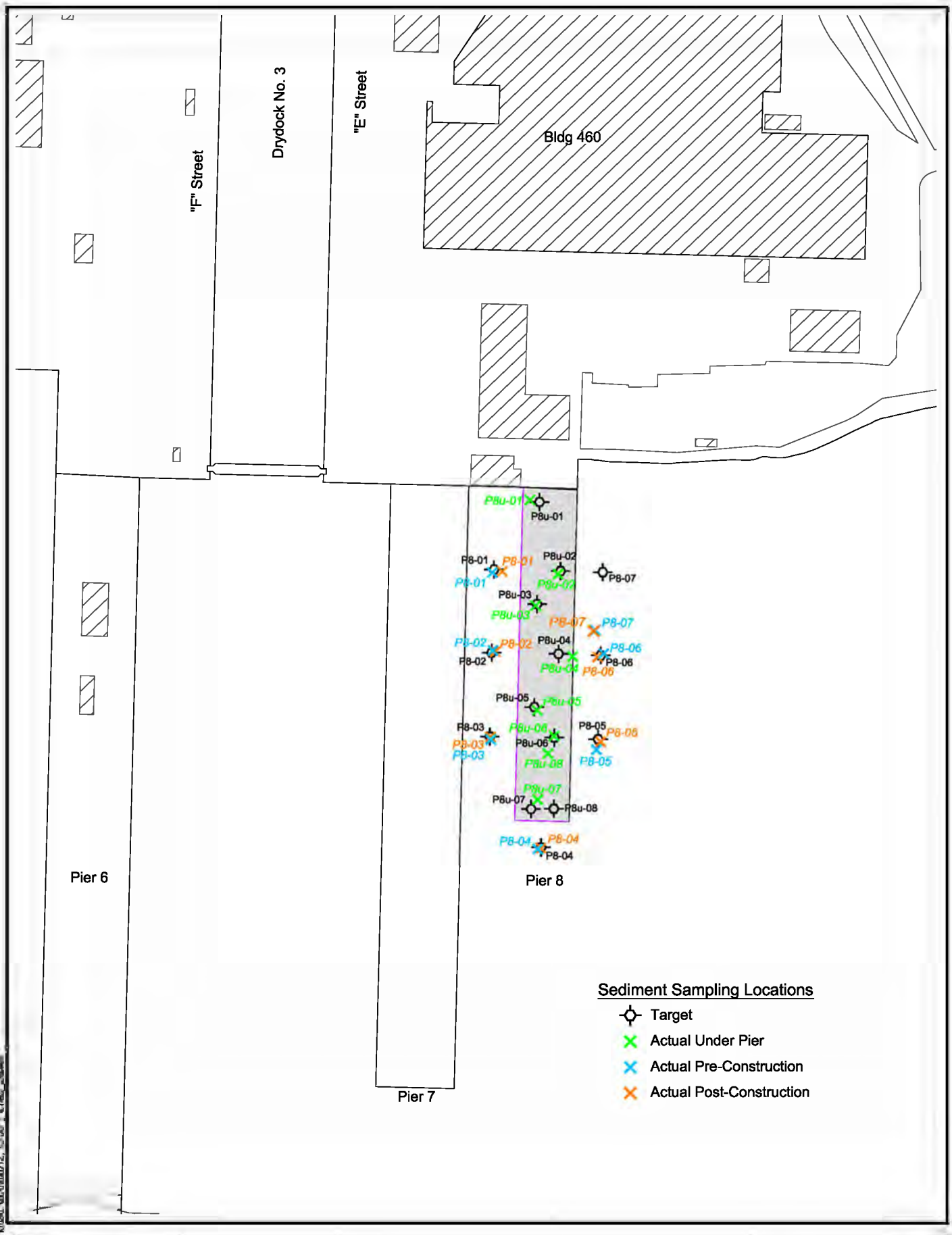
T:\PSNS\IDIQ\DO 46\Sed Mon Report\2012\Figure 3-1 (Pier B).dwg
Mod: 10/31/2012, 11:32 | Plotted: 02/20/2012, 15:52 | Chad Sickel

U.S. NAVY

0 125 250
SCALE IN FEET

Figure 3-1
Sampling at Pier B

Delivery Order 0046
Bremerton Naval Complex
PIER B REPLACEMENT
SEDIMENT MONITORING REPORT



U.S. NAVY

0 75 150
SCALE IN FEET

Figure 3-2
Sampling at Pier 8

Delivery Order 0046
Bremerton Naval Complex
PIER B REPLACEMENT
SEDIMENT MONITORING REPORT

T:\PSNS\IDIQ\DO 46\Sed Mon Report\2012\Figure 3-2 (Sampling Plan Pier 8).dwg
Wed, 02/01/2012, 11:32 | Plotted: 02/01/2012, 15:53 | Plot Scale

Table 3-1
Sampling of Periphery of Piers B and 8 - PCBs and Mercury

	Mercury (mg/kg)		Pre-Construction			Pre-Construction Reanalysis			Post-Construction		
Sample ID	**Pre-Con**	**Post-Con**	**TOC (%)**	**Bulk PCBs (µg/kg)**	**PCBs (mg/kgOC)**	**TOC (%)**	**Bulk PCBs (µg/kg)**	**PCBs (mg/kgOC)**	**TOC (%)**	**Bulk PCBs (µg/kg)**	**PCBs (mg/kgOC)**
SQS/CSL	**0.41/0.59**		**---**	**---**	**12/65**	---	---	**12/65**	---	---	**12/65**
PB-01	0.38	0.26	6.2	140	2.3	---	---	---	0.89	35	3.9
PB-02	0.75	**0.59**	3.4	320 J	9.4 J	---	---	---	3.4	140	4.1
PB-03	0.64	0.64	3.0	100 J	3.3 J	---	---	---	3.1	160	5.2
PB-03 FD	0.71	---	3.0	130 J	4.3 J	---	---	---	---	---	---
PB-04	0.67	0.66	3.0	95 J	3.2 J	---	---	---	3.4	120	3.5
PB-05	**0.49**	0.67	2.9	90 J	3.1 J	---	---	---	3.7	120	3.2
PB-06	**0.54**	0.68	2.8	100 J	3.6 J	---	---	---	3.3	120	3.6
PB-07	0.60	**0.56**	2.5	190 J	7.6 J	---	---	---	2.9	160	5.5
PB-09	**0.49**	**0.44**	3.2	240 J	7.5 J	---	---	---	3.4	150	4.5
PB-09 FD	---	**0.57**	---	---	---	---	---	---	3.1	170	5.5
PB-10	**0.52**	1.0	1.5	43	2.9	---	---	---	2.1	70	3.3
P8-01	0.32	0.88	4.1	180 J	4.4 J	---	---	---	0.84	53	6.3
P8-02	0.24	0.22	7.0	140 J	2.0 J	---	---	---	0.97	90	9.3
P8-03	0.65	2.4	5.6	260 J	4.6 J	---	---	---	2.4	169	7.0
P8-03 FD	---	**0.54**	---	---	---	---	---	---	2.7	130	4.8
P8-04	0.67	0.37	3.7	1,100 J	**30 J**	5.3	250 J	4.7 J	4.7	132	2.8
P8-05	0.40	0.37	5.0	530 J	11 J	---	---	---	2.2	134	6.1
P8-06	1.5	2.3	4.1	140 J	3.4 J	---	---	---	1.4	47	3.4
P8-07	**0.54**	0.37	4.9	140 J	2.9 J	---	---	---	2.4	92	3.8

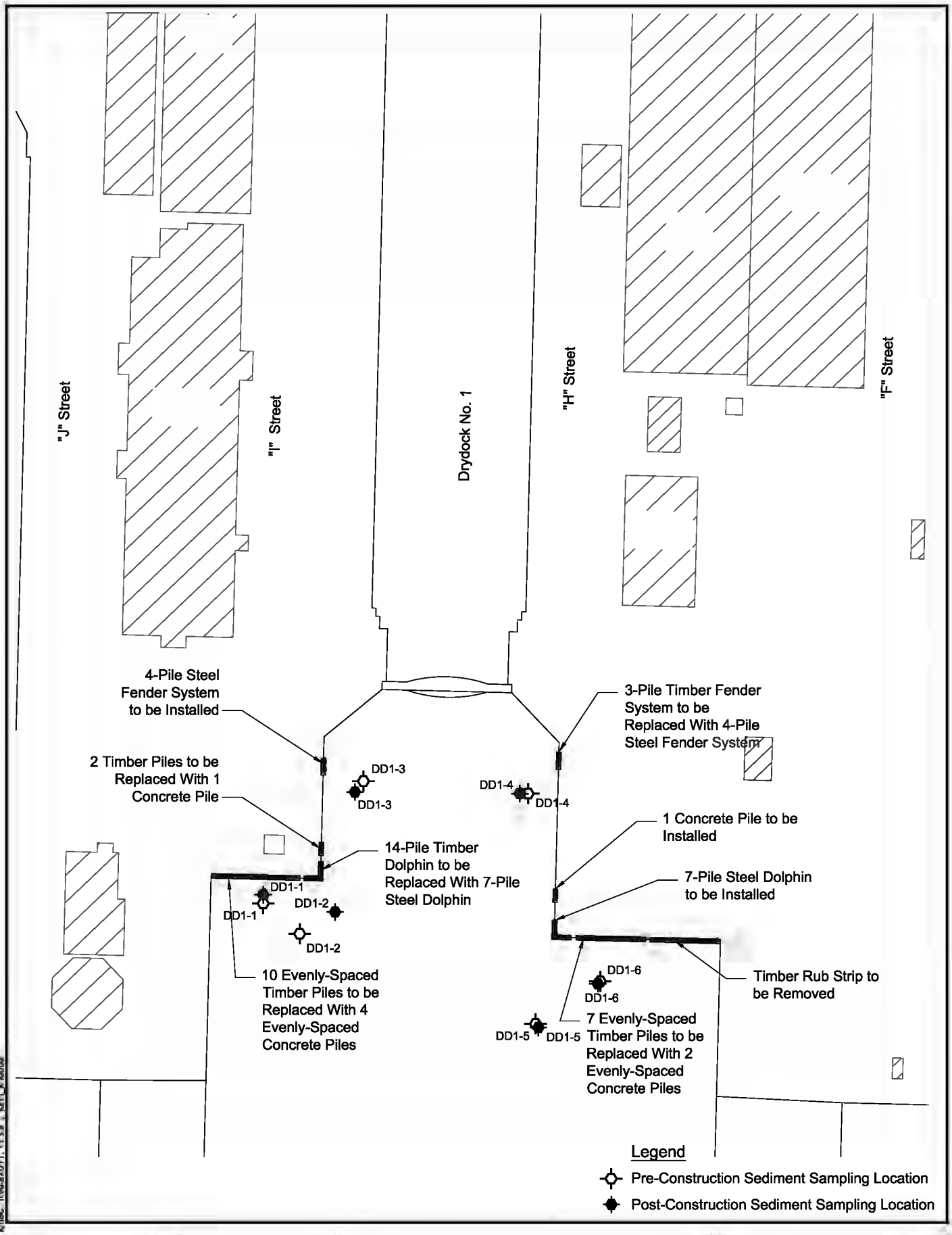
Notes:
Shaded - exceedance of CSL
Bold - exceedance of SQS
J - value qualified as estimated
FD - field duplicate

Table 3-2
Sampling of Periphery of Piers B and 8 - Metals

Location	Arsenic (mg/kg)		Cadmium (mg/kg)		Chromium (mg/kg)		Copper (mg/kg)		Lead (mg/kg)		Silver (mg/kg)		Zinc (mg/kg)	
	Pre-Con	Post-Con	Pre-Con	Post-Con	Pre-Con	Post-Con	Pre-Con	Post-Con	Pre-Con	Post-Con	Pre-Con	Post-Con	Pre-Con	Post-Con
SQS/CSL	**57/93**		**5.1/6.7**		**260/270**		**390/390**		**450/530**		**6.1/6.1**		**410/960**	
PB-01	7.8	4.1 J	0.73	0.10 J	23	18	130	49 J	54	41	0.45	0.20 J	140	120
PB-02	10	8.3	1.1	0.87	34	34	150	130 J	62	54	0.71	0.40 J	160	160
PB-03	10	9.8	1.2	1.1	36	40	160	130 J	60	63	0.73	0.60 J	170	180
PB-03 FD	9.7 J	---	1.0 J	---	34	---	230	---	56	---	0.76	---	170 J	---
PB-04	9.0	10	0.94	1.1	35	41	150	140 J	55	62	0.66	0.40 J	210	190
PB-05	8.7	12	0.91	1.1	30	44	140	140 J	45	59	0.59	0.50 J	160	180
PB-06	9.1	9.7	1.0	1.0	34	38	150	150 J	50	52	0.60	0.50 J	140	170
PB-07	9.0	9.1	0.96	0.97	33	39	180	120 J	52	55	0.64	0.50 J	160	170
PB-09	25	18	0.88	1.2	34	92 J	180	140 J	110	100	0.62	0.50 J	380	350
PB-09 FD	---	20	---	1.1	---	**270 J**	---	140 J	---	120	---	0.60 J	---	330
PB-10	8.4	8.5	0.72 J	0.54	33	34	91	80 J	52	56	0.47	0.30 J	150	150
P8-01	12	20	0.74	0.86	63	18	120	710	59	210	0.31	0.90	230	**500**
P8-02	5.3	5.7	0.80	0.48	18	11	48	47	42	22	0.15	0.13	120	110
P8-03	5.6	7.8	0.68	0.87	16	22	110	170	51	120	0.23	0.34	190	**620**
P8-03 FD	---	6.6	---	0.75	---	23	---	460	---	93	---	0.26	---	**500**
P8-04	11	9.4	1.9	1.1	32	29	190	120	68	44	0.56	0.40	**490**	**500**
P8-05	5.7	10	0.65	0.95	18	50	82	730	54	89	0.28	0.42	160	390
P8-06	6.6	7.2	1.8	0.81	19	23	100	120	58	87	0.41	0.19	140	**650**
P8-07	9.3	7.5	0.69	1.1	34	33	200	120	200	180	13	0.15	1,000	390

Notes:
Pre-Con - pre-construction
Post-Con - post-construction
NYS - not yet sampled

Shaded - exceedance of CSL
Bold - exceedance of SQS
J - value qualified as estimated
FD - field duplicate



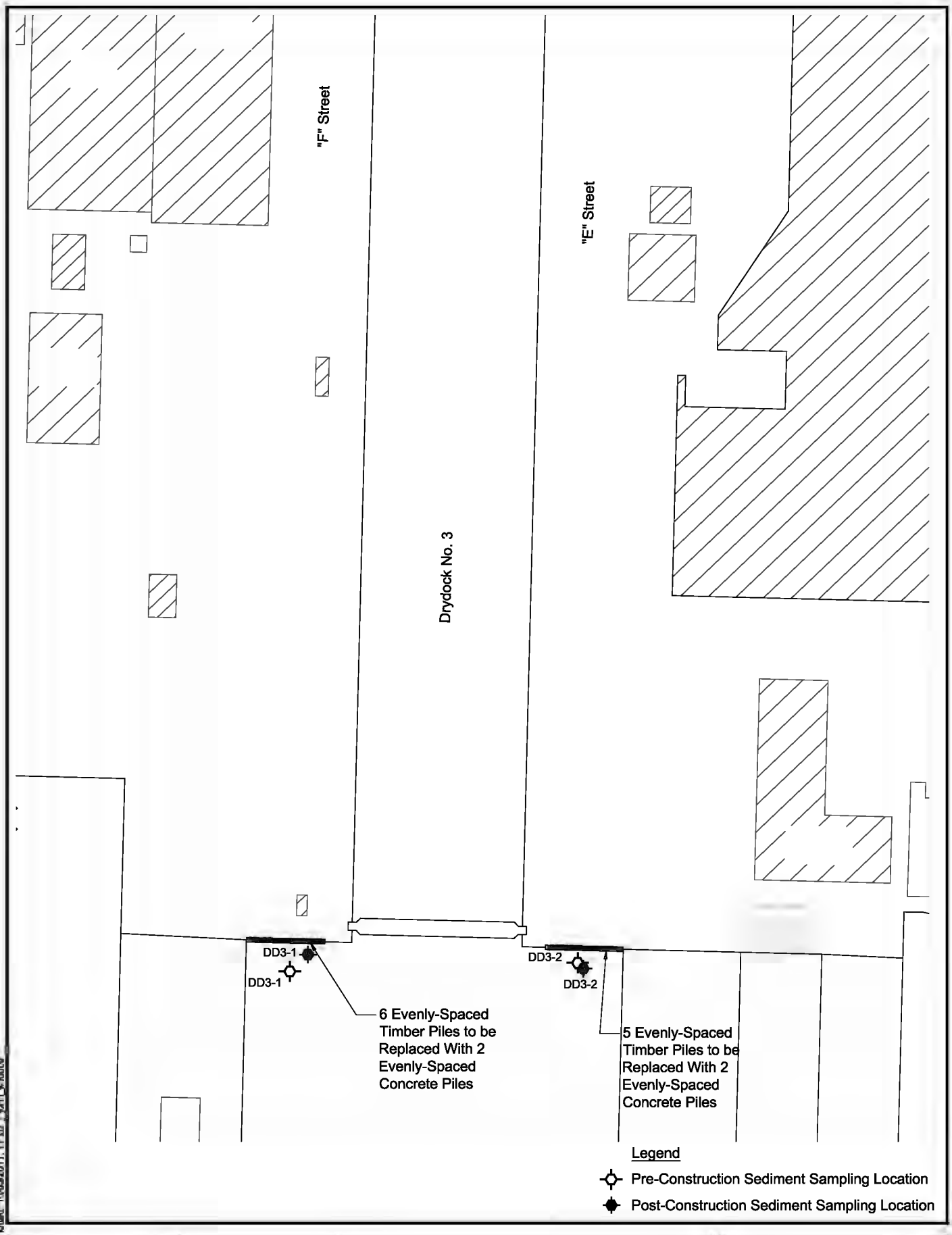
T:\PSNS\DIQ\DO 20\Sed Mon Report\Figure 3-1 Dry Dock 1.dwg
Mod: 09/24/2011 16:38 | Plotted: 10/03/2011 11:39 | tom_moebs

U.S. NAVY

0 50 100
SCALE IN FEET

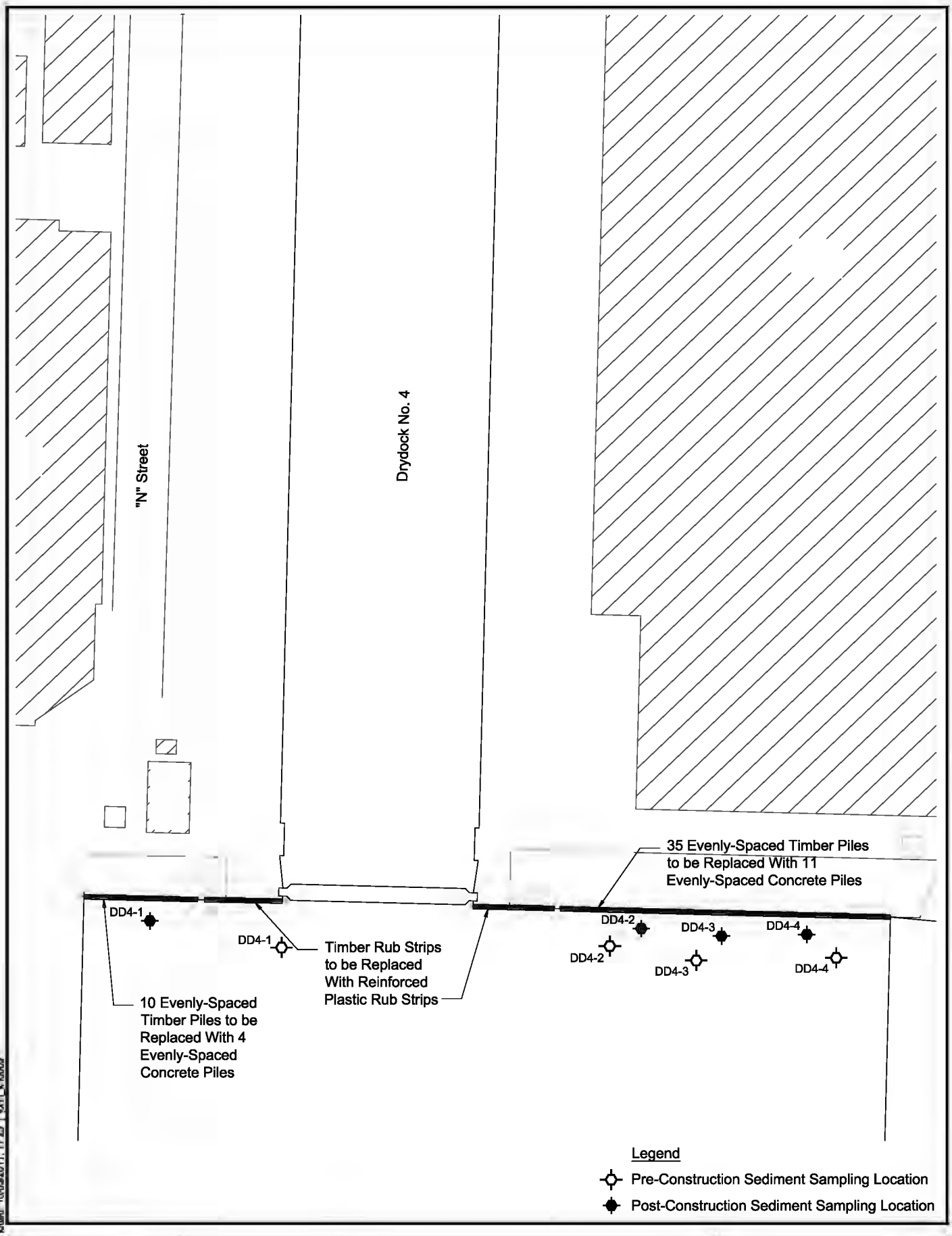
Figure 3-1
Sediment Sampling Locations, Drydock 1

Delivery Order 0020
Bremerton Naval Complex
QUAY WALL AND DRYDOCK ENTRANCE
SEDIMENT SAMPLING REPORT



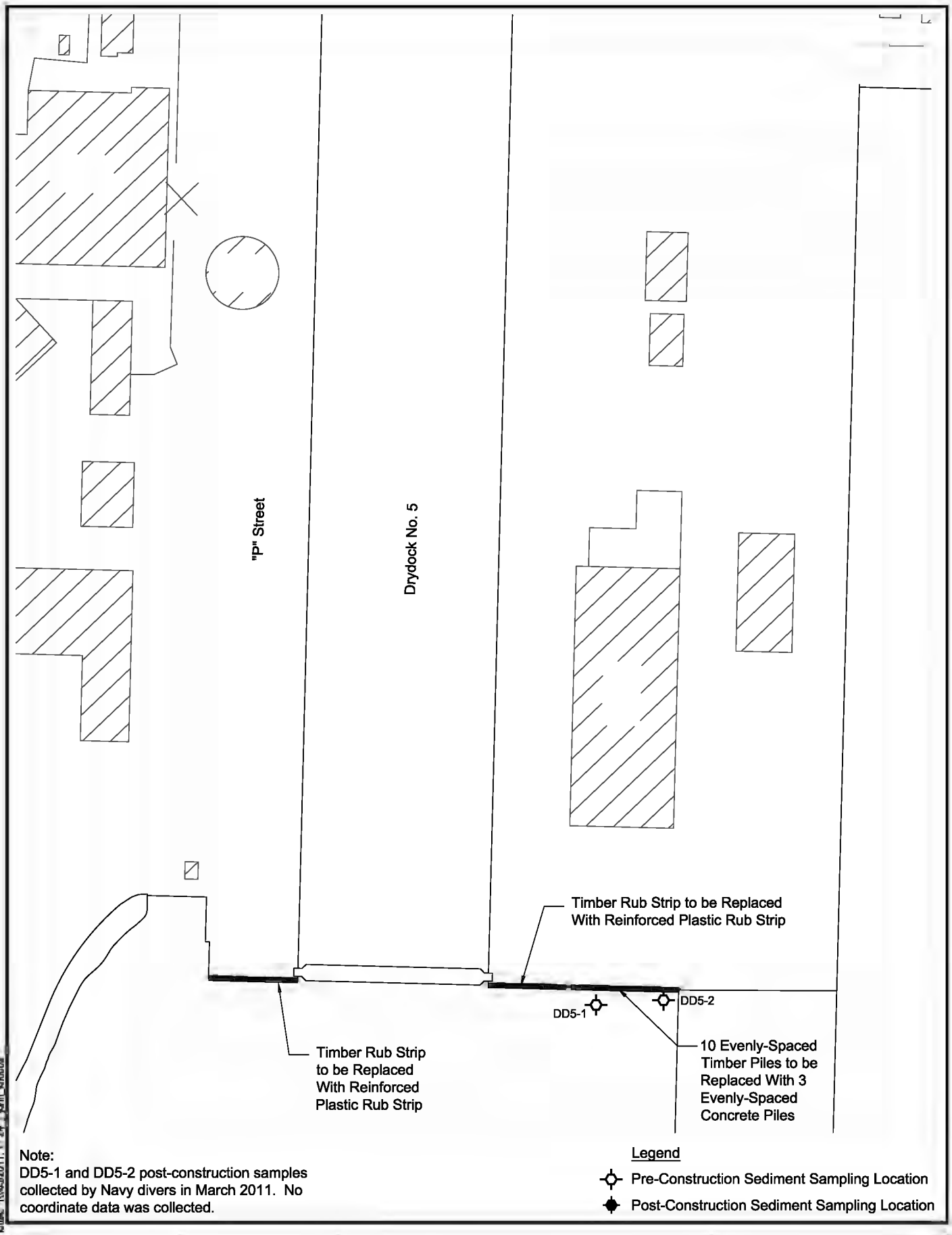
T:\PSNS\IDIQ\DO 20\Sed Mon Report\Figure 3-2 Dry Dock 3.dwg
Mod: 09/29/2011, 16:11 | Plotted: 10/03/2011, 11:29 | John Jacobs

U.S. NAVY	0 50 100 SCALE IN FEET	**Figure 3-2** **Sediment Sampling Locations, Drydock 3**	Delivery Order 0020 Bremerton Naval Complex QUAY WALL AND DRYDOCK ENTRANCE SEDIMENT SAMPLING REPORT



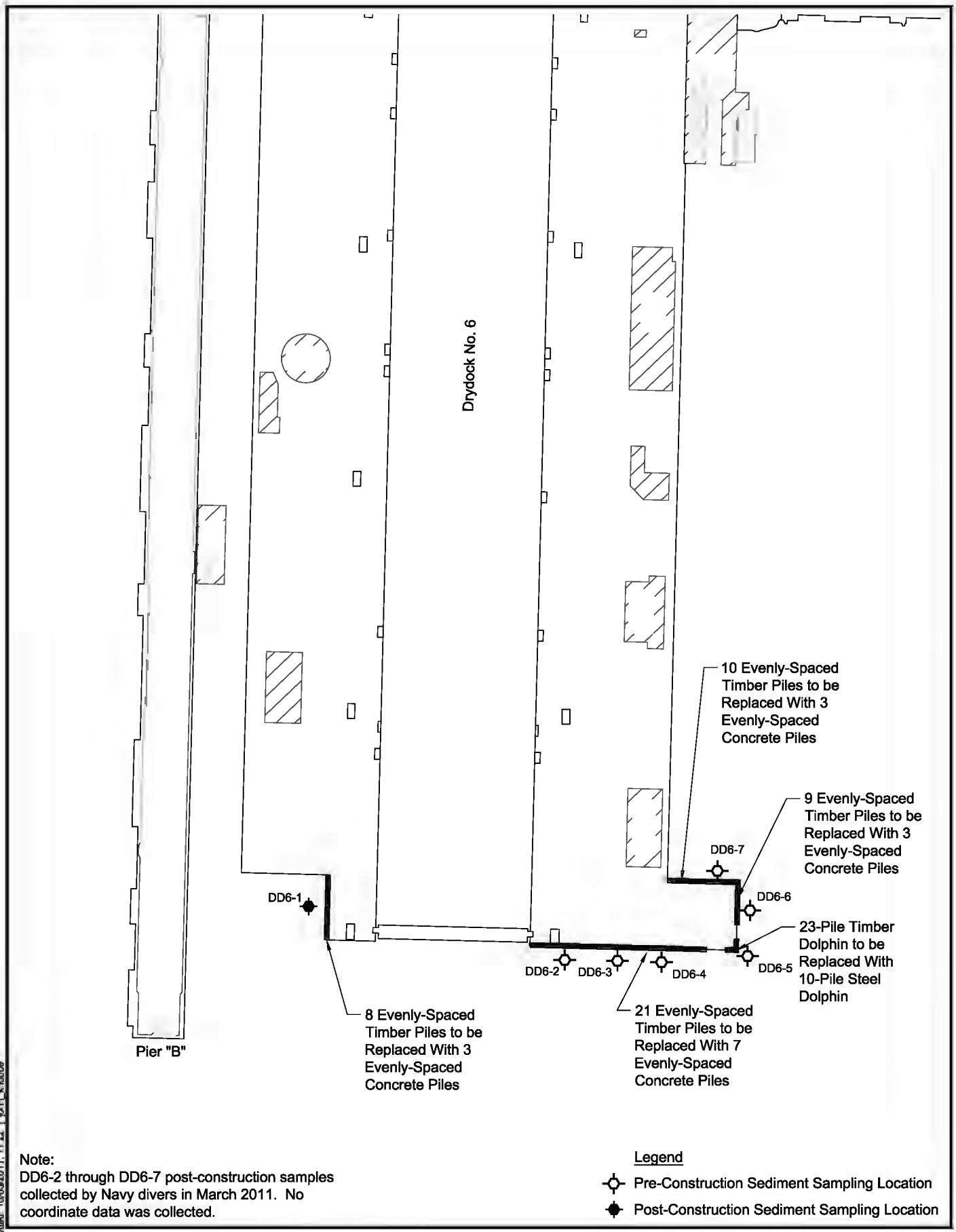
T:\PSNS\IDIQ\DO 20\Sed Mon Report\Figure 3-3 Dry Dock 4_Quay.dwg
Mod: 09/23/2011, 16:11 | Plotted: 10/03/2011, 11:25 | John_Knobbs

U.S. NAVY	0 50 100 SCALE IN FEET	**Figure 3-3** **Sediment Sampling Locations, Drydock 4 and Quay Wall**	Delivery Order 0020 Bremerton Naval Complex QUAY WALL AND DRYDOCK ENTRANCE SEDIMENT SAMPLING REPORT



T:\PSNS\IDIQ\DO 20\Sed Mon Report\Figure 3-4 Dry Dock 5.dwg
Mod: 09/23/2011, 10:16 | Plotted: 10/03/2011, 11:24 | tom_knobbe

U.S. NAVY	0 50 100 SCALE IN FEET	**Figure 3-4 Sediment Sampling Location, Drydock 5**	Delivery Order 0020 Bremerton Naval Complex QUAY WALL AND DRYDOCK ENTRANCE SEDIMENT SAMPLING REPORT



Note:
DD6-2 through DD6-7 post-construction samples collected by Navy divers in March 2011. No coordinate data was collected.

Legend
- Pre-Construction Sediment Sampling Location
- Post-Construction Sediment Sampling Location

T:\PSNS\IDIQ\DO 20\Sed Mon Report\Figure 3-5 Dry Dock 6_Pier 3.dwg
Mod: 09/23/2011, 16:27 | Plotted: 10/03/2011, 11:22 | John_Knobbe

U.S. NAVY	N 0 75 150 SCALE IN FEET	Figure 3-5 Sediment Sampling Locations, Drydock 6 and Pier 9	Delivery Order 0020 Bremerton Naval Complex QUAY WALL AND DRYDOCK ENTRANCE SEDIMENT SAMPLING REPORT

Table 3-2
Results of PCBs and Mercury Analyses

Sample ID	Mercury (mg/kg)		Pre-Construction			Post-Construction		
	Pre-con	Post-con	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)
SQS/CSL	**0.41/0.59**		-	-	**12/65**	-	-	**12/65**
DD1-1	**0.604**	**0.546 J**	4.57	243	5.3	1.51	269 J	**17.8 J**
DD1-2	**1.14**	**0.425 J**	3.58	172	4.8	1.59	78 J	4.91 J
DD1-3*	**1.19**	**0.477 J** **0.422 J**	3.24	370	11	6.23 6.21	118 150	1.89 2.41
DD1-4	0.289	0.144 J	0.612	79	**13**	5.13	99	1.93
DD1-5	**6.78**	**1.53 J**	7.11	32	0.45	3.62	86	2.38
DD1-6	**2.19**	**2.16 J**	1.22	111	9.1	3.23	45	1.39
DD3-1	**0.905 J**	**1.39 J**	3.05	79 J	2.6 J	2.18	280 J	**12.8 J**
DD3-2	0.148 J	0.142 J	0.562	35 J	6.2 J	0.632	57 J	9.02 J
DD4-1	**11.5**	0.364 J	2.73	290 J	11 J	1.66	420 J	**25.3 J**
DD4-2	**0.443**	0.394 J	2.23	460	**21**	2.21	380 J	**17.2 J**
DD4-3	**0.927**	**0.771 J**	3.09	1,220 J	**40 J**	2.24	340	**15.2**
DD4-4*	**1.22**	**0.739 J** **0.490 J**	2.61	890	**34**	2.13 1.99	600 J 430 J	**28.2 J** **21.6 J**
DD5-1	0.27 J	0.331 J	1.78	610 J	**34.3 J**	2.79	270	9.68
DD5-2	0.102 J	0.127 J	2.96	98 J	3.31 J	1.72	70	4.07
DD6-1*	0.215 0.207	0.163 J 0.159 J	1.29 1.36	37 J 39	2.9 J 2.9	0.883 0.693	114 J 260 J	**12.9 J** **37.5 J**
DD6-2	0.306	0.097 J	1.44	90 J	6.3 J	1.29	6.3	0.488
DD6-3	**0.605**	0.244 J	3.37	71 J	2.1 J	1.45	91	6.28
DD6-4*	**0.615**	0.168 J 0.078 J	3.35	49 J	1.5 J	1.26 0.574	64 J 27 J	5.08 J 4.70 J
DD6-5	0.352	0.082 J	0.729	152 J	**21 J**	0.405	15	3.70
DD6-6	**0.416**	0.100 J	2.13	47 J	2.2 J	1.11	47	4.23
DD6-7	0.306	**0.429 J**	0.959	114 J	12	1.94	84 J	4.33 J

Notes:
Bolded value – exceedance of SQS
Shaded value - exceedance of CSL
J - estimated value
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
mg/kg OC - milligram per kilogram of organic carbon
TOC - total organic carbon
* - field duplicate results presented below primary sample results
PCBs - polychlorinated biphenyls
Post-con - post-construction sample
Pre-con - pre-construction sample
SQS/CSL - Washington State sediment quality standard/cleanup screening level

Table 3-3
Results of Metals Analyses

Sample ID	Arsenic (mg/kg)		Cadmium (mg/kg)		Chromium (mg/kg)		Copper (mg/kg)		Lead (mg/kg)		Silver (mg/kg)		Zinc (mg/kg)	
	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con
SQS/CSL	**57/93**		**5.1/6.7**		**260/270**		**390/390**		**450/530**		**6.1/6.1**		**410/960**	
DD1-1	8.53	9.7	1.52 J	1.3	43.1	60.8	172	161	70.6	106	0.997 J	0.9 J	249	261
DD1-2	12.5	9.9	1.81 J	1.08	45.8	39.5	201	161	87	49	0.934 J	0.7 J	291	168
DD1-3*	12.6	6.5 6.5	1.87 J	0.82 0.71	39.1	20.4 20.8	198	97.1 J 124 J	117	42 39	0.694 J	0.5 J 0.2 J	321	181 J 162 J
DD1-4	4.07	7.2	0.409 J	0.79	9.24	19.7	**1,160**	**907 J**	23.5	39	0.191 J	0.2 J	397	**631 J**
DD1-5	8.1	12.4	0.638 J	1.27	24.5	42.8	**857**	203 J	310	191	0.416 J	0.9 J	217	334 J
DD1-6	8.28	9.6	1.93 J	0.93	29.7	23.6	253	184 J	**1,570**	**699**	0.381 J	0.6 J	**1,090**	**468 J**
DD3-1	13.3	13.3	1.16 J	1.29	23.2	35.7	164	195	82.2	63	0.453 J	0.8 J	378	252
DD3-2	3.59	6.7	0.368	0.51	10.6	22.8	37.7	87.4	23.1 J	27	0.09	0.3 J	82.8	108
DD4-1	**78.1**	50	2.11 J	0.94	55.8	34.8	**537**	271 J	141	113	0.792 J	0.4 J	**459**	**564**
DD4-2	9.35	8.4	0.976 J	0.80	25.2	21.1	129	138 J	55.4	38	0.702 J	0.4 J	206	165
DD4-3	18.5	21	2.61 J	1.93	65	38.5	**465**	**1,120 J**	109	105	1.11 J	1.1	**433**	**693**
DD4-4*	10.8	15.4 13	1.45 J	1.87 1.78	27.2	33.2 30.2	192	**411 J** **1,780 J**	58.5	72 96	0.795 J	1.8 2.0	261	379 J **875 J**
DD5-1	10.3	11.1	1.26	1.09	40.3	30.7	188	121 J	51	46	0.6 J	0.2 U	**413**	361
DD5-2	10.9	4.7	0.53	0.40	15.5	10.7	66.9	71.3 J	25	21	0.3 J	0.1 U	143	119
DD6-1*	23.2 21	38.4 27.9	0.265 J 0.205 J	0.45 0.43	37 36.1	42.7 35	374 266	**635** **618**	182 145	186 132	0.531 J 0.413 J	0.6 J 0.8 J	**889** **646**	**809** **638**
DD6-2	20.2	4.4 J	0.984 J	3.36 J	27.3	14.1	203	136 J	96.3	14	0.786 J	0.2 U	**545**	**586**
DD6-3	18.2	32.3	2.32 J	4.50	37.4	24.4	261	240 J	93.6	112	0.667 J	0.3 J	328	**1,370**
DD6-4*	11.9	**489 J** **252 J**	1.65 J	3.10 J 1.14 J	35.9	67.4 J 31.9 J	205	**1,200 J** **523 J**	60	**563 J** 244 J	0.52 J	2.6 0.6 J	260	**2,440 J** **1,190 J**

Table 3-3 (Continued)
Results of Metals Analyses

Sample ID	Arsenic (mg/kg)		Cadmium (mg/kg)		Chromium (mg/kg)		Copper (mg/kg)		Lead (mg/kg)		Silver (mg/kg)		Zinc (mg/kg)	
	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con	Pre-con	Post-con
DD6-5	13.3	**155**	0.328 J	1.25 J	26.9	51.1	**426**	**1,160 J**	169	150	4.29 J	0.2 U	**912**	**1,390**
DD6-6	12.1	**164**	1 J	2.13 J	72.7	53.9	122	**1,390 J**	93.1	195	0.612 J	0.2 U	282	**1,450**
DD6-7	9.01	48.1	0.259 J	0.67 J	31.8	47.2	122	**855 J**	124	159	0.229 J	0.6 J	175	**647**

Notes:
Bolded value - exceedance of SQS
Shaded value - exceedance of CSL
mg/kg - milligram per kilogram
J - estimated value
Pre-Con - pre-construction sample
Post-Con - post-construction sample
SQS/CSL - Washington State sediment quality standard/cleanup screening level
U - not detected above reported quantitation limit
* - field duplicate results presented below primary sample results

Table 3-3
Underpier Sampling at Piers B and 8

Location	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)	Mercury (mg/kg)	TOC (%)	Bulk PCBs (µg/kg)	PCBs (mg/kgOC)
SQS/CSL	**57/93**	**5.1/6.7**	**260/270**	**390/390**	**450/530**	**6.1/6.1**	**410/960**	**0.41/0.59**	**---**	**---**	**12/65**
PBU-1-Lower	17	1.7 J	56	260	190	2.3	310	1.4	2.5	520 J	**21 J**
PBU-1-Upper	8.9	1.0 J	30	140	70	0.88	180	0.65	3.0	186	6.2
PBU-2-Lower	11	1.7 J	45	220	100	1.2	300	0.81	3.5	168	4.8
PBU-2-Upper	8.3	1.4 J	39	190	70	0.74	200	0.66	3.5	83	2.4
PBU-3-Lower	12	0.91 J	39	130	88	1.2	170	0.64	1.6	234	**15**
PBU-3-Upper	11	1.4 J	38	160	72	0.73	180	0.60	3.6	105	2.9
PBU-4-Lower	17	1.6 J	53	200	140	1.5	290	1.0	2.4	250	10
PBU-4-Upper	10	1.2 J	34	160	67	0.79	230	**0.55**	2.9	116	4.0
P8U-01	12	0.78	24	170	140	0.94	260	**0.50**	0.93	85	9.1
P8U-02	6.0	1.2	16	71	43	1.4	140	0.34	5.2	89	1.7
P8U-03	3.9	0.41	14	46	36	0.22	100	0.18	3.0	69	2.3
P8U-04	16	1.5	74	210	360	1.5	**490**	0.89	2.7	330	12
P8U-04 FD	14	2.3	49	180	190	1.2	**490**	0.82	2.1	330	**16**
P8U-05	5.0	0.62	15	45	34	0.17	120	0.25	1.8	50	2.8
P8U-06	2.8	0.37	9.5	24	12	0.079	170	0.25	2.6	17	0.65
P8U-07	4.2	0.42	12	48	21	0.14	83	0.18	2.1	31	1.5
P8U-08	3.9	0.51	9.8	33	21	0.15	81	0.19	3.8	30	0.79

Notes:
Shaded - exceedance of CSL
Bold - exceedance of SQS
J - value qualified as estimated

APPENDIX B

Interview Responses

Agency

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
Type 2 Interview – Regulatory Agency
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Nancy Harney
Title: Remedial Project manager
Organization: EPA
Telephone: 206 553-6635
E-mail: Harney.nancy@epa.gov
Address: 1200 Sixth Ave., Suite 900
Seattle, WA 98101

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 7, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I am very familiar with OU B Marine, OUB Terrestrial and OUD. Ecology has been the lead regulator for OUA and OU NSC, however, I have some familiarity with OUA due to my involvement with Charleston Beach. For OU B M and T, I have been very involved with the monitoring and maintenance of the remedies for those operable units.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC? Do you believe the remedies met the intent of the RODs for these sites? Do you feel the remedies continue to be effective? Please indicate the basis for your assessment.

   Response: I think the remedy implementation has been very successful and the remedies do meet the intent of the RODs.

3. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective

regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

Response: The tech memo for mercury was an initial step in trying to identify human health risks associated with mercury. The results of that assessment indicated that mercury could be considered a contaminant of concern however, there was a lot of uncertainty due to significant data gaps. Further data collection is needed and is planned for the coming year. Therefore, at the moment, I am not going to speculate on risks attributable to mercury in Sinclair Inlet. As for the progress towards a protectiveness statement for the OUB Marine remedy, the Navy and EPA completed a Five Year Review Addendum in September, 2011, that addressed the protectiveness determination. The conclusions in that Addendum should be incorporated into this upcoming 5 Year Review.

4. To your knowledge, since the RODs were signed have there been any new scientific findings that relate to projecting potential site risks which might call into question the protectiveness of the remedy?

   Response: Off hand I can't think of anything, but this is a question that needs a more detailed analysis in the 5 year review as part of the answers to Questions B and C.

5. To the best of your knowledge, are institutional controls and operation and maintenance procedures being utilized at the BNC consistent with the terms of the RODs?

   Response: Yes. However, it has become obvious that the existing institutional/land use controls need to be reassessed and beefed up. Both the recent pier construction projects and the construction of a day care facility across the street from the CIA have shown that broader sitewide ICs need to be added to the current restrictions. This is an issue that should be identified in the 5 year review.

6. Following signing of the RODs, have there been any complaints, violations, or other incidents related to BNC installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: No.

7. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedy been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

Response: Yes. The basis for this assessment is review of the monitoring reports, ongoing project team meetings, recent 5 Year Review Addendum, discussion with Navy project managers.

8. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

   Response: No.

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

   Response: No.

10. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response: The list looks fine.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
Type 3 Interview – Natural Resources Trustee
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Doris Small
Title: Fish and Wildlife Habitat Biologist
Organization: Washington Dept of Fish and Wildlife
Telephone: 360-895-4756
E-mail: doris.small@dfw.wa.gov
Address: 450 Port Orchard Blvd, Suite 250, Port Orchard WA 98366

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: November 30, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I am familiar with some of the marine remediation work more than the upland remediation work. I have worked with the BNC on cleanup and construction projects since around 1995. I am most familiar with OUA & OUB.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC? Do you believe the remedies met the intent of the RODs for these sites? Do you feel the remedies continue to be effective? Please indicate the basis for your assessment.

   Response: The RODs were implemented according to plan. However, I remain concerned about the effectiveness of covering contaminated areas with large rock rip as a method of containment from a water quality standpoint and from a shoreline habitat loss standpoint. I have monitored the Charleston Beach work from plan development to maintenance work. I think it is a good demonstration as to why protection of contaminated soils in place is not a good long term solution.

3. What effects have post-ROD remedy implementation had on your agency and the surrounding community?

Response: While WDFW is interested in a toxin cleanup, habitat loss is often part of the remedy. Sinclair Inlet supports millions of juvenile salmon migrating along shorelines. Shallow shorelines offer refuge and good food sources for these small fish, contrary to rock rip rap banks commonly part of remediation work. More recently, we've seen movement toward more habitat friendly designs along shorelines & encourage this type of work in remediation.

4. Are you aware of any concerns within your agency or the community regarding implementation of the remedies at the five operable units at BNC? If so, please give details.

   Response: I've heard concerns voiced about re-contamination as dredge soils are dispersed and older areas are discovered. Source control appears to be a priority for the BNC which will help in this regard. However, there is still a long history of work at the Shipyard that may lead to discovery of more contaminated areas over time. And, as our understanding of toxins, and particularly the combination of toxins, increase, we may find new areas for cleanup.

5. To the best of your knowledge, are institutional controls and operation and maintenance procedures being utilized at the BNC consistent with the terms of the RODs?

   Response: Yes.

6. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedy been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

   Response: We are having some trouble with the Charleston Beach mitigation work, as it is not self-supporting. From the beginning, we advised that this location may need ongoing maintenance to meet project objectives (i.e. continual addition of gravels). This was not built into the project budget and is now an issue.

7. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the BNC?

   Response: No

8. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

Response: Dan Doty, WDFW, Rich Brooks, Suquamish Tribe and Jay Davis, USFWS

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
Type 3 Interview – Natural Resources Trustee
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Denice Taylor
Title: Environmental Scientist
Organization: Suquamish Tribe
Telephone: 360-394-8449
E-mail: dtaylor@suquamish.nsn.us
Address: Suquamish Tribe
Fisheries Department
18490 Suquamish Way
P.O. Box 498
Suquamish, WA 98392

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 13, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: As the current DoD CERCLA project manager for the Suquamish Tribe, I am familiar with BNC, as well as the specific RODS, remedies, monitoring and maintenance programs for OU NSC, OU A, OU B Marine, OU B Terrestrial and OU D.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC? Do you believe the remedies met the intent of the RODs for these sites? Do you feel the remedies continue to be effective? Please indicate the basis for your assessment.

   Response: I believe that the remedies were generally implemented as intended by the RODs. Exceptions to be noted include the contamination of the area around the CAD pit and the lack of coordination by the City of Bremerton regarding land use controls for the portion of OU D that was subject to a property transfer.

While many components of the various remedies remain protective in the short-term, monitoring and inspection programs reveal that some components cannot be considered to be protective of human health and the environment in the long-term.

For the upland areas of the terrestrial operable units, the primary remedy components rely on maintenance and repair of asphalt/concrete pavement, and the maintenance and cleaning of stormwater systems, to prevent direct contact, limit infiltration and reduce erosion. However, based on inspection reports, the maintenance and repair of the pavement and stormwater systems may not be consistently implemented. In the shoreline areas of OU BT and OU A, failure of, or damage to, several stretches of the shoreline protection system has resulted in the need for interim repair actions. At OU A, an extensive long-term remedy repair process in underway. In addition, groundwater monitoring at OU BT indicates that contaminants are still being release to the marine environment.

For the marine operable unit, monitoring data indicate that the area wide concentrations of PCBs in sediments have declined and may meet the 10 year timeframe for natural recovery. Mercury concentrations in both sediment and marine organisms continue to be of concern. In addition, sample data related to in-water construction projects show that localized areas of higher contamination remain.

3. What effects have post-ROD remedy implementation had on your agency and the surrounding community?

   Response: As commented in the previous two Five Year Reviews, the actions taken have been important steps in reducing the contaminant load in Sinclair Inlet. However, the remedial actions have had limited direct beneficial effect on tribal members. Harvest restrictions remain in effect, and the armoring of the BNC shoreline, while generally effective in preventing erosion, is detrimental to the habitat of treaty-protected resources.

4. Are you aware of any concerns within your agency or the community regarding implementation of the remedies at the five operable units at BNC? If so, please give details.

   Response: Please see the response to Question 2 for issues regarding long-term protectiveness of the remedies. Of current concern are continued mercury concentrations in sediments and groundwater, as well as the potential habitat impacts of the long-term remedy repair at OU A.

5. To the best of your knowledge, are institutional controls and operation and maintenance procedures being utilized at the BNC consistent with the terms of the RODs?

Response: Yes, although the Tribe does not generally regard the use of ICs, specifically fish advisories and harvest restrictions, as viable long-term remedies. In the Tribe's perspective, ICs are used to avoid and/or minimize exposure until the remedial objectives and goals for the sites are met. ICs alone do not reduce contaminant concentrations or control sources.

6. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedy been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

   Response: In general, the monitoring at BNC has been sufficient to meet the goals of the RODs. As the sites mature, if remedial objections and goals are not being met, if the data reveal increasing or flat trends in contaminant concentrations, or if new information becomes available that changes assumptions about human health or ecological exposure pathways, the monitoring programs should be flexible enough to be address current concerns.

7. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the BNC?

   Response: As the mercury issues demonstrate, the terrestrial and marine environments must be addressed from a more holistic perspective to ensure an effective remedy.

8. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

   Response: I do not have any other suggestions.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
Type 2 Interview – Regulatory Agency
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Chung Ki Yee
Title: State Project Engineer
Organization: Washington State Department of Ecology
Telephone: 360-407-6991
E-mail: cyee461@ecy.wa.gov
Address: 300 Desmond Drive SE, Lacey, WA 98503

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 5, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I am the Ecology staff assigned to the Bremerton Naval Complex. With the exception of OU B Marine, I am familiar with the Record of Decisions and remedial activities related to the Bremerton Naval Complex. Mr. Kevin MacLachlan is the Ecology staff assigned to the OU B Marine Operable Unit.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC? Do you believe the remedies met the intent of the RODs for these sites? Do you feel the remedies continue to be effective? Please indicate the basis for your assessment.

   Response: Excluding OU B Marine OU, the remedies for the four operable units were implemented in compliance with the Record of Decisions. The remedies met the intent of the RODs and are generally continue to be effective. However, to ensure remedies to be continually effective, the Navy needs to implement the Annual Remedy Inspection, Controls, and Management Reports' recommendations on site maintenance.

3. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both

PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

Response: I am not familiar with OU B Marine. Mr. Kevin MacLachlan is the Ecology staff assigned to the OU B Marine Operable Unit.

4. To your knowledge, since the RODs were signed have there been any new scientific findings that relate to projecting potential site risks which might call into question the protectiveness of the remedy?

   Response: No.

5. To the best of your knowledge, are institutional controls and operation and maintenance procedures being utilized at the BNC consistent with the terms of the RODs?

   Response: Institutional controls have been utilized consistent with the terms of the RODs. The Navy needs to implement recommended maintenance procedures to ensure continual effectiveness of site remedies.

6. Following signing of the RODs, have there been any complaints, violations, or other incidents related to BNC installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: No.

7. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedy been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

   Response: Yes.

8. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

   Response: The Navy needs to implement recommended maintenance procedures to ensure continual effectiveness of site remedies.

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

Response: No.

10. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response: No.

Community

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
Type 4 Interview – Community Member
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Susan Moore
Title: Environmental Consultant
Organization: CH2M HILL
Telephone: 206-779-4176
E-mail: smoore@ch2m.com
Address: 1133 NW 200th Street, Shoreline, WA 98177

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 13, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I began as a contractor for EPA in the mid-1990s and since 2007 have been working for the Navy as a third-party technical reviewer for issues related to OU B Marine. I am very familiar with the OU B Marine ROD, implementation of the remedy, and monitoring. I am less slightly familiar with OU B Terrestrial and OU A, and much less with OU NSC and OU D.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC? Do you believe the remedies met the intent of the RODs for these sites? Do you feel the remedies continue to be effective? Please indicate the basis for your assessment.

   Response: For OU B Marine, I believe the remedy has met the intent of the RODs for these sites. For OU B, the data indicate that natural recovery has been effective in reducing area-wide PCB concentrations and will meet the MCUL specified in the ROD. However, I think mercury contamination in sediment, related to fish consumption pathways, remains a problem to be solved – as well as what to do when additional data gathered during for monitoring in-water construction effects reveal extremely high concentrations of PCBs and/or mercury.

For OU B Terrestrial, the cleaning and repair of the storm drains seemed a very well supported solution. I don't know about the status of ongoing repairs, but am aware that there are some areas of the upland that appear to still contribute metals to surface water, and that this is the subject of further study. For OU A, I am aware that erosion of material placed as part of a mitigation action has prompted the need for additional work, but I don't know the status of that work and how it has affected the intent of the remedy. No comment on OU NSC and OU D.

3. What effects have post-ROD remedy implementation had on the surrounding community?

   Response: Not sure.

4. Are you aware of any community concerns regarding implementation of the remedies at the five operable units at BNC? If so, please give details.

   Response: No

5. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

   Response: None

6. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and telephone number.

   Response: No

Navy

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
Type 1 Interview – Navy Personnel
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Dina Ginn
Title: Former Navy RPM
Organization: NAVFAC NW
Telephone: 360-396-0016
E-mail: dina.ginn@navy.mil
Address: 1101 Tautog Circle, Suite 203, Silverdale, WA 98315

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 15, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response:

   I am familiar with the RODs and monitoring activities conducted through 2007 as a former RPM for the site. I remain familiar with information after this period based on reports from Navy staff.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC?

   Response:

   Overall, remedies were implemented in accordance with the requirements of the RODs and remedial designs. In some instances site conditions after implementation were not as anticipated, dispersion of sediment during filling of confined aquatic disposal cell, however, these issues were addressed prior to completion of remedial construction.

3. To the best of your knowledge, did the improvements made to pavement and vegetative cover within the terrestrial operable units effectively meet the goals stated in the RODs, namely to reduce the potential for human contact with

chemicals of concern in soil and to reduce the potential for infiltrating precipitation to transport chemicals to groundwater? Has on-going pavement maintenance been timely and effective? Please indicate the basis for your assessment of the paving improvements.

Response: The pavement improvements have reduced potential for contact and infiltration potential from pre-ROD conditions. To my knowledge pavement improvements have been conducted by the Navy for sites that have been determined to have a significant impact on exposure or infiltration potential.

4. To the best of your knowledge, did the storm drain cleaning and repairs carried out at OU NSC, OU B Terrestrial, and OU D effectively meet the ROD goal of reducing the potential for chemicals of concern to be discharged to Sinclair Inlet? Has on-going storm drain maintenance been timely and effective? Please indicate the basis for your assessment of the storm drain cleaning and repairs.

Response:

The storm drain cleaning and repair projects were significant and reduced the potential for chemicals of concern (contaminated site soil) to be discharged to Sinclair Inlet. I am unaware of any significant maintenance issues.

5. To the best of your knowledge, did the shoreline stabilization at Site 1, the paved area south of Buildings 851 and 480, carried out as part of the remedy for OU B Marine effectively meet the ROD goal of controlling potential erosion of fill material to Sinclair Inlet? Please indicate the basis for your assessment of these shoreline measures.

Response: The shoreline stabilization has provided erosion control for fill material in this location. I am unaware of any changes since the previous 5 Year Review.

6. How aware are you of the ongoing studies of beach dynamics at Charleston Beach at OU A in response to repeated erosion of materials placed in the intertidal zone to enhance shoreline habitat? What is your impression of the short-term effectiveness of the actions to date in meeting the ROD goal of enhancing shoreline habitat? What are your thoughts about possible approaches for achieving this goal in the long term?

Response: I am aware of studies of beach dynamics at Charleston Beach OUA and erosion. The short term repairs appear to be adequately addressing erosion on a temporary basis.

Vegetative strip appears to be providing benefits. In some locations fish mix was placed on top of rip rap to provide potential habitat improvements. The

Navy anticipated this material to be distributed by wave action. This was confirmed during previous 5 Year Review. Adaptive management of fish mix placed on top of rip rap was not required by ROD.

7. To the best of your knowledge, did the sediment dredging and disposal, capping, and enhanced natural recovery included in the remedy for OU B Marine effectively meet the ROD goals of reducing the concentrations of PCBs in shallow sediments and removing sediments with high concentrations of mercury collocated with PCBs? Please indicate the basis for your assessment of these measures.

   Response: The remedial construction components removed contaminant load from the biologically active zone and reduced surface sediment concentrations. Additional action, ERN was conducted as defined in an ESD to address CAD area dispersion.

8. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

   Response: The Navy completed an addendum to the 5 Year Review to address the protectiveness statement of OU B Marine.

9. Are you aware of any prior or pending land use or ownership changes since the signing of the RODs that may impact the effectiveness of any component of the selected remedies?

   Response: I am not aware of any pending land use or ownership changes since the previous 5 Year Review.

10. Please describe any notifications that you are aware of that have been given to Navy personnel following signing of the RODs stating that the use of groundwater from beneath BNC is restricted. Are you aware of any use of groundwater from beneath the site?

    Response: Information is included in the IC Plan, IC instruction and digging permit process. Navy personnel are also reminded of LUC restrictions during presentations by NAVFAC NW Environmental Restoration staff. I am not aware of any groundwater use. I am also unaware of any beneficial use of groundwater for this area.

11. To the best of your knowledge, do institutional controls and operation and maintenance practices in use at BNC meet the intent of the RODs regarding limiting the potential for contact with or movement of contaminants left in place, e.g. in connection with excavation management, petroleum management, and storm drain system monitoring and maintenance?

    Response: The institutional controls and operation and maintenance procedures for Operable Units within the facility meet the intent of the ROD and complied with the institutional work plan during my tenure as an RPM for the site. I am not aware of any specific issues after this time.

12. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedies been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

    Response: Monitoring and inspections were conducted in accordance with the schedules agreed between EPA, Ecology and the Navy during my tenure as an RPM and were sufficiently thorough. I am not aware of any deviation from agreements since that time.

13. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

    Response: No

14. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

    Response: No

15. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response:

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
Type 1 Interview – Navy Personnel
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Suzanna Jefferis
Title: Environmental Engineer
Organization: NAVFAC NW
Telephone: 360-396-0053
E-mail: suzanna.jefferis@navy.mil
Address: 547 Eliason St. Poulsbo WA 98370

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 8, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I was the RPM for the BNC terrestrial sites for about 18 months ending approximately September 2008. I worked on the interim bank stabilization project at Charleston Beach, and was working on implementing items from the second Five-Year Review.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC?

   Response: I am not familiar with the marine remedy. I was also concerned that the cap was not being maintained by IR funding and that much of the maintenance for the cap was expected to be maintained by PW (facility maintenance). It was not clear that PW was prepared to maintain the cap per the ROD expectations. I don't know what has happened since September 2008. Perhaps communications have improved and the cap is being upgraded and maintained.

3. To the best of your knowledge, did the improvements made to pavement and vegetative cover within the terrestrial operable units effectively meet the goals stated in the RODs, namely to reduce the potential for human contact with chemicals of concern in soil and to reduce the potential for infiltrating

precipitation to transport chemicals to groundwater? Has on-going pavement maintenance been timely and effective? Please indicate the basis for your assessment of the paving improvements.

Response: I believe that the improvements made to cap the terrestrial operable units have reduced the potential for human contact with the COC in the soil. I don't know if maintenance of pavement has been timely and effective since September 2008. It was not clear to me that it was timely and effective during my brief time as the RPM. There are still many areas left uncapped. I also believe that the potential for precipitation infiltration and COC transport to the ground water has been improved (reduced). Not sure about transport through the stormwater system to receiving water.

4. To the best of your knowledge, did the storm drain cleaning and repairs carried out at OU NSC, OU B Terrestrial, and OU D effectively meet the ROD goal of reducing the potential for chemicals of concern to be discharged to Sinclair Inlet? Has on-going storm drain maintenance been timely and effective? Please indicate the basis for your assessment of the storm drain cleaning and repairs.

   Response: I can't speak very well to this question. I haven't kept up with the metrics established to measure the effectiveness or if PW has been responsive to maintenance issues that concern the ROD. I do know that there are stormwater manholes that are made of brick and are very old. It seems like shallow ground water could infiltrate into the stormwater system from these manholes.

5. To the best of your knowledge, did the shoreline stabilization at Site 1, the paved area south of Buildings 851 and 480, carried out as part of the remedy for OU B Marine effectively meet the ROD goal of controlling potential erosion of fill material to Sinclair Inlet? Please indicate the basis for your assessment of these shoreline measures.

   Response: Don't know.

6. How aware are you of the ongoing studies of beach dynamics at Charleston Beach at OU A in response to repeated erosion of materials placed in the intertidal zone to enhance shoreline habitat? What is your impression of the short-term effectiveness of the actions to date in meeting the ROD goal of enhancing shoreline habitat? What are your thoughts about possible approaches for achieving this goal in the long term?

   Response: I was involved in the first interim bank stabilization where we added rock and some fish mix (2008), and started the study for URS to determine a long term fix, but have not kept up on the progress of this project.

7. To the best of your knowledge, did the sediment dredging and disposal, capping, and enhanced natural recovery included in the remedy for OU B Marine effectively meet the ROD goals of reducing the concentrations of PCBs in shallow sediments and removing sediments with high concentrations of mercury collocated with PCBs? Please indicate the basis for your assessment of these measures.

   Response: Don't know.

8. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

   Response: I was involved at the beginning of the USGS study, but can't speak to any of the outcomes or conclusions.

9. Are you aware of any prior or pending land use or ownership changes since the signing of the RODs that may impact the effectiveness of any component of the selected remedies?

   Response: I am not sure how the OUD cap issues have been resolved between the City of Bremerton, the Navy, and EPA. The last I knew, September 2008, there was a problem concerning responsibilities for the maintenance of the remedy. It is my understanding the rail road is planned to be leased, I don't know if this may have any impact on OUA. I am not aware of any other issues.

10. Please describe any notifications that you are aware of that have been given to Navy personnel following signing of the RODs stating that the use of groundwater from beneath BNC is restricted. Are you aware of any use of groundwater from beneath the site?

    Response: I am aware there has been enough infiltration into the stormwater conveyance system to cause fecal coliform measurements at some of the stormwater outfalls. So, there may be some ground water entering the stormwater system as well as sanitary from cross connection problems (this is currently under study). Although this is not a use of groundwater, this may be a discharge issue.

11. To the best of your knowledge, do institutional controls and operation and maintenance practices in use at BNC meet the intent of the RODs regarding limiting the potential for contact with or movement of contaminants left in place, e.g. in connection with excavation management, petroleum management, and storm drain system monitoring and maintenance?

    Response: Don't know. See my concerns from above.

12. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedies been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

    Response: Don't know.

13. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

    Response: No.

14. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

    Response: I attended a meeting recently concerning stormwater monitoring at PSNS. The RPM, Mark Wicklein, attended that meeting. I think this type of presence of the RPM is excellent. I think that in order to keep pushing for the continued maintenance and controls necessary to maintain the remedy as time goes on, it is very important for the RPM to be actively involved in many programs at PW and at NAVFAC. Money is likely the biggest issue. My most recent understanding is that IR doesn't program enough funds for the continued maintenance and upgrade to the remedies. I don't know if PW has programmed funding to maintain the remedy per the ROD. I'm not sure if IR is actively part of the Environmental Management System (EMS) process. If not, this may be a way to gain recognition ($), at the installation command, for the needs of the ROD. Perhaps objectives and targets could eventually be developed for IR remedy issues.

15. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response: Dwight Leisle and Dianne Vogel

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
Type 1 Interview – Navy Personnel
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Mark L Kougl
Title: Remedial Project Manager
Organization: NAVFAC NW
Telephone: 360-396-0058
E-mail: mark.kougl@navy.mil
Address: 1101 Tautog Circle
Silverdale, WA 98312

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 9, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, and the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I am familiar with these RODs and the remedies in place, current monitoring and recent data trends for terrestrial OUs.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC?

   Response: They are nominally functional, considering the nature of facility operations. Ongoing study is and should continue to be undertaken to evaluate performance and potential for improved life-cycle performance.

3. To the best of your knowledge, did the improvements made to pavement and vegetative cover within the terrestrial operable units effectively meet the goals stated in the RODs, namely to reduce the potential for human contact with chemicals of concern in soil and to reduce the potential for infiltrating precipitation to transport chemicals to groundwater? Has on-going pavement maintenance been timely and effective? Please indicate the basis for your assessment of the paving improvements.

Response: Pavement upgrades do provide improved isolation of groundwater contamination and soil contact. They do not remove or treat the contamination. However, other mechanisms for groundwater contaminant transport/mobilization are currently of concern and under investigation. Pavement maintenance has not been effectively programmed and executed except by circumstance of other construction efforts. The yearly Remedy Inspection Reports provide the data and background for cap performance/maintenance.

4. To the best of your knowledge, did the storm drain cleaning and repairs carried out at OU NSC, OU B Terrestrial, and OU D effectively meet the ROD goal of reducing the potential for chemicals of concern to be discharged to Sinclair Inlet? Has on-going storm drain maintenance been timely and effective? Please indicate the basis for your assessment of the storm drain cleaning and repairs.

   Response: I have not been involved with storm drain performance.

5. To the best of your knowledge, did the shoreline stabilization at Site 1, the paved area south of Buildings 851 and 480, carried out as part of the remedy for OU B Marine effectively meet the ROD goal of controlling potential erosion of fill material to Sinclair Inlet? Please indicate the basis for your assessment of these shoreline measures.

   Response: The pavement cap does reduce exposure to the soil at this site. Rip-rap along the shoreline does provide protection from excessive erosion into Sinclair Inlet. Yearly remedy inspections provide evidence that these systems are in good condition. A large portion of this site was recently re-paved. No significant degradation of the rip-rap has been detected.

6. How aware are you of the ongoing studies of beach dynamics at Charleston Beach at OU A in response to repeated erosion of materials placed in the intertidal zone to enhance shoreline habitat? What is your impression of the short-term effectiveness of the actions to date in meeting the ROD goal of enhancing shoreline habitat? What are your thoughts about possible approaches for achieving this goal in the long term?

   Response: The current actions have provided an isolated pocket of habitat for surf smelt spawning. The success rate and survivability on this site is anecdotally effective but not supported by the sparse objective surveys to date. This solution requires continual monitoring and maintenance/replenishment to remain marginally effective. Currently, plans to revert to a durable and protective remedy are under consideration. The primary focus must be to protect human health and the environment. Mitigation should be considered for sites that can support more effective and sustainable lifespan. More sustainable mitigation measures are being considered.

7. To the best of your knowledge, did the sediment dredging and disposal, capping, and enhanced natural recovery included in the remedy for OU B Marine effectively meet the ROD goals of reducing the concentrations of PCBs in shallow sediments and removing sediments with high concentrations of mercury collocated with PCBs? Please indicate the basis for your assessment of these measures.

   Response: I have little knowledge of the evaluations for these measures.

8. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

   Response: I have little knowledge of this data and information.

9. Are you aware of any prior or pending land use or ownership changes since the signing of the RODs that may impact the effectiveness of any component of the selected remedies?

   Response: Only OU D was transferred to the City of Bremerton. OU D was created to accommodate that land transfer. Memorandum of Agreement discussions is currently underway between the Navy and the city. Preliminary investigation raises concerns about the effectiveness of remedy since the city has assumed responsibility of this site. Changes made within this NPL site have been performed with full participation of stakeholders and completion has provided the same level of protection or better.

10. Please describe any notifications that you are aware of that have been given to Navy personnel following signing of the RODs stating that the use of groundwater from beneath BNC is restricted. Are you aware of any use of groundwater from beneath the site?

    Response: There are statements informing site users of the groundwater restrictions in the Institutional Control Plan, Operation and Maintenance Plan, quitclaim deeds for OU D, Land Use Control instruction LUC NAVFASEKITSAPINST 5090.14 and work plans. To my knowledge, there is not currently any groundwater usage for other than environmental sampling and analysis.

11. To the best of your knowledge, do institutional controls and operation and maintenance practices in use at BNC meet the intent of the RODs regarding limiting the potential for contact with or movement of contaminants left in place, e.g. in connection with excavation management, petroleum management, and storm drain system monitoring and maintenance?

    Response: Yes, the process to obtain excavation permits, the prohibition of any excavation without excavation permits, a culture of oversight, security measures and base instructions all contribute to effective land use controls. Storm drain monitoring studies are ongoing. Maintenance, however, is currently difficult to budget and execute.

12. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedies been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

    Response: Yes. The program is effective through continual collection of data, inclusion of interested stakeholders and continual effort to adjust implementation according to analytical information.

13. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

    Response: OU A has some impact on a community led effort to create and ecologically friendly bike/walk path from Gorst to Bremerton.

14. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

    Response: Off-site contamination contributing to facility liability is largely un-identified and has an unknown effect on effective protection. Both co-mingled plumes of volatile organic compounds and undetermined underground storage tanks in the surrounding community leave some questions to this kind of impact. Dry dock pumping and geology influence groundwater flow from the surrounding community through this facility to Sinclair Inlet.

15. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response: No recommendations.

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
Type 1 Interview – Navy Personnel
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: John Pittz
Title: Navy Technical Representative (NTR)
Organization: Naval Facilities Engineering Command Northwest
Telephone: 360-396-0005
E-mail: john.pittz@navy.mil
Address: NAVFAC NW
Environmental Department
1101 Tautog Circle
Silverdale, WA 98315

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 3, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: I am very familiar with BNC, some knowledge of the RODs, and I conducted oversite of the contractor work performed at all of the sites.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC?

   Response: I feel the remedy implementation has been successful.

3. To the best of your knowledge, did the improvements made to pavement and vegetative cover within the terrestrial operable units effectively meet the goals stated in the RODs, namely to reduce the potential for human contact with chemicals of concern in soil and to reduce the potential for infiltrating precipitation to transport chemicals to groundwater? Has on-going pavement maintenance been timely and effective? Please indicate the basis for your assessment of the paving improvements.

Response: I believe the initial improvements made were quite good, but over time the facility has not been responsive enough in making repairs to pavement problems, as indicated in annual reports by the Long-Term Monitoring contractor. The same applies to vegetative covers, primarily in the OU-A area.

4. To the best of your knowledge, did the storm drain cleaning and repairs carried out at OU NSC, OU B Terrestrial, and OU D effectively meet the ROD goal of reducing the potential for chemicals of concern to be discharged to Sinclair Inlet? Has on-going storm drain maintenance been timely and effective? Please indicate the basis for your assessment of the storm drain cleaning and repairs.

   Response: I was involved in the oversight of the contractor that did the storm drain inspections and repairs and feel the repairs and cleaning did effectively reduce chemicals of concern from being discharged into Sinclair Inlet. It is uncertain if storm drain repairs have been maintained in a timely manner. Many times the LTM contractor cannot access manhole covers for inspection due to items stored upon the cover and the "owner" of the material cannot be ascertained in order to get material moved to gain access. The BNC as old as it is, I feel a facility-wide upgrade of the entire infrastructure is needed to keep it working properly for the next 100 years.

5. To the best of your knowledge, did the shoreline stabilization at Site 1, the paved area south of Buildings 851 and 480, carried out as part of the remedy for OU B Marine effectively meet the ROD goal of controlling potential erosion of fill material to Sinclair Inlet? Please indicate the basis for your assessment of these shoreline measures.

   Response: As NTR of the facility, I have had several occasions to observe the shoreline stabilization at Site 1. I conducted oversight of the contractor performing the work. I feel it is working as designed, but in a few more years may require additional stabilization material to be placed.

6. How aware are you of the ongoing studies of beach dynamics at Charleston Beach at OU A in response to repeated erosion of materials placed in the intertidal zone to enhance shoreline habitat? What is your impression of the short-term effectiveness of the actions to date in meeting the ROD goal of enhancing shoreline habitat? What are your thoughts about possible approaches for achieving this goal in the long term?

   Response: I have been the NTR on all Charleston Beach work since the installation of the sheet pile wall. All of the temporary fixes have failed, because they need to be constantly repaired or replenished. I feel the only long-term fix would be for the sheet pile wall to be extended to the rip-rap jetty to the West end of Charleston Beach, then place rip-rap from near the top to the toe of the sheet pile, at the same slope as other shoreline restoration in

the area, to prevent future erosion. That should maintain the intregrity of the landfill cap (paved lot) and keep any landfill material from escaping. I also feel removal of some of the rip-rap jetty should be looked at to possibly reduce scouring at the West end of Charleston Beach and displacement of the fish mix. I'm told by knowledgeable persons that Surf Smelt do not do well at spawning in hot (direct sunlight) locations, of which Charleston Beach is. I'm told the Port Orchard side of the inlet is much more productive. Is it financially sound to keep replacing the fish mix at Charleston Beach every couple of years for such a low producing area? Strictly looking at the use of my tax dollars, I feel it is not a sound investment.

7. To the best of your knowledge, did the sediment dredging and disposal, capping, and enhanced natural recovery included in the remedy for OU B Marine effectively meet the ROD goals of reducing the concentrations of PCBs in shallow sediments and removing sediments with high concentrations of mercury collocated with PCBs? Please indicate the basis for your assessment of these measures.

   Response: I performed backup oversight on the project for a very short time during the final stages of the installation of the cap. I feel the dredging for the cap removed most, if not all, heavy concentrations of PCBs and the CAD has contained, after an adjustment, the disposed waste effectively. Port Operations at BNC has done an excellent job of ensuring no vessels drop anchor in the area of the CAD.

8. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

   Response: I have been personally involved in the USGS study and contractor sampling events over the years. I do believe or shoreline restoration and other remedies have been effective. I personally, feel that much of the Mercury is likely to be coming from outside the BNC fence line.

9. Are you aware of any prior or pending land use or ownership changes since the signing of the RODs that may impact the effectiveness of any component of the selected remedies?

   Response: Yes. After the Navy completed the vegetative cap. at considerable expense, at the OU-D area, the property was transferred to the City of Bremerton for a park. One week after the transfer, the entire cap was

gone and the entire site was dirt, without any erosion control measures in place. The Navy did not remove all contaminated soil because it was going to be capped. I have seen the City excavate into suspected contaminated soil and remove it from the site to be used at another construction site.

10. Please describe any notifications that you are aware of that have been given to Navy personnel following signing of the RODs stating that the use of groundwater from beneath BNC is restricted. Are you aware of any use of groundwater from beneath the site?

    Response: I personally conduct Use of Groundwater Interviews when I do an Excavation Permit Interview of contractors and Public Works do any ground-disturbing activity below 6".

11. To the best of your knowledge, do institutional controls and operation and maintenance practices in use at BNC meet the intent of the RODs regarding limiting the potential for contact with or movement of contaminants left in place, e.g. in connection with excavation management, petroleum management, and storm drain system monitoring and maintenance?

    Response: The IC and OM controls at BNC, per the RODs, are sufficient. The problem arises when they are not strictly enforced. It appears the facility has left much of the "enforcement" to be conducted by NAVFAC NW.

12. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedies been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

    Response: I have observed several Long-Term Monitoring contractors at BNC, since the RODs were approved. Each performed inspections of pavement and vegetative caps and each made reports of the results of the inspections to the Navy. It seems when the information is passed along to BNC, it is ignored or placed on the back burner for later. I have personally seen asphalt alligator cracks go from hairline to ¾" – 1" wide and clearly deeper than the asphalt thickness. It may take several years before the cracks are resealed or a seal coat placed over large areas.

13. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

    Response: None that I am aware of.

14. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

Response: I think I've already stated my concerns and/or suggestions.

15. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

    Response: List appears quite complete to me.

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
Type 1 Interview – Navy Personnel
Bremerton Naval Complex
Bremerton, WA

Individual Contacted: Mark Wicklein
Title: Remedial Project Manager (RPM)
Organization: NAVFAC NW
Telephone: 360-396-0226
E-mail: mark.wicklein@navy.mil
Address: 1101 Tautog Circle, Silverdale, WA 98315

Contact made by: E-mail
Response type: Personally answered by interviewee, returned via e-mail
Date: December 5, 2011

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Bremerton Naval Complex (BNC), the Records of Decision (RODs) for OU NSC, OU A, OU B Marine, OU B Terrestrial, and OU D, the implementation of the remedies at these operable units, and the monitoring and maintenance that has taken place since implementation of the remedies.

   Response: Some. I have been RPM for OUB Marine since July 2011.

2. What is your overall impression of the remedy implementation following signing of the RODs at the five operable units at BNC?

   Response: For OUB Marine, the remedy has been implemented as presented in the ROD. An active remedy was performed and periodic monitoring is occurring with input from stakeholders.

3. To the best of your knowledge, did the improvements made to pavement and vegetative cover within the terrestrial operable units effectively meet the goals stated in the RODs, namely to reduce the potential for human contact with chemicals of concern in soil and to reduce the potential for infiltrating precipitation to transport chemicals to groundwater? Has on-going pavement maintenance been timely and effective? Please indicate the basis for your assessment of the paving improvements.

   Response: None.

4. To the best of your knowledge, did the storm drain cleaning and repairs carried out at OU NSC, OU B Terrestrial, and OU D effectively meet the ROD goal of reducing the potential for chemicals of concern to be discharged to Sinclair Inlet? Has on-going storm drain maintenance been timely and effective? Please indicate the basis for your assessment of the storm drain cleaning and repairs.

   Response: None.

5. To the best of your knowledge, did the shoreline stabilization at Site 1, the paved area south of Buildings 851 and 480, carried out as part of the remedy for OU B Marine effectively meet the ROD goal of controlling potential erosion of fill material to Sinclair Inlet? Please indicate the basis for your assessment of these shoreline measures.

   Response: None.

6. How aware are you of the ongoing studies of beach dynamics at Charleston Beach at OU A in response to repeated erosion of materials placed in the intertidal zone to enhance shoreline habitat? What is your impression of the short-term effectiveness of the actions to date in meeting the ROD goal of enhancing shoreline habitat? What are your thoughts about possible approaches for achieving this goal in the long term?

   Response: None.

7. To the best of your knowledge, did the sediment dredging and disposal, capping, and enhanced natural recovery included in the remedy for OU B Marine effectively meet the ROD goals of reducing the concentrations of PCBs in shallow sediments and removing sediments with high concentrations of mercury collocated with PCBs? Please indicate the basis for your assessment of these measures.

   Response: Yes. The active remedy was installed as planned. Periodic monitoring is indicating a steady or declining contaminant trend for PCBs.

8. In the 2007 5-year review, the protectiveness statement for OU B Marine was deferred pending additional data collection and interpretation regarding both PCBs and mercury. Since that time several additional studies have been conducted, including Navy-funded studies by USGS and the Corps of Engineers. These studies are on-going. Please provide your perspective regarding the risks attributable to mercury in Sinclair Inlet, and whether there are outstanding mercury source control issues that still need to be addressed. What is your opinion regarding the progress towards a protectiveness statement for the OU B Marine remedy?

Response: Since the OUB Marine ROD was executed, additional information has been collected, and a human health risk assessment completed which suggests that not only PCBs, but mercury as well, are contaminants of concern. However, there are relatively few data points and there is uncertainty with the data. Additional data needs to be collected to reflect current conditions in Sinclair Inlet and reduce uncertainties associated with the data that was used for the HHRA. This will ensure the Navy has sufficient and accurate data: 1) to evaluate site risks; 2) to determine whether we need to do additional work to reduce mercury risk, and 3) to accurately measure, during after action monitoring, whether progress\improvements have been made from the baseline in reducing mercury risk.

9. Are you aware of any prior or pending land use or ownership changes since the signing of the RODs that may impact the effectiveness of any component of the selected remedies?

   Response: None.

10. Please describe any notifications that you are aware of that have been given to Navy personnel following signing of the RODs stating that the use of groundwater from beneath BNC is restricted. Are you aware of any use of groundwater from beneath the site?

    Response: None.

11. To the best of your knowledge, do institutional controls and operation and maintenance practices in use at BNC meet the intent of the RODs regarding limiting the potential for contact with or movement of contaminants left in place, e.g. in connection with excavation management, petroleum management, and storm drain system monitoring and maintenance?

    Response: None.

12. To the best of your knowledge, has the on-going program of environmental monitoring at BNC following implementation of the remedies been sufficiently thorough and frequent to meet the goals of the RODs? Please indicate the basis for your assessment.

    Response: The frequency and extent of the monitoring program at BNC is an on-going process. The Navy solicits and incorporates input, as appropriate, from stakeholders into the monitoring process and because of this consultation, the monitoring has been sufficiently thorough.

13. Are you aware of any community concerns regarding implementation of the remedies at BNC? If so, please give details.

    Response: None.

14. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented to protect human health and the environment at the Bremerton Naval Complex?

Response: None.

15. Please review the attached lists of interviewees for the five-year review. Are there other individuals you feel we should contact? If so, please provide their name, title, and contact information if you have it.

Response: None.