FINAL
8 October 2010

Third Five-Year Review

Naval Base Kitsap Bangor
Silverdale, 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 Naval Base Kitsap (NBK) Bangor, the U.S. Navy has completed the third 5-year review of remedial actions 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 (NCP) (40 CFR Part 300). The purpose of this 5-year review is to ensure that the remedial actions selected in the Records of Decision (RODs) for operable units (OUs) at NBK Bangor remain protective of human health and the environment. A 5-year review is required because the remedies allow contaminants to remain in place at concentrations that do not allow unlimited site use and unrestricted exposure. This third 5-year review was prepared in accordance with *Navy/Marine Corps Policy for Conducting Environmental Response, Compensation, and Liability Act (CERCLA) Statutory Five-Year Reviews* (May 2004) and the U.S. Environmental Protection Agency's *Comprehensive Five-Year Review Guidance* (OSWER 9355.7-03B-P, June 2001).

The remedies implemented for NBK Bangor remain protective of human health and the environment in the short term. In order for the remedies at OU 1, OU 2, and OU 8 to remain protective in the long term, follow-through on the recommendations identified during this 5-year review is needed, as listed on the Five-Year Review Summary Form.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Bangor Naval Submarine Base

EPA ID *(from WasteLAN)*: 110000771219

Region: 10	**State:** WA	**City/County:** Kitsap

SITE STATUS

NPL status: Final **X** Deleted Other (specify)________________

Remediation status (choose all that apply): Under Construction Operating **X** Complete **X**

Multiple OUs?* YES **X** NO	**Construction completion date:** September 1997 (OU 1)

Has site been put into reuse? YES NO **X**

REVIEW STATUS

Lead agency: EPA State Tribe Other Federal Agency: Navy

Author name: Raymond Kobeski

Author title: Remedial Project Manager	**Author affiliation:** NAVFAC NW

Review period:** September 2005 to December 2009

Date(s) of site inspection: September 8, 2009

Type of review:
Post-SARA Pre-SARA NPL-Removal only
Non-NPL Remedial Action Site NPL State/Tribe-lead
Regional Discretion

Review number: 1 (first) 2 (second) 3 (third) Other (specify)________________

Triggering action:
Actual RA Onsite Construction at OU#____ Actual RA Start at OU
Construction Completion Previous Five-Year Review Report
Other (specify):________________

Triggering action date *(from WasteLAN)*: October 24, 2005

Due date *(five years after triggering action date)*: 10/24/2010

*["OU" refers to operable unit.]

**[Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (Cont'd)

Issues:

Operable Units (OUs) 1 and 2

- Labels on valves, treatment equipment, and other components of the Sites A and F treatment systems reflect historical, rather than current, system operation. This creates the potential for error during system operation.
- There is no mechanism to gauge the flow rate from individual extraction wells.
- Treatment system operation, maintenance, and monitoring (OM&M) data for Sites A and F are difficult to locate within consistently titled periodic reports.
- The U.S. Environmental Protection Agency (EPA) is currently reevaluating the RDX cancer slope factor, and changes to this slope factor could affect the protectiveness of Sites A and F.

Operable Unit 1

- The potential contaminant contribution to the shallow aquifer from the perched aquifer and residual soil contamination is unclear, as is the quantity of contaminant mass removed from the shallow aquifer by the pump and treat system as compared to natural attenuation.
- The Site A groundwater treatment system is not functioning as intended by the Record of Decision (ROD).
- The thorny brush meant to discourage access to Debris Area 2 is insufficient for its intended purpose.

Operable Unit 2

- The Site F groundwater treatment system is not functioning as intended by the ROD.
- The Site F groundwater plume has expanded beyond the area of institutional controls (ICs). The concentration trend at F-MW67, which is beyond the limits of the extraction system containment, is increasing.
- The containment assessment for Site F does not explicitly consider Otto fuel at Site E/11.
- The current groundwater monitoring program does not take into account the higher cleanup levels that would be calculated today for some compounds.
- Six of the OU 2 chemicals of concern (COCs) are not regularly summarized in the long-term monitoring (LTM) reports and may not need to be part of the LTM program any longer.

Operable Unit 3

- Results of the EPA evaluation for arsenic could impact OU 3. If, as anticipated, the cleanup level for arsenic decreases significantly, the ICs for OU 3 should be reviewed and potentially made more rigorous if arsenic is actually present above local background levels.
- Groundwater ICs do not appear to be necessary at OU 3.

Operable Unit 6

- Five-year reviews may no longer be necessary for Site D.

Operable Unit 7

- Five-year reviews are no longer necessary for Sites 2 and 26.

Five-Year Review Summary Form (Cont'd)

Operable Unit 8

- Benzene concentrations in the core of the plume at OU 8 exhibit an increasing trend over at least the last 4 years, and free product is again observed in one monitoring well.
- The OU 8 remedy is taking longer to meet the remedial action objectives than anticipated in the ROD.
- There is the potential for vapor intrusion into buildings above the volatile organic compound (VOC) plume at OU 8.
- Documentation of COC concentrations remaining in soil following removal actions is not readily available, preventing review of whether residual COC concentrations in soil are protective of groundwater.

General

- The current Institutional Controls Management Plan (ICMP) has outdated field checklists and figures, and shoreline monitoring needs to be reviewed for possible enhancements.
- The draft Notice of Intent to Delete for soils at Sites A, D, E, F, 2, 11, and 26 has not yet been issued by EPA.
- The Mann-Kendall analysis currently being used to evaluate trends may not be the best available method given the data sets available.

Recommendations and Follow-up Actions:

Operable Units 1 and 2

- Update the labeling of valves, treatment equipment, and other components of the Sites A and F treatment systems to reduce the potential for error in system operation.
- If pump and treat will continue in the long term and if it is feasible, consider including individual extraction well line flow totalizers to enhance functionality assessments.
- Title the annual reports that include both monitoring and treatment system operation data "*year* Operations, Maintenance, and Monitoring Report."
- Monitor EPA's reevaluation of the RDX cancer slope factor and reassess the protectiveness of Sites A and F when the reevaluation is complete.

Operable Unit 1

- Update the conceptual site model to portray the latest understanding of contaminant inputs from residual soil and perched aquifer contamination and contaminant removal from natural attenuation and pump and treat.
- Complete the assessment of an alternative remedy to the current treatment system, and take action based on the results of the assessment.
- Plant additional thorny bushes to discourage access to Debris Area 2, or fence the area.

Operable Unit 2

- Complete the ongoing assessment and optimization of the Site F treatment system to address containment issues, downgradient plume extent, and the portion of the plume downgradient of the current capture zone. Include an assessment of the capture and treatment of Otto fuel from Site E/11.
- Expand the IC boundary for Site F to cover the larger area of the groundwater plume.

Five-Year Review Summary Form (Cont'd)

- Review the groundwater analytical program at OU 2, considering the higher cleanup levels that would be calculated today for some compounds, and update the monitoring plan based on the results.
- Review the analytical results for the six OU 2 COCs not regularly summarized in the LTM reports against their ROD remediation goals (RGs) and potential cleanup level changes to evaluate whether the LTM program should continue to analyze groundwater for these chemicals. Revise the OU 2 LTM program based on the conclusions.

Operable Unit 3

- Track EPA's reevaluation of arsenic toxicity and evaluate the need for changes to ICs for soil at OU 3 if arsenic concentrations in soil are confirmed to be above background levels. Revise the ICMP based on the conclusions.
- Evaluate OU 3 based on current and historical groundwater monitoring data to determine if groundwater ICs can be removed. Revise the ICMP based on the conclusions.

Operable Unit 6

- Collect and analyze soil and sediment samples for 2,4-dinitrotoluene to evaluate whether current concentrations meet the Method B level. Based on the results, consider discontinuing 5-year reviews at OU 6.

Operable Unit 7

- Discontinue 5-year reviews at Sites 2 and 26.

Operable Unit 8

- Implement the currently planned pilot testing to evaluate potential additional contingent remedial actions at OU 8 to address the slower-than-anticipated remediation progress of the selected remedy, the increasing benzene concentrations, and the return of free product.
- Perform an investigation of the vapor intrusion pathway within the Public Works Industrial Area of OU 8 following completion of the current pilot testing program. If the use of the buildings located above the COC plume in groundwater changes, accelerate the vapor intrusion investigation.
- Obtain documentation of COC concentrations remaining in soil following removal actions, assess whether residual COC concentrations in soil are protective of groundwater, and update the OU 8 conceptual site model accordingly.

General

- Revise the ICMP to include updated field checklists and figures and an enhanced shoreline monitoring procedure.
- Prepare draft Notice of Intent to Delete for soils at Sites A, D, E, F, 2, 11, and 26.
- Evaluate alternative methods for analyzing data trends.

Protectiveness Statement(s):

The remedies implemented for Naval Base Kitsap (NBK) Bangor remain protective of human health and the environment in the short term. At many of the sites and OUs at NBK Bangor, remedial actions have resulted in COC concentrations below the RGs for specific media. Where RGs have not been met, active remediation systems, OM&M programs, and ICs serve to make progress toward meeting RGs and to control exposure pathways in the interim.

Five-Year Review Summary Form (Cont'd)

For the remedy at OU 1 (Site A), the monitored natural attenuation evaluation should continue to determine if it is appropriate. For the remedy at OU 2 (Site F), further evaluation is warranted to assess the degree of loss of plume containment and options for reestablishing plume containment.

For the remedy at OU 8, the potential for vapor intrusion should be evaluated in buildings located above the known extent of the VOC plume.

Other Comments: None.

Signature sheet for the Naval Base Kitsap Bangor third five-year review report.

M. Olson Captain, U.S. Navy Commanding Officer, Naval Base Kitsap	Date

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TABLES

ABBREVIATIONS AND ACRONYMS

ACM	asbestos-containing material
ARAR	applicable or relevant and appropriate requirement
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
DCA	dichloroethane
DCE	dichloroethene
DCLP	Determination of Cleanup Level Plan
DDT	dichlorodiphenyltrichloroethane
demil	demilitarization
DNB	dinitrobenzene
DNT	dinitrotoluene
Ecology	Washington State Department of Ecology
EDB	dibromoethane
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EVO	emulsified vegetable oil
FFA	Federal Facilities Agreement
FS	feasibility study
ft	foot
GAC	granular activated carbon
gpm	gallon per minute
IC	institutional control
ICMP	Institutional Controls Management Plan
I&M	inspection and maintenance
IRA	interim remedial action
IRIS	Integrated Risk Information System
K/B	Keyport/Bangor
LNAPL	light nonaqueous-phase liquid
MCL	maximum contaminant level
µg/L	microgram per liter
mg/kg	milligram per kilogram

ABBREVIATIONS AND ACRONYMS (Continued)

mg/kg-day	milligram per kilogram per day
mg/kgoc	milligram per kilogram corrected for organic carbon content
mg/L	milligram per liter
mg/m^3	milligram per cubic meter
MNA	monitored natural attenuation
MSL	mean sea level
MTCA	Model Toxics Control Act
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFAC NW	Naval Facilities Engineering Command Northwest
Navy	U.S. Navy
NBK	Naval Base Kitsap
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NWTPH-Dx	Northwest Total Petroleum Hydrocarbon—Diesel
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGDN	propylene glycol dinitrate
PQL	practical quantitation limit
PRG	preliminary remediation goal
PSEP	Puget Sound Estuary Program
PWIA	Public Works Industrial Area
RAB	Restoration Advisory Board
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
redox	oxidation reduction potential
RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
RSL	Residential Screening Level
SMS	sediment management standards
SQS	sediment quality standards
SVE	soil vapor extraction
SVOC	semivolatile organic compound

ABBREVIATIONS AND ACRONYMS (Continued)

TNB	trinitrobenzene
TNT	trinitrotoluene
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
UST	underground storage tank
UV/Ox	ultraviolet/oxidation
UXO	unexploded ordnance
VOC	volatile organic compound
WAC	Washington Administrative Code
WET	whole effluent toxicity

1.0 INTRODUCTION

This report presents the results of the third 5-year review performed for the Naval Base Kitsap (NBK) Bangor National Priorities List (NPL) site, more commonly known simply as NBK Bangor. The purpose of 5-year reviews is to determine whether the remedies selected for implementation in the Records of Decision (RODs) for a site are 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 any issues found during the review and provide recommendations to address them. This report was prepared using U.S. Navy (Navy) and U.S. Environmental Protection Agency (EPA) guidance (U.S. Navy 2004a and USEPA 2001).

The Navy, the lead agency for NBK Bangor, has prepared this 5-year review report 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). The RODs documenting the remedies implemented at NBK Bangor were signed after October 17, 1986. Therefore, this is considered a statutory, rather than a policy, review. 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.

The Navy's Naval Facilities Engineering Command Northwest (NAVFAC NW) has conducted this 5-year review of the remedial actions implemented at NBK Bangor. This review evaluated data over the period September 2005 to December 2009. This report documents the results of the review.

There are eight operable units (OUs) at NBK Bangor (Figures 1-1 and 1-2, located at the end of Section 1). This report covers the remedies selected in the signed RODs for OUs 1, 2, 3, 6, 7, and 8 (U.S. Navy, USEPA, and Ecology 1991a, 1994a, 1994c, 1994d, 1996, and 2000a). Pursuant to the RODs for these OUs, contaminants were left in place above levels that allow for unrestricted use and unrestricted exposure. No further action was recommended for OUs 4 and 5

(U.S. Navy, USEPA, and Ecology 1993 and 1994b), and, therefore, these OUs are not addressed in this report.

This is the third 5-year review for NBK Bangor. The triggering action for this review was the completion of the second 5-year review in September 2005 (U.S. Navy 2005a).

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Legend:

❷ Location of Site

U.S.NAVY	**Figure 1-1** **NBK Bangor Vicinity Map**	NBK Bangor THIRD 5-YEAR REVIEW

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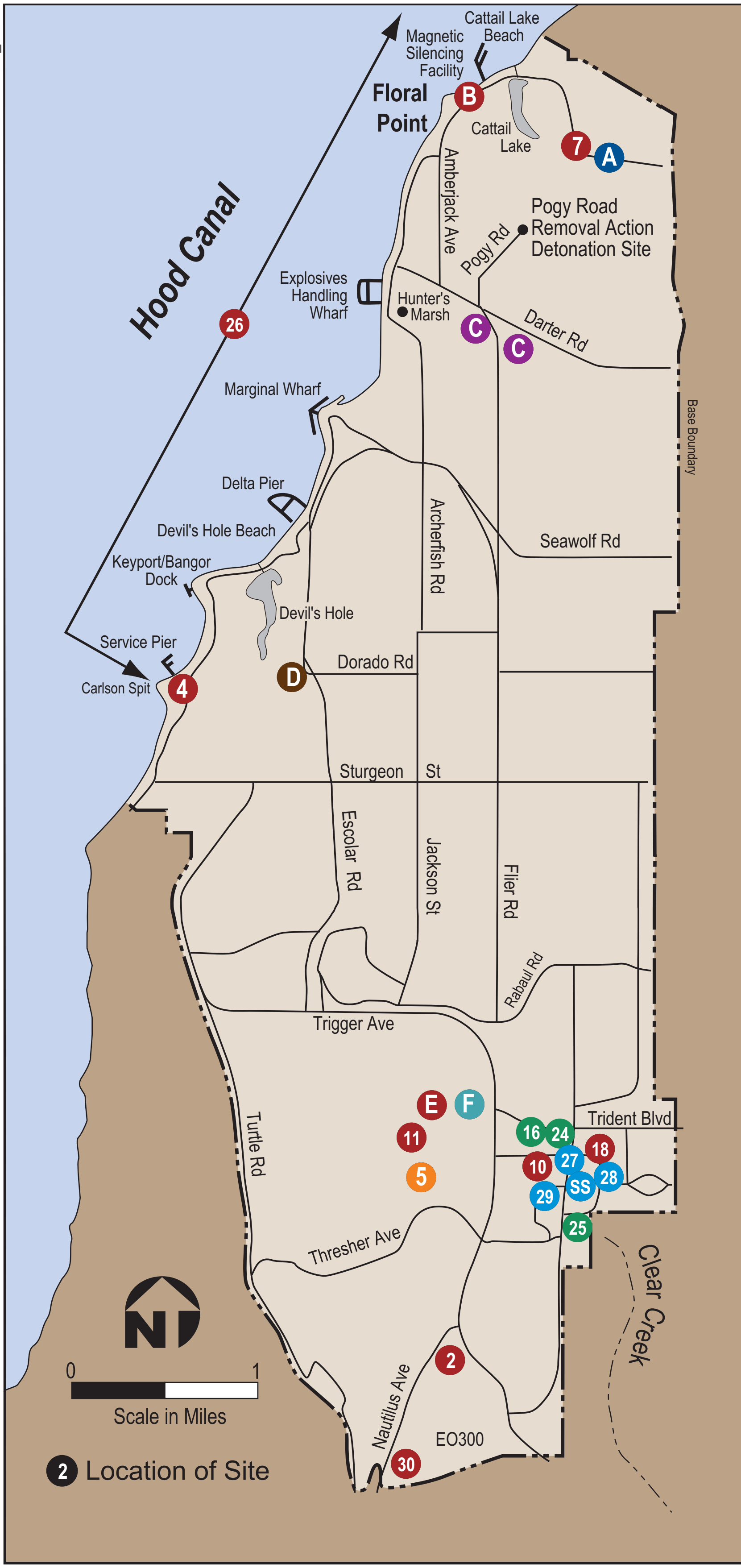

OPERABLE UNIT 1 (OU 1)
Site A Bangor Ordnance Disposal Site

OPERABLE UNIT 2 (OU 2)
Site F Former Wastewater Location

OPERABLE UNIT 3 (OU 3)
Site 16 Drum Storage Area
Site 24 Former Incinerator Site
Site 25 Former Treatment Plant Outfall

OPERABLE UNIT 4 (OU 4 - No Further Action)
Site C-West Bldg 7700 Fill Area
Site C-East Ordnance Wastewater Disposal Area

OPERABLE UNIT 5 (OU 5 - No Further Action)
Site 5 Former Metallurgy Lab Rubble

OPERABLE UNIT 6 (OU 6)
Site D Munitions Burn Area

OPERABLE UNIT 7 (OU 7)
Site B Floral Point
Site E Acid Disposal Pit
Site 2 Classification Yard/ Fleet Deployment Parking
Site 4 Carlson Spit
Site 7 Old Paint Can Disposal Site
Site 10 Pesticide Storage Quonset Huts
Site 11 Pesticide/Herbicide Drum Disposal Area
Site 18 PCB Spill Site
Site 26 Hood Canal Sediments
Site 30 Railroad Tracks

OPERABLE UNIT 8 (OU 8)
Site 27 Steam Cleaning Pit
Site 28 Paint Shop Drainage Ditch
Site 29 Public Works Maintenance Garage
SS Public Works Industrial Area Service Station

EO300 Small Arms Ranges

U.S.NAVY	**Figure 1-2** **NBK Bangor Sites and Operable Units**	NBK Bangor THIRD 5-YEAR REVIEW

2.0 SITE CHRONOLOGY

Table 2-1 (located at the end of Section 2) lists the substantive events in the chronology of NBK Bangor related to site discovery, investigation, and remediation.

Naval activities began at NBK Bangor in June 1944, when the U.S. Naval Magazine, Bangor was established. From 1944 to the early 1970s, the Navy facility at Bangor was primarily used as a transshipment and storage point for ordnance. Ordnance arrived by train and ship to support U.S. military efforts. In February 1977, NBK Bangor was commissioned as the West Coast home port for the Trident Submarine Launched Ballistic Missile System.

In 1978, the Navy Assessment and Control of Installation Pollutants (NACIP) program was initiated, and waste disposal sites at NBK Bangor were evaluated under this program. Additional investigation was completed as part of the initial assessment study (NEESA 1983) and characterization studies (U.S. Navy 1988 and 1989). In all, 42 areas were identified for investigation of possible hazardous substances in various environmental media. Of those 42 areas, 20 were subsequently determined to present no concern. The remaining 22 were carried forward for further investigation. These 22 sites are variously designated by either letter designations (e.g., “Site A”), or numerical designations between 2 and 30 (e.g., “Site 25”).

NBK Bangor is listed twice on EPA’s National Priorities List (NPL) for investigation and, if necessary, cleanup of past waste disposal sites. Site A (OU 1) was listed on the NPL in July 1987, and the rest of the sites were listed in August 1990. In January 1990, the Navy, EPA, and Washington State Department of Ecology (Ecology) entered into a Federal Facilities Agreement (FFA). In the FFA, the 22 sites at NBK Bangor were divided into 8 OUs for management purposes. Figure 1-2 (located at the end of Section 1) depicts the locations of the 22 sites and lists the division of the sites into their respective OUs. In October 1994, OU 8 was added to the FFA to include Sites 27, 28, and 29, which were originally investigated as part of OUs 3 and 7, and the Public Works Industrial Area (PWIA) service station.

The dates that the RODs for the NBK Bangor OUs were signed are as follows:

- OU 1: December 1991 (U.S. Navy, USEPA, and Ecology 1991a)
- OU 2: September 1994 (U.S. Navy, USEPA, and Ecology 1994d)
- OU 3: April 1994 (U.S. Navy, USEPA, and Ecology 1994a)
- OU 4: July 1994 (U.S. Navy, USEPA, and Ecology 1994b)
- OU 5: September 1993 (U.S. Navy, USEPA, and Ecology 1993)
- OU 6: September 1994 (U.S. Navy, USEPA, and Ecology 1994c)
- OU 7: April 1996 (U.S. Navy, USEPA, and Ecology 1996)
- OU 8: September 2000a (U.S. Navy, USEPA, and Ecology 2000a)

In April 2008, the Navy published and submitted to EPA a partial remedial action completion report for soils at various NBK Bangor OUs (U.S. Navy 2008c). This document was to be used as supporting documentation for a Notice of Intent to Delete for the partial delisting of NBK Bangor soils from the NPL. At the time of this 5-year review, the Notice of Intent to Delete had not been issued by EPA.

Table 2-1
Chronology of Key Events—Operable Units 1 Through 8

Event	Completion Dates by Operable Unit (OU)							
	OU 1	**OU 2**	**OU 3**	**OU 4**	**OU 5**	**OU 6**	**OU 7**	**OU 8**
Discovery	Aug-79	Dec-87	Dec-87	Dec-87	Dec-87	Dec-87	Dec-87	Dec-87
Preliminary assessment	Sept-84	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88
Site inspection	Sept-84	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88	Nov-88
Hazard ranking system package	Sept-84	Jun-89	Jun-89	Jun-89	Jun-89	Jun-89	Jun-89	Jun-89
National Priorities List (NPL) listing	Jul-87	Aug-90	Aug-90	Aug-90	Aug-90	Aug-90	Aug-90	Aug-90[a]
Remedial investigation/feasibility study	Aug-91	Nov-93	Apr-93	May-93	Dec-92	Dec-93	Oct-94	Apr-00
Record of Decision	Dec-91	IRA: Sept-91 FRA: Sept-94	Apr-94	Jul-94	Sept-93	Sept-94	Apr-96	Sept-00
Explanation of Significant Differences	No. 1: Jul-94 No. 2: Mar-98 No. 3: Jul-00	Jul-94[b]	None	None	None	None	None	None
Remedial action construction	Soil: Sept-97 GW: Nov-97	IRA: Dec-94 Soil: Dec-97 GW (FRA): Jan-97	None	None	None	Dec-97	Site B: Nov-97 Site E/11: Aug-97 Site 2: Dec-95	Apr-01
Remedial action operations and monitoring	Soil: Nov-99 GW: ongoing	Soil: Oct-98 GW: ongoing	Site 16/24 ICs: ongoing Site 25 GW: Sept-99	None	None	Dec-97	Site B inspections: annually Site E/11 GW: ongoing Site 2 ICs: ongoing Site 10 GW: Mar-95, IC inspections annually Site 26 seds: 2004	MNA: Oct-00 to present LNAPL recovery: Jan-01 to June-04, annual IC inspections ORC: 2010
Memorandum to Administrative Record	NA	NA	NA	NA	NA	NA	Expansion of the Site 10 IC boundary (U.S. Navy 2008e)	NA

[a]Although the sites comprising OU 8 were listed on the National Priorities List in August 1990, OU 8 was added to the Federal Facilities Agreement in October 1994.
[b]For interim remedial action Record of Decision

Notes:
FRA - final remedial action
GW - groundwater
IC - institutional control
IRA - interim remedial action
LNAPL - light nonaqueous-phase liquid
MNA - monitored natural attenuation
NA - not applicable
ORC - Oxygen Release Compound
seds - sediments

3.0 BACKGROUND

NBK Bangor covers 7,201 acres on the Kitsap peninsula in Kitsap County, Washington, at a location on Hood Canal approximately 10 miles north of Bremerton. The Kitsap County Comprehensive Plan Land Use Map (Kitsap County 2007) lists land immediately surrounding NBK Bangor as rural residential (one dwelling unit per 5 acres). The following sections describe each of the OUs at NBK Bangor, including physical characteristics, land and resource use, the history of contamination, removal actions performed, and the basis for taking remedial action.

3.1 OU 1 (SITE A)

The 12-acre Bangor Ordnance Disposal site (Site A) is located in the northern portion of NBK Bangor. Land use immediately adjacent to the site is undeveloped forest land, with Cattail Lake downhill to the west and the off-base community of Vinland located approximately 2,000 feet to the north. Hood Canal, which borders NBK Bangor, is located to the west of Site A, Vinland, and Cattail Lake (Figure 3-1, located at the end of Section 3).

From 1962 to 1975, the Navy used Site A to detonate and incinerate various ordnance materials. Soil, surface water, and shallow groundwater were contaminated as a result of these activities. Municipal water supplies for Vinland are obtained from the deeper sea level aquifer, which has not been impacted by activities at Site A (U.S. Navy 1991).

Site A consisted of a burn area, Debris Areas 1 and 2, and a stormwater discharge area. The site originally consisted of burn mounds, facilities for personnel, fire suppression vehicles and equipment, an incinerator for ammunition, and a blast pit for ordnance detonation. Buildings at the site were demolished and burned on site in 1977. Grading and redistribution of soil at the Site A burn area continued through 1984. In 1983, the Navy constructed a stormwater diversion structure to convey surface water discharges from the Site A burn area to Hood Canal to minimize the potential of contamination to Vinland (U.S. Navy 1991).

Groundwater of interest occurs in two zones at Site A. The first is the perched zone, which occurs within a localized deposit of recessional outwash extending from ground surface to depths of 20 feet. When present seasonally, the perched zone is encountered at depths typically ranging from 10 to 20 feet below grade. The perched water sits upon lower permeability glacial till, which separates the perched zone from the underlying shallow aquifer. The shallow aquifer at Site A is an unconfined aquifer occurring within the stratified sand/silt deposits underlying the till (groundwater surface at depths of 70 to 90 feet below the burn area). Groundwater in the shallow aquifer beneath the former burn area flows toward the west-northwest, with discharge to the Cattail Lake drainage (U.S. Navy 1991).

The remedial investigation (RI) included the collection and chemical analysis of surface and subsurface soil, groundwater, surface water, marine sediment, and fish and shellfish tissue to characterize the nature and extent of contamination at the site. The risk assessment concluded that contaminants in groundwater in the shallow aquifer beneath the burn area and in soil in the burn area and Debris Area 2 pose an unacceptable risk to human health, assuming residential site use. The contaminant plume in the shallow aquifer extends from beneath the leach basin to approximately 250 feet downgradient (roughly west) of the western edge of the leach basin.

For the burn area, the primary chemicals of concern (COCs) driving remediation were 2,4,6-trinitrotoluene (2,4,6-TNT), 2,6-dinitrotoluene (2,6-DNT), and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in the soil and groundwater. In addition to the three ordnance compounds, phthalates were identified as chemicals of potential concern (COPCs) in groundwater and were included on a cleanup level table in the ROD. However they were not risk drivers and have not been included in the long-term monitoring at the site (see Sections 4.1 and 7.2). In the RI summary table of water data (including groundwater, seeps, Vinland Creek, and Cattail Lake, although the majority is groundwater data) results for the phthalates were as follows:

- Di-n-butyl phthalate: 2 detections out of 73 samples
- Butyl benzyl phthalate: 0 detections out of 73 samples
- Di-n-octyl phthalate: 5 detections out of 73 samples
- Bis(2-ethylhexyl)phthalate (BEHP): 53 detections out of 73 samples (22 of the detections were "B" qualified, indicating the compound was present in the blank, and 11 detections were "E" qualified, indicating there were interferences in the samples and the value is estimated.)

On-site drinking water risks for BEHP were based on the maximum detected concentration in shallow groundwater of 28 µg/L (maximum was B qualified from well A-MW37). The average upgradient shallow groundwater BEHP concentration was 9 µg/L, and the maximum upgradient groundwater concentration was 23 µg/L, B qualified, from well A-MW21. Risks from drinking BEHP were 4×10^{-6}. Total groundwater risks were 3×10^{-4} from RDX (2×10^{-4}), 2,4,6-TNT (4×10^{-5}), 2,4-DNT (2×10^{-5}), and 2,6-DNT (1×10^{-5}). BEHP cancer risks were approximately 1 percent of the total cumulative risks. Based on the low risks, qualified data, and upgradient concentrations, phthalates do not appear to be a concern in groundwater for this area.

For Debris Area 2, polychlorinated biphenyls (PCBs) (human health risk) and lead (ecological risk) in soil were the COCs driving remediation.

No unacceptable risks were identified for Debris Area 1 or the stormwater discharge area, and therefore no COCs were established for these sites.

3.2 OU 2 (SITE F)

Site F (Figure 3-2, located at the end of Section 3), a former wastewater lagoon and overflow ditch, was used between approximately 1960 and 1970 for the disposal of wastewater produced during the demilitarization (demil) of ordnance items in the adjacent segregation facility building. Between approximately 1957 and 1978, the segregation facility's primary function was demil of ordnance items using steam cleaning and/or steam melt-out procedures. Prior to 1972, wastewater from the demil process was discharged into an unlined wastewater lagoon. The wastewater contained relatively high concentrations of TNT and RDX and lower concentrations of other explosive compounds. Much of the wastewater apparently infiltrated through the lagoon bottom. During periods of heavy discharge, wastewater overflowed the lagoon to a narrow ditch south of the lagoon. Periodically, the wastewater lagoon was allowed to drain, and waste materials at the surface of the lagoon were "burned off" in place or transported to Site A for burning and disposal. Beginning in 1972 to 1973, the lagoon was taken out of service and the wastewater was collected into barrels and delivered to the base liquid-waste incinerator (Sites 16/24).

In February 1972, 500 cubic feet of soil were excavated from the top several feet of the former lagoon and taken to Site A for burning. The former lagoon area was backfilled and covered with asphalt in 1980. Also in 1980, demil operations at the Bangor segregation facility were transferred to the Indian Island Annex. The buildings were subsequently decontaminated and converted to storage.

Ordnance contamination in soil was limited to the area of the former wastewater lagoon and overflow ditch. Beneath the former lagoon, the soil contamination extends to the groundwater surface approximately 50 feet below grade. Within the shallow aquifer, RDX extends approximately 4,900 feet downgradient from the former lagoon, whereas TNT and DNT are limited to within approximately 1,000 feet downgradient of the lagoon. The shallow aquifer is not used as a drinking water source for NBK Bangor. Ordnance contamination from Site F has not impacted the deeper sea level aquifer, which is a drinking water supply source on and off base. Periodic sampling of the drinking water supply wells shows no impact to the sea level aquifer.

Based on the risk assessment, contaminants in groundwater in the shallow aquifer and in soil beneath portions of the former wastewater lagoon and overflow ditch, pose an unacceptable risk to human health, assuming residential (unrestricted) site use.

The primary COCs driving remediation at Site F were TNT, RDX, and DNT in soil and TNT, RDX, DNT, and 1,3,5-trinitrobenzene (1,3,5-TNB) in groundwater. In addition, potential ecological risks to sensitive aquatic species were predicted at the discharge area for the shallow aquifer (seeps near the western base boundary) should ordnance contamination in shallow aquifer groundwater arrive there unremediated in the future.

3.3 OU 3 (SITES 16/24 AND 25)

OU 3, located in the southeastern portion of the base, consists of Sites 16, 24, and 25 (Figure 3-3, located at the end of Section 3). Sites 16 and 24 are the locations of former solid- and liquid-waste incinerators and a drum storage area. Because of their proximity, they are addressed together as Sites 16/24. Between 1973 and 1983, the liquid-waste incinerator reportedly burned demil wastewater from Site F, Otto fuel wastewater, and waste solvents. The solid-waste unit burned solid waste, including rags, sawdust, and protective clothing and carbon filters contaminated with Otto fuel. Both incinerators were deactivated and removed in 1983. Site 25, downgradient of Sites 16/24, is the location of a former sewage treatment plant outfall from the base's industrial area. Site 25 has since been regraded and currently consists of two stormwater detention ponds that discharge to Clear Creek.

The OU 3 risk assessment concluded that excess cancer and noncancer risks for Sites 16/24 and 25, assuming residential use, are within EPA's acceptable risk range. However, chemical concentrations in Sites 16/24 surface soil and Site 25 groundwater exceeded Washington State Model Toxics Control Act (MTCA) cleanup levels. The assessment also concluded that potential ecological risks posed by the sites are negligible, with the possible exception of the headwaters of Clear Creek's central branch (adjacent to Site 25), where some chemical concentrations exceeded state water and/or sediment quality criteria. Concentrations detected in water and sediment farther downstream were below their respective criteria or were comparable to background concentrations. Risks from COPCs in groundwater were also assessed and no unacceptable risk was found. This assessment constitutes an empirical demonstration that COPC concentrations in soil were protective of groundwater.

COCs driving remediation at Sites 16/24 were antimony and beryllium in soil. COCs driving remediation at Site 25 were cadmium and manganese in groundwater.

3.4 OU 6 (SITE D)

Site D is a former ordnance disposal area in the west-central portion of the base (Figure 3-4, located at the end of Section 3). Site D served as the principal area for burning, detonation, and possible burial of ordnance at NBK Bangor from 1946 until 1963 when these activities were transferred to Site A. Site D was used sporadically for ordnance disposal until approximately 1965. Waste disposal areas at Site D included a small arms incinerator, a burn trench, and smaller burn areas or mounds. Ordnance materials reportedly disposed of at Site D included explosive D (ammonium picrate) sludge, photo flash bombs and ammonium nitrate blocks, smokeless powder, black powder, rocket propellant, white phosphorus shells, compound B (TNT and RDX), amatol, and propulsion missile grains.

Much of Site D is seasonally wet, with the lower portion of the site beneath standing water during the wet season. Surface water enters the site from two ephemeral drainages and one perennial stream, becomes impounded by a railroad grade, and leaves the site via an ephemeral drainage to Devil's Hole Lake to the northwest. Groundwater from a perched zone also discharges to the site.

During the RI, samples of soil, freshwater sediment, groundwater, and surface water were collected for chemical analysis. TNT and DNT in surface soils were the primary COCs driving remediation at Site D, based on both human health and ecological risk.

3.5 OU 7 (SITES B, E, 2, 4, 7, 10, 11, 18, 26, AND 30)

OU 7 comprises 10 known or suspected waste sites (Sites B, E, 2, 4, 7, 10, 11, 18, 26, and 30) at locations across NBK Bangor. Figures 3-5 through 3-12 (located at the end of Section 3) show the locations of these 10 sites. Sites 27, 28, and 29 were originally part of OU 7, but were included in OU 8 in 1994 following the investigation of surrounding areas. Although not part of OU 7 as defined in the FFA, three lake or wetland areas (Cattail Lake, Hunter's Marsh, and Devil's Hole [Figure 1-2, located at the end of Section 1], collectively termed the Ecological Areas) were included for study with the 10 sites.

The OU 7 risk assessment concluded that conditions at Sites 4, 7, 18, 30, and the three Ecological Areas pose no unacceptable risks to human health (under an unrestricted use scenario) or the environment. The OU 7 ROD declared that no remedial action (and no institutional control [IC] or monitoring) is required for these sites/areas, and no 5-year review is required. Thus, they are not discussed further here.

The OU 7 ROD declared that four sites (B, E, 2, and 11) require remedial action and two sites (10 and 26) require no remedial action with monitoring, as described in the sections that follow. Sites E and 11 are addressed together as Site E/11.

3.5.1 Site B (Floral Point)

Site B (Floral Point) covers approximately 5 acres of natural shoreline along Hood Canal (Figure 3-5, located at the end of Section 3). Pyrotechnic testing was reportedly completed at Floral Point in the 1950s and 1960s. Black powder was also reportedly burned. Floral Point was also used for station dumping, including pit disposal, landfilling, and trash burning, from approximately 1950 to 1968. In 1966 to 1967, the site was also reportedly used for open burning of RDX and TNT residuals from Site F.

Floral Point has no surface water drainages, and groundwater beneath the shoreline site is saline (nonpotable) because of tidal mixing. The beach south of Floral Point is currently used by base personnel for shellfish harvesting and fishing every 3 to 5 years on a rotational basis with other base beaches. The beach at and north of Floral Point is not used for shellfishing because suitable sediment substrate is lacking.

The OU 7 risk assessment concluded that polycyclic aromatic hydrocarbons (PAHs) and PCBs in Site B soil pose an unacceptable cancer risk for an assumed future residential use, and metals pose a marginal hazard to sensitive ecological receptors. These two COCs in soil drove the remedial action at Site B.

3.5.2 Site E (Acid Disposal Pit) and Site 11 (Pesticide/Herbicide Drum Disposal Area)

Sites E and 11 are located in the south-central portion of the base (Figure 3-6, located at the end of Section 3). Site E was reportedly used as an acid disposal site for electroplating wastes and Otto fuel from 1960 to 1973. The materials were disposed of in an unlined pit. Site 11 is a pesticide/herbicide disposal area where, in 1968 or 1969, empty pesticide containers were buried between two barricaded railroad siding areas. The containers, which reportedly contained 2,4-dichlorophenoxyacetic acid, DDT, and Tordon, were reportedly triple rinsed and dried prior to burial. In 1992, a time-critical removal action was initiated at Site 11, during which 85 containers were removed along with approximately 400 cubic yards of soil containing pesticides. Soil excavated during this action was stockpiled on site. Sites E and 11 are contiguous, and there was concern that pesticide/herbicide drums may also have been disposed of at Site E. Therefore, the two sites are addressed together (Site E/11) in the OU 7 ROD.

Because of the presence of DDT, cancer risks of approximately 2 in 100,000 and 2 in 1,000,000 were estimated for the ingestion of stockpiled soil by assumed residents and industrial workers, respectively. The DDT in stockpiled soils also poses a marginal hazard to sensitive ecological receptors. Assuming site groundwater is used as a drinking water source, Otto fuel poses unacceptable cancer and noncancer risks to assumed future residents. RDX detected in the lower portion of the shallow aquifer at Site E/11 also contributes to the estimated drinking water risk, but is part of the Site F plume. Site soils (in place) pose no unacceptable risk under unrestricted site use.

The COCs driving remediation at Site E/11 were DDT in stockpiled soil (not in situ soil) and Otto fuel in groundwater.

3.5.3 Site 2 (Classification Yard/Fleet Deployment Parking)

Site 2 (Classification Yard/Fleet Deployment Parking) is located in a north-south-trending ravine between Nautilus and Trigger Avenues (Figure 3-7, located at the end of Section 3). Surface water from Site 2 flows through an artificial channel into Trident Lakes. Site 2 was divided into two subareas designated Sites 2A and 2B. Site 2A was a disposal area for small-caliber projectiles. Site 2B was an unauthorized disposal area with wastes including paint sludge, waste oil, and drums. A cleanup of surface debris at Site 2A was completed in 1986 and 1987. A removal action for debris and drums from Site 2B was completed in 1993. Soils excavated during this action were placed in two stockpiles on site, referred to as Containment Cell Nos. 1 and 2.

PCBs detected in stockpiled site soils resulted in an estimated cancer risk of approximately 1 in 100,000 for assumed future residents of the site. Site soils (in place) and site groundwater pose no unacceptable risk under unrestricted site use. The OU 7 ROD states that no chemical was detected in in situ soil above background concentrations or applicable or relevant and appropriate requirements (ARARs). Risks at Site 2 were from stockpiled soil that had been excavated during removal actions. Groundwater was sampled as part of the site assessment following the soil removal actions and no unacceptable risk was found for COPCs in groundwater. This is effectively an empirical demonstration that COC concentrations in soil are protective of groundwater.

PCBs in stockpiled soil (not in situ soil) were the COCs driving remediation of Site 2.

3.5.4 Site 10 (Pesticide Storage Quonset Huts)

Site 10, the location of two former pesticide storage Quonset huts, is located just west of the PWIA in the southeastern portion of the base (Figure 3-10, located at the end of Section 3). The two former wooden floor Quonset huts were used prior to 1979 to store pesticides and herbicides. The site is currently the paved parking area for Buildings 2011 and 2012. Chemicals known to have been stored in the huts include Hyvar X, bromacil, 2,4-dichloro-phenoxyacetic acid, and 2,4,5-trichloro-phenoxyacetic acid.

Based on a detection of total petroleum hydrocarbons (TPH) in one groundwater sample, an unacceptable noncancer risk was estimated for groundwater ingestion by an assumed future site resident. Site soils did not pose an unacceptable risk for unrestricted site use.

At the time of the OU 7 ROD, the COC driving remedy selection at Site 10 was TPH in groundwater.

3.5.5 Site 26 (Hood Canal Sediments)

Site 26 (Hood Canal Sediments) consists of eight areas along the western shore of the base where the base service piers are located. These eight areas are known as Cattail Lake Beach/Magnetic Silencing Facility, Floral Point, Explosives Handling Wharf, Marginal Wharf, Delta Pier, Devil's Hole Beach, Keyport/Bangor Dock, and Service Pier (Figure 3-11, located at the end of Section 3). The wharf, dock, and pier structures along the shoreline serve to limit the potential for erosion and result in local trapping of sediments transported from other areas.

Of the eight Site 26 subareas evaluated, possible ecological risks to marine receptors were identified for four (Marginal Wharf, Devil's Hole Beach, Keyport/Bangor Dock, and Service Pier). Chemicals driving the estimated ecological risks were PAHs, pesticides, and BEHP at Marginal Wharf; pesticides at Devil's Hole Beach; mercury and PAHs at Keyport/Bangor Dock; and PAHs, pesticides, and dibenzofuran at Service Pier.

Ecological risk was also assessed under Washington State's sediment management standards (SMS). Under this evaluation, BEHP concentrations at Marginal Wharf exceeded the SMS cleanup screening level (CSL) for minor adverse effects. However, bioassay tests were below the SMS sediment quality standards (SQS) for no adverse effects. For Service Pier, detected sediment concentrations were below the respective CSLs, but two bioassay test results exceeded the CSL. No unacceptable human health risks were identified for Site 26 (based on recreational exposure to sediments and ingestion of clams).

No COC was established for Site 26. Instead, minor ecological issues identified for sediments were to be addressed through confirmation sampling (see Section 4.5.5).

3.6 OU 8

OU 8 consists of approximately 150 acres of land and is located in the southeastern corner of NBK Bangor (Figure 3-13, located at the end of Section 3). It encompasses the PWIA and off-base residential community along Mountain View Road between Clear Creek Road and the NBK Bangor boundary. OU 8 was added to the FFA in October 1994 and consists of the following known or suspected former waste sites, for which investigations began in 1991:

- Site 27, Steam Cleaning Pit
- Site 28, Paint Shop Drainage Ditch
- Site 29, Public Works Maintenance Garage

Sites 27, 28, and 29 are located within the PWIA and were also studied during remedial investigations of OU 7. Though Sites 10, 18, and 25 are also located within the PWIA, these sites were investigated under different OUs. Sites 10 and 18 were investigated under OU 7, and Site 25 was investigated under OU 3.

The Navy has completed two time-critical removal actions at OU 8. In 1995, the Navy connected the Mountain View neighborhood, southeast of the base boundary, to a municipal water supply. In 1996, the Navy installed a groundwater containment system to minimize off-base plume migration. The containment system consisted of a groundwater pump and treat system that pumped groundwater from two extraction wells (E1 and E2) located near the base boundary, removed the volatile organic compounds (VOCs) in an aboveground treatment plant, and returned the treated groundwater to the aquifer through two reintroduction wells (R1 and R2). Each extraction well was constructed to pump between 30 to 100 gallons per minute (gpm). The actual pumping rate from each well was 45 gpm for a combined flow rate of 90 gpm. Results from the natural attenuation studies and the computer modeling performed as part of the feasibility study (FS) indicated that the pump and treat system did not significantly remove VOCs from groundwater, as compared to VOCs removed by natural attenuation. Therefore, the pump and treat system was shut down in December 1999.

In addition to these two removal actions, a variety of removal and remedial actions were conducted under the NBK Bangor underground storage tank (UST) program within and around the PWIA from 1986 through 2000. Tightness tests were performed on USTs in the PWIA to identify potential leaks from tanks and associated piping systems. This program documented releases from several tanks and associated piping, and several USTs were removed or abandoned in place to prevent further releases to the subsurface.

OU 8, as defined in the ROD (U.S. Navy, USEPA, and Ecology 2000a), includes contaminated groundwater on base that migrates off base from the PWIA and extends in a southeasterly direction toward the Mountain View residential neighborhood, as well as contaminated soil that extends from a depth of 15 feet bgs to the water table. The contaminated soil was limited to the central portion of the PWIA, beneath the gasoline service station, where a gasoline release from a UST was discovered in 1986. LNAPL was present on the groundwater surface in this area at the time the ROD was signed in 2000.

In August 1986, a free-product recovery system was installed in the PWIA service station area. The recovery system consisted of three product-recovery wells equipped with pneumatic pumps (RW1, RW2, and RW3) located in the area of known free product. Groundwater mixed with free product was pumped to an oil/water separator. Petroleum from the oil/water separator was pumped into an aboveground holding tank, and the wastewater was discharged into the sanitary sewer. The system was shut down in November 1998 after recovering approximately 6,000 gallons of light nonaqueous-phase liquid (LNAPL) from an estimated 20,000 gallons released.

In 1994, a combined soil vapor extraction (SVE) and bioventing system was installed in the vicinity of the gasoline release at the PWIA service station to remediate petroleum-contaminated soil. The system consisted of a combination of 15 SVE wells, 4 air sparging wells, and 1 vent well. The SVE wells were manifolded into a blower, and the sparging wells were connected to a compressor. Extracted soil vapor was piped to a regenerative thermal oxidation unit for treatment. In March 1996, the aboveground components of the system were dismantled, but the vapor wells and underground piping were left in place.

The SVE system was restarted in January 1997 using the original in-ground components of the system. New aboveground system components were added, including a moisture knockout tank, blower, catalytic oxidizer, and control unit. This second phase of SVE operation lasted from December 1997 through March 2000, and approximately 35,000 pounds of petroleum hydrocarbon vapors were recovered (equivalent to approximately 5,300 gallons of gasoline) (U.S. Navy 2001c). In December 1999, confirmatory soil samples were collected beneath the PWIA to a depth of 15 feet below ground surface (bgs). The results indicated that the soil had been sufficiently remediated to meet Ecology's cleanup levels. In February 2000, Ecology notified NBK Bangor that no further action is necessary to clean up the soil beneath the PWIA to a depth of 15 feet bgs. COC concentrations remaining in soil following SVE and the earlier UST decommissioning efforts are not readily available.

The OU 8 risk assessment estimated unacceptable cancer and noncancer risks for assumed future site residents drinking on-base groundwater. Unacceptable noncancer risks to future off-base residents were predicted from the combination of residents drinking off-base groundwater and irrigating their crops with it. Ecological risks are not anticipated. The compounds 1,2-dichloroethane (1,2-DCA) and benzene are the primary VOCs present in OU 8 groundwater and were the COCs driving remediation at the site. No current unacceptable risks from benzene through inhalation pathways were found at the time of the ROD (see Table 5-9 of the ROD [U.S. Navy, USEPA, and Ecology 2000a]).

3.7 OTHER CLEANUP ACTIONS

Two cleanup actions have been conducted at NBK Bangor since execution of the most recent ROD (for OU 8), one at the Pogy Road site and one at site EO300. These two cleanup actions are summarized in this section.

3.7.1 Pogy Road Cleanup Action

The Pogy Road site is located in the northern portion of Naval Base Kitsap at Bangor at the northern terminus of Pogy Road (Figure 3-14, located at the end of Section 3). The area was used on January 10, 2001, for emergency treatment of selected ordnance items recovered during a time-critical removal action involving the clearance of munitions and explosives of concern at Jackson Park Family Housing.

The treatment was performed under an emergency Resource Conservation and Recovery Act (RCRA) permit by Explosive Ordnance Disposal Mobile Unit ELEVEN, Detachment Bangor. Standard military procedures for emergency detonations were followed. The munitions were placed in a hole with donor charges alongside the munitions. Soil from the adjacent hillside was then tamped over the munitions. Following the initial blast, kick-out ordnance was collected and again placed in the trench. A second blast with donor charges under tamped soil was conducted to complete the detonations.

Following the munitions treatment, two soil characterizations conducted by the Navy and summarized in the Determination of Cleanup Level Plan (DCLP) (U.S. Navy 2004g) identified the presence of ordnance-related compounds in shallow soil at the site. Determination of soil cleanup levels in accordance with the MTCA regulations (Washington Administrative Code [WAC] 173-340) indicated that a small soil removal was warranted to address ordnance-related compounds in the treatment area (U.S. Navy 2004g).

Soil removal was subsequently performed as an independent cleanup action under the MTCA regulation. Soil removal was conducted between August 12 and 29, 2005. The residual ordnance-contaminated soils within the treatment pit were excavated and transported off site via the Olympic View Transfer Station for disposal at the nonhazardous waste landfill located at Columbia Ridge, Oregon.

Confirmation soil samples were collected and analyzed following the soil removal. The results of the confirmation sampling were compared to risk-based cleanup levels developed in the DCLP. No results were reported above the risk-based cleanup levels identified in the DCLP. In addition to the risk-calculated cleanup levels presented in the DCLP, an additional comparison was completed relative to EPA preliminary remediation goals (PRGs). No site contaminant was reported above the PRGs at any location. Based on confirmation sampling results, the closure report concluded that no residual contamination exists at the site at or even near the risk-based cleanup levels or EPA PRGs (U.S. Navy 2005e).

3.7.2 Site EO300 Time-Critical Removal Action

EO300 comprises two former pistol ranges and a skeet range (Figure 3-15, located at the end of Section 3). Soil sampling was conducted in 2008. Lead was identified in soil at concentrations exceeding the MTCA Method A cleanup level for unrestricted land use of 250 mg/kg. An RI/FS was initiated based on the preliminary soil sampling results. However, the site was identified as a high recreational use area and a time-critical removal action was planned for the pistol range (U.S. Navy 2009e). The RI/FS was temporarily suspended. Additional sampling was conducted during the time-critical removal action. The time-critical removal action has been completed and a completion report is pending. The RI/FS is scheduled to be finalized during September 2010 (U.S. Navy 2010b).

U.S.NAVY

Figure 3-1
Site A Location Map

NBK Bangor
THIRD 5-YEAR REVIEW

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U.S.NAVY	**Figure 3-2** **Site F Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

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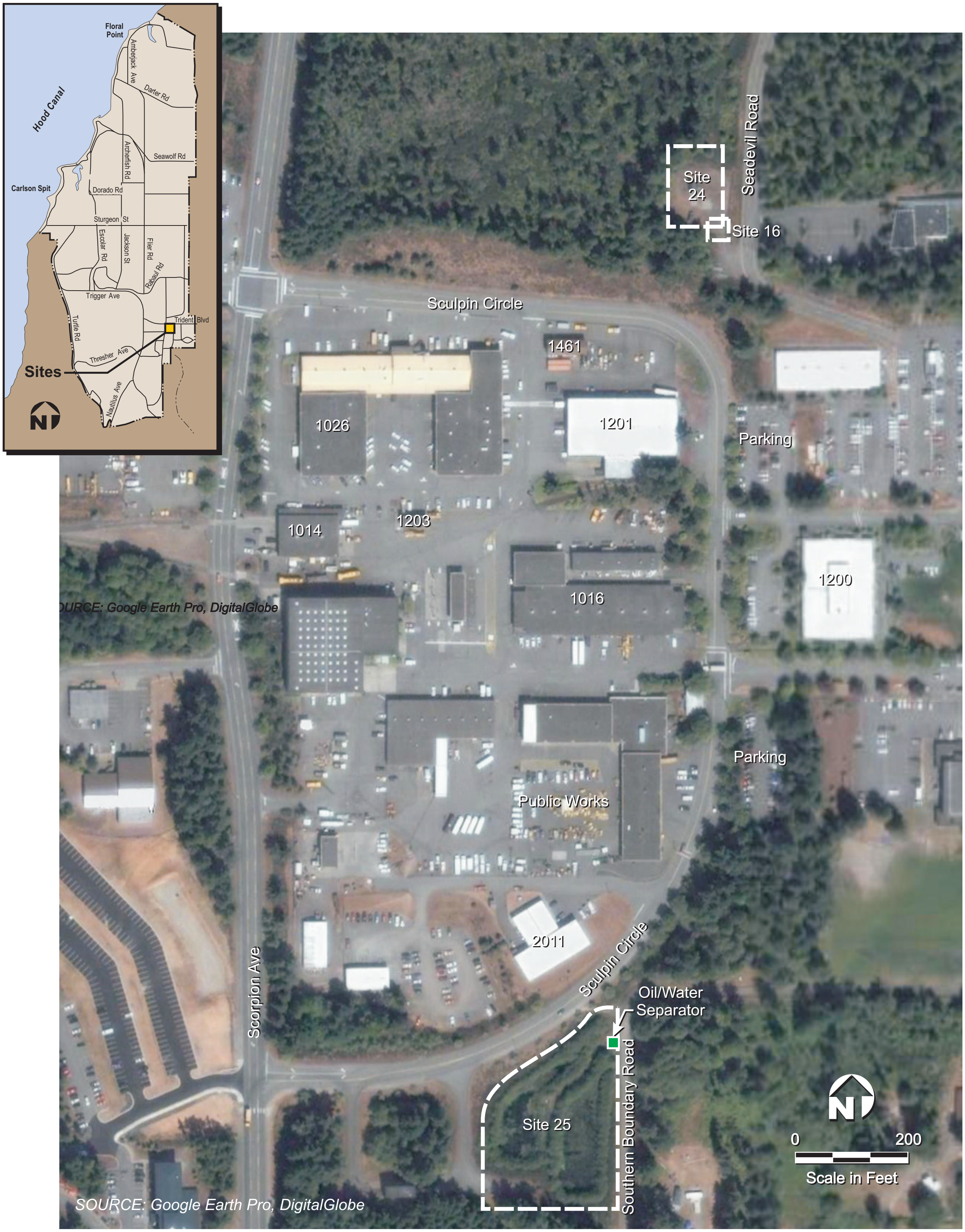
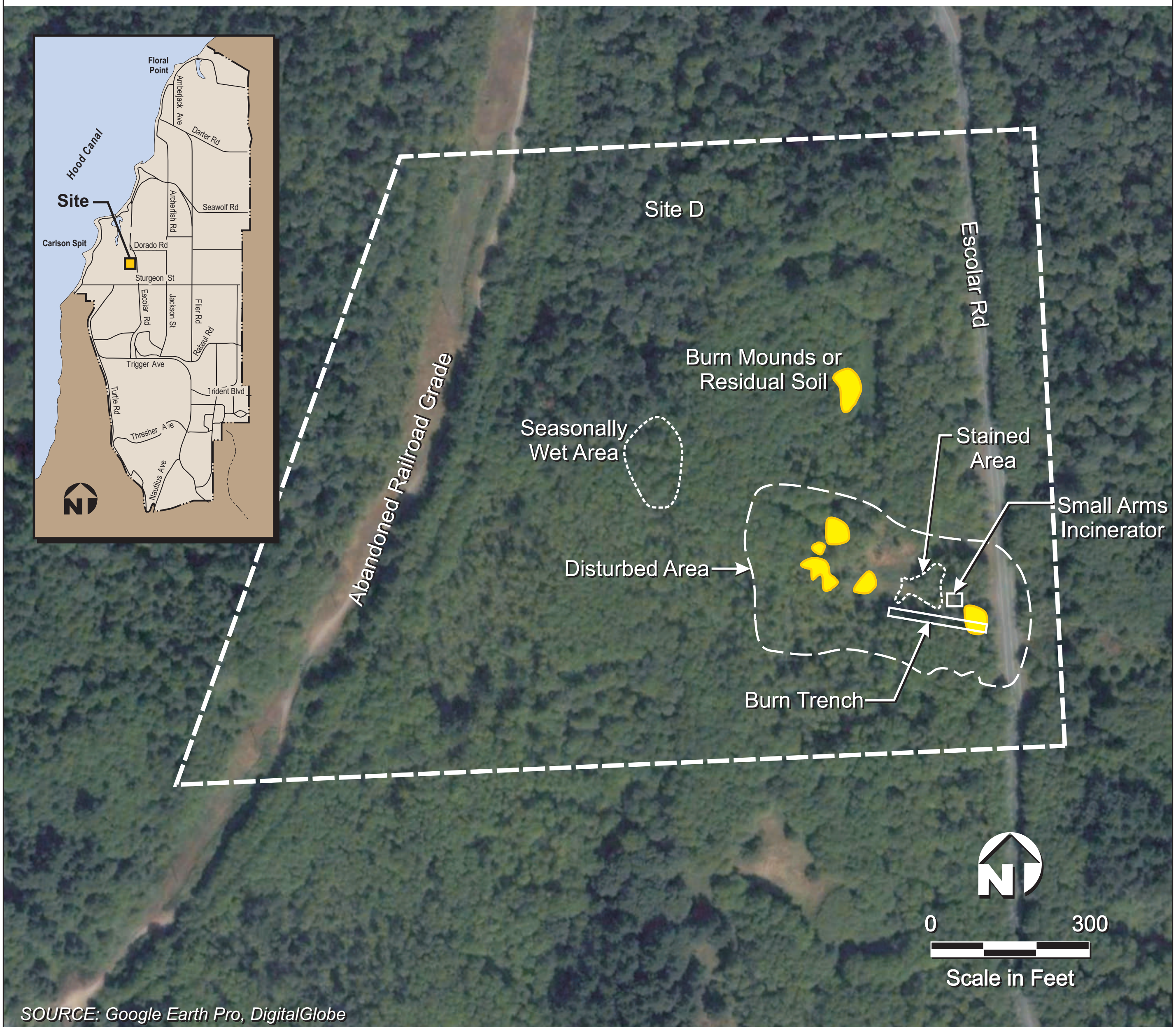


U.S.NAVY

Figure 3-3
OU 3, Sites 16/24 and 25 Location Map

NBK Bangor
THIRD 5-YEAR REVIEW



U.S.NAVY

Figure 3-4
OU 6, Site D Location Map

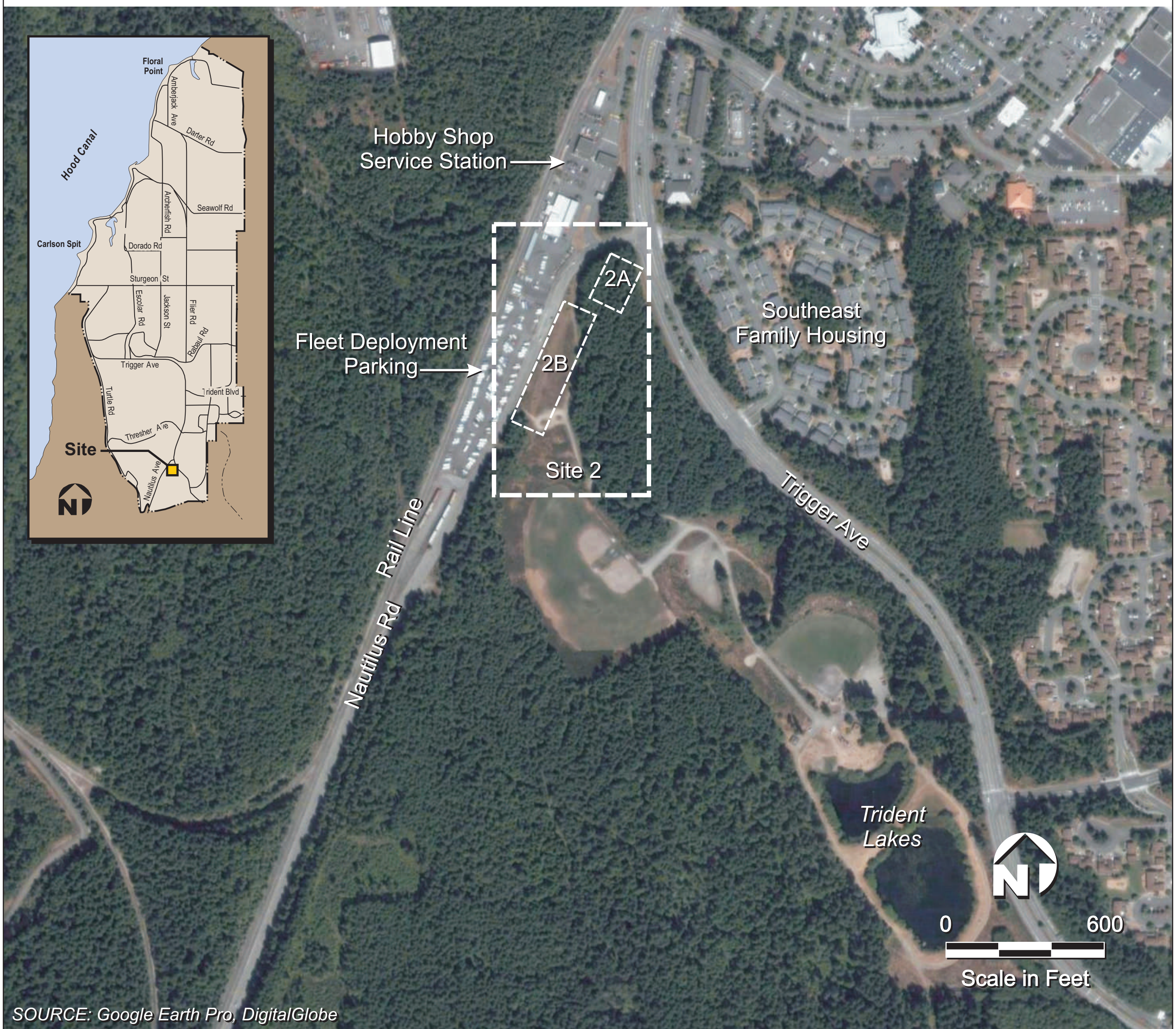
NBK Bangor
THIRD 5-YEAR REVIEW

33759564_07.cdr

U.S.NAVY	**Figure 3-5** **OU 7, Site B Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

U.S.NAVY	**Figure 3-6** **OU 7, Site E/11 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

33759564_09.cdr



U.S.NAVY	**Figure 3-7** **OU 7, Site 2 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

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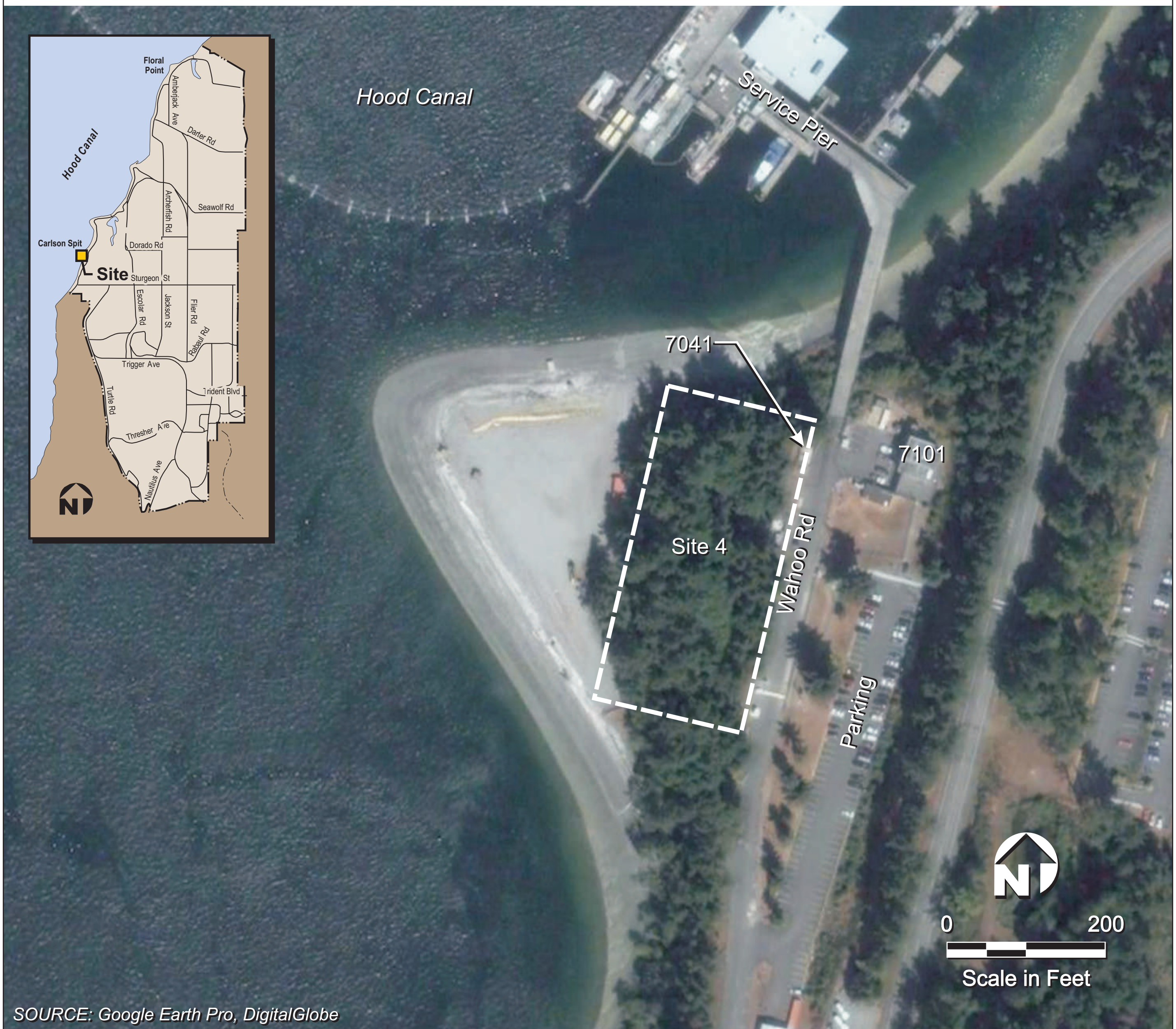
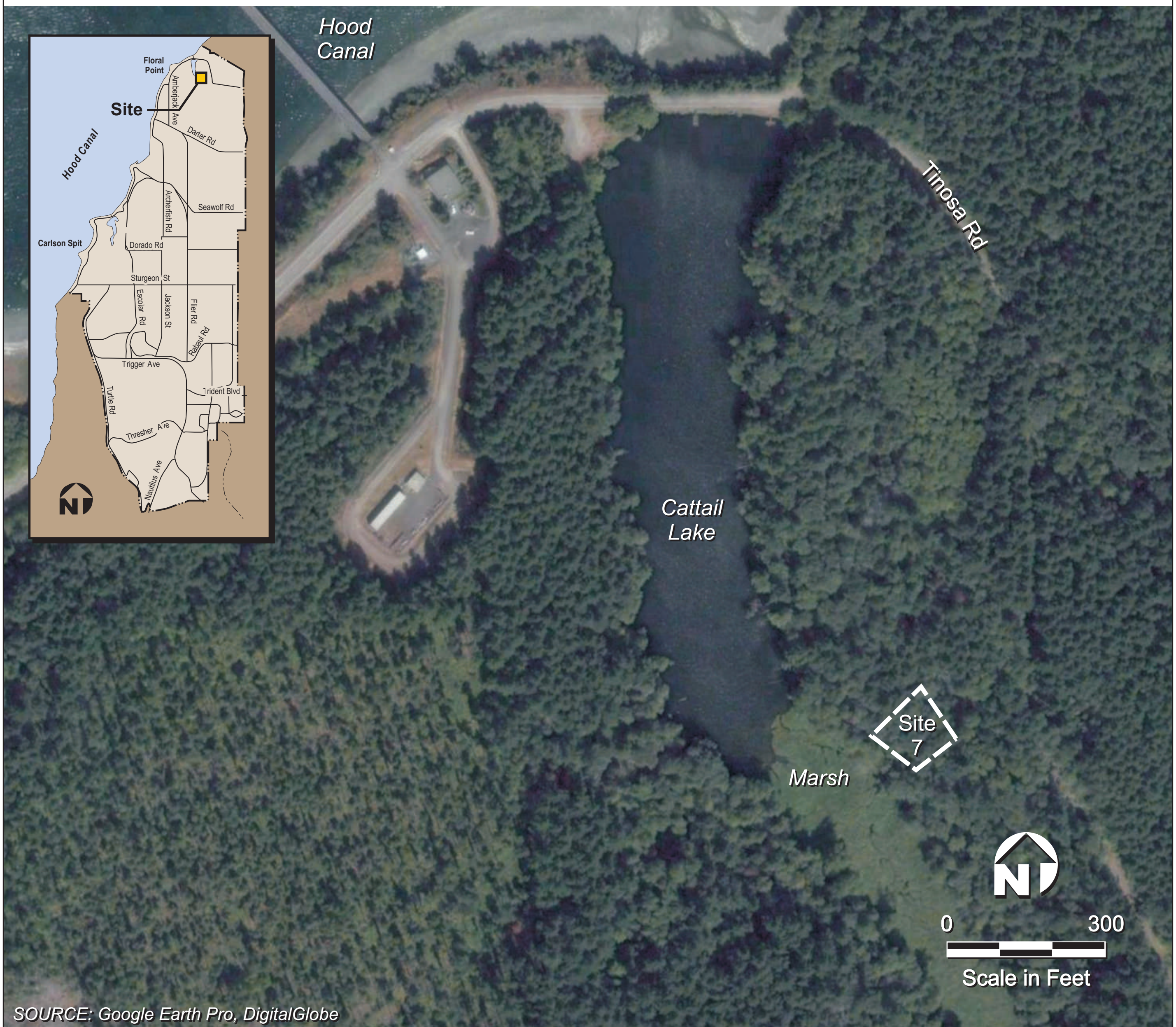


U.S.NAVY	**Figure 3-8** **OU 7, Site 4 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW



U.S.NAVY	**Figure 3-9** **OU 7, Site 7 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

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U.S.NAVY	**Figure 3-10** **OU 7, Sites 10 and 18 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

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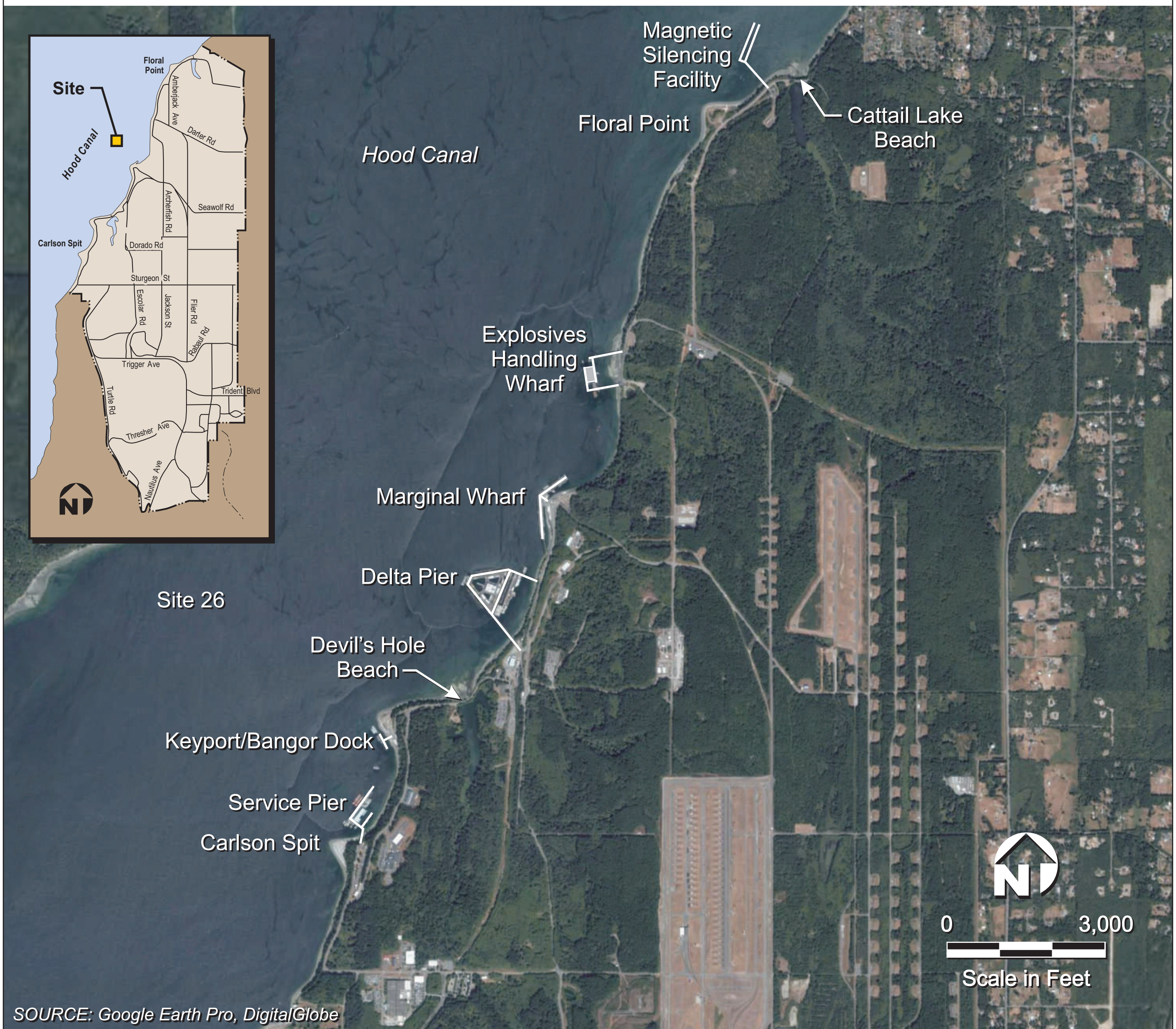

U.S.NAVY	**Figure 3-11** **OU 7, Site 26 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

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U.S.NAVY

Figure 3-12
OU 7, Site 30 Location Map

NBK Bangor
THIRD 5-YEAR REVIEW

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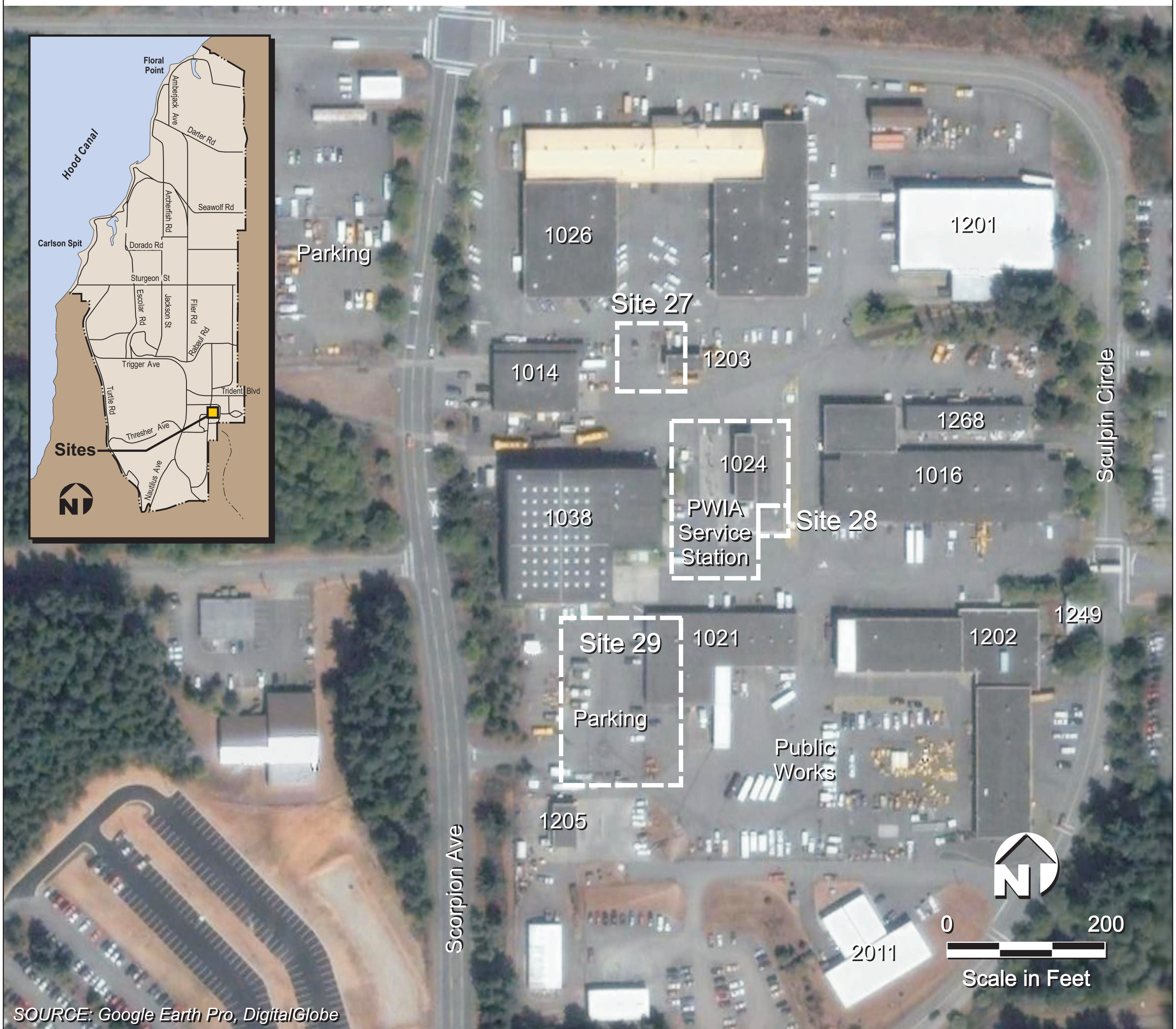

U.S.NAVY

Figure 3-13
OU 8, Sites 27, 28, 29, and PWIA Service Station Location Map

NBK Bangor
THIRD 5-YEAR REVIEW

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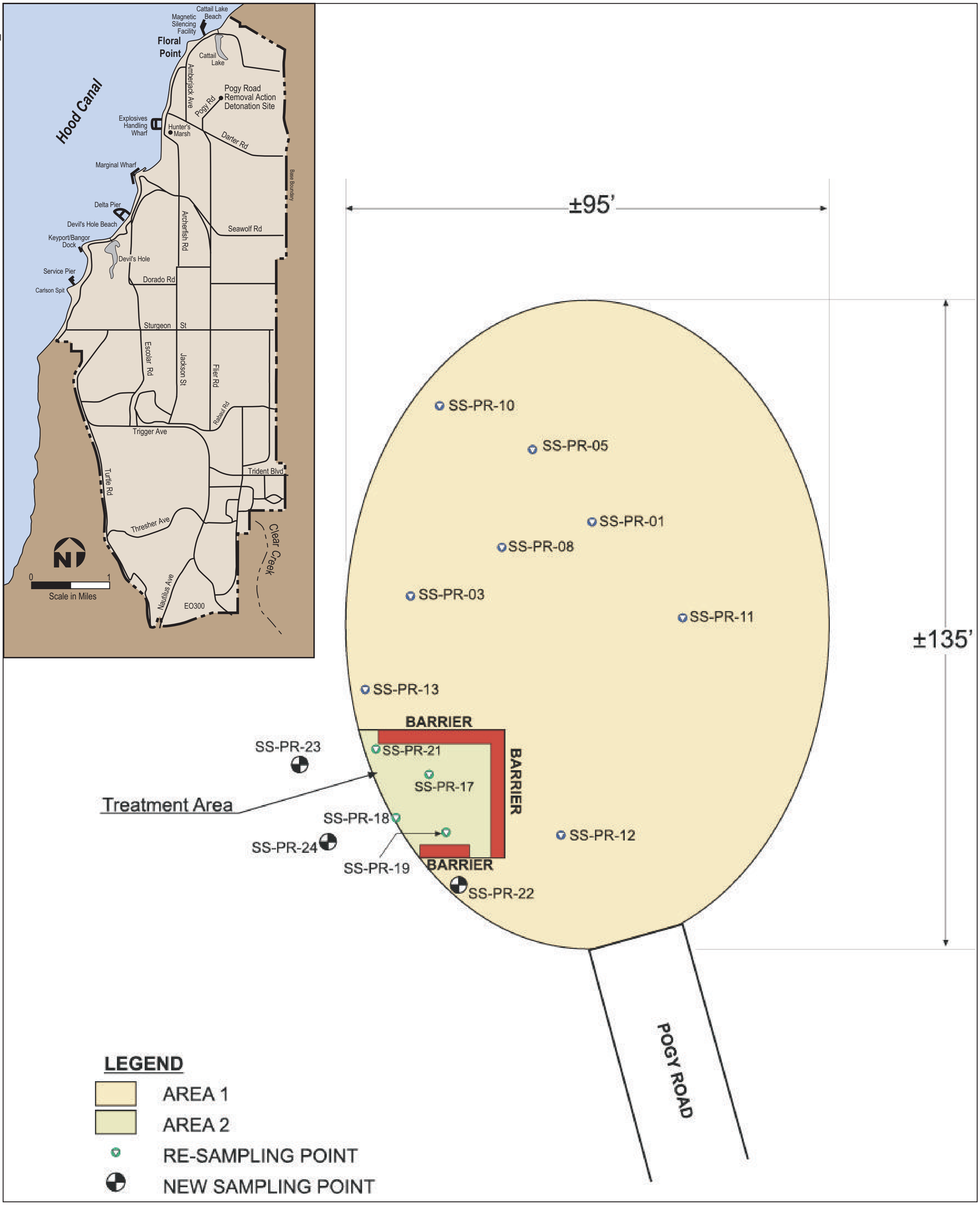


U.S.NAVY	**Figure 3-14** **Pogy Road Site Map**	NBK Bangor THIRD 5-YEAR REVIEW

33759564_16.cdr

U.S.NAVY	**Figure 3-15** **Site EO300 Location Map**	NBK Bangor THIRD 5-YEAR REVIEW

4.0 REMEDIAL ACTIONS

Based on the investigations and site conditions summarized in Sections 2 and 3, further investigation through the RI/FS process was warranted at eight OUs. For six of these OUs, some remedial action was required. This section provides a brief description of remedy selection and implementation at each of these six OUs (1, 2, 3, 6, 7, and 8).

4.1 OU 1 (SITE A)

4.1.1 Remedy Selection

Remedial action objectives (RAOs) were discussed in the context of ARARs in the RI/FS (U.S. Navy 1991) and "cleanup standards" in the ROD (U.S. Navy, USEPA, and Ecology 1991a). The overall RAOs for OU 1 were the following:

- Reduce the concentrations of contaminants in soil to be protective of human health for an unrestricted site use.
- Reduce concentrations of contaminants in the shallow aquifer groundwater to levels below MTCA groundwater cleanup standards.

For the burn area, the primary COCs driving remediation were 2,4,6-TNT, 2,6-DNT, and RDX in the soil and groundwater.

For Debris Area 2, PCBs (human health risk) and lead (ecological risk) in soil were the COCs driving remediation.

No unacceptable risks were identified for Debris Area 1 or the stormwater discharge area, and therefore no COCs were established for these sites.

To achieve the RAOs, the remedial action components and expectations listed below were specified in the OU 1 ROD (U.S. Navy, USEPA, and Ecology 1991a).

Well Abandonment

Immediately abandon all older monitoring wells that may not have competent surface seals.

Soil Remediation

- Excavate approximately 7,000 cubic yards of soil from the Burn Area that exceed MTCA direct contact cleanup levels for ordnance (33 mg/kg TNT, 1.5 mg/kg DNT, and 9.1 mg/kg RDX). Excavate soils from Debris Area 2 that also exceed these action levels and/or 250 mg/kg lead. The excavated soils will be modified as necessary by mechanical or chemical means to ensure that the subsequent treatment (washing) process will be effective and efficient. Place all such soils in a soil washing basin constructed at the Site A burn area. The soils from Debris Area 2 with lead concentrations exceeding 250 mg/kg will be placed in a separate cell in the soil washing basin. The basin will include a synthetic membrane liner to prevent escape of the leachate. Construction details of the soil washing basin will be determined during final design.

- Conduct verification monitoring during and/or following the excavation to assure that all soils exceeding the cleanup levels have been excavated. The point of compliance shall be throughout the burn area and Debris Area 2. Evaluate compliance with the cleanup standards using compliance monitoring procedures defined in WAC 173-340.

- Pending successful completion of the ongoing treatability study and subsequent final design, perform soil washing on soils placed in the treatment basin, treating the leachate with an ultraviolet/oxidation (UV/Ox) treatment system. Recycle the treated water back to the leach basin (zero discharge). Although the soil treatment process is expected to be completed within approximately 1 year, it is possible that a longer time frame may be required to achieve the cleanup levels. In this case, continuation or modification of the soil washing may be addressed during the first 5-year review of the cleanup action, in accordance with the FFA for NBK Bangor.

- Treatment will be considered completed when soils within the basin are below the MTCA direct contact cleanup levels for ordnance (33 mg/kg TNT; 1.5 mg/kg DNT; and 9.1 mg/kg RDX) and when the RDX concentration in the treated leachate is less than the MTCA groundwater protection level for RDX of 0.8 µg/L. Treatment will also be considered complete if the treated leachate concentrations are below updated practical quantitation limits (PQLs). Compliance with the cleanup standards will be determined using compliance monitoring provisions defined in WAC 173-340.

- Upon completion of the soil washing, the basin, liner, and soil contents will all be abandoned in place. A 1-foot soil cover will be placed over the treated materials and revegetated to prevent erosion. The site will be graded to allow for surface water drainage, including drainage from the abandoned leach basin. Debris Area 2 soils that still contain lead concentrations above 250 mg/kg after treatment will be excavated and disposed of at a permitted off-site solid waste facility.

Groundwater Remediation

- Following completion of the soil treatment action, groundwater protection will be assessed by monitoring ordnance concentrations in the seasonal perched groundwater zone immediately underlying the burn area. The point of compliance for comparison with state groundwater protection (drinking water use) levels will be established throughout the perched zone. If compliance with state groundwater protection criteria has not been achieved within 5 years from commencement of this action, modifications to the groundwater remediation system will be considered, as discussed below under "Groundwater Remedial Action Measures and Goals."

- Concurrent with the soil washing, conduct additional groundwater monitoring and pilot-level treatability studies to support the final design of the groundwater restoration program. The restoration program shall initially be designed to achieve the MTCA groundwater cleanup level for RDX of 0.8 µg/L in the most cost-effective manner within a 10-year period of operation. The point of compliance will be throughout the shallow aquifer.

- Pending final design, the groundwater restoration program will include the installation of approximately eight extraction wells within the vicinity of the burn area. The system will operate at a combined flow of approximately 12 gpm. Extracted groundwater will be treated using UV/Ox to reduce RDX concentrations to less than 0.8 µg/L or the updated PQL, whichever is greater. In the unlikely event that the results of the treatability study or system performance monitoring data reveal inadequate treatment, there may be a need to install an effective effluent polishing process in order to achieve the treatment standards. Treated groundwater will be reintroduced on site through approximately 15 reinjection wells configured to facilitate maximum flushing of the aquifer.

- As with any groundwater remediation, the effectiveness of the shallow aquifer restoration program at Site A will be continuously monitored and evaluated as a component of operation and maintenance, as discussed below. System operation will cease when it can be demonstrated either that the cleanup standards have been met, or that continued operation is no longer practicable, following evaluation criteria defined in WAC 173-340.

Technical analyses, as presented in the final RI/FS for Site A, have shown that soil washing combined with UV/Ox treatment of the leachate is feasible and effective in permanently removing and destroying ordnance constituents present in soils. The RI/FS analyses have also demonstrated that groundwater restoration through extraction, UV/Ox treatment, and reintroduction should be feasible, though additional data are needed to support final design and implementation.

The cancer risk levels corresponding to the MTCA (Method B) cleanup levels that are the goal of the site cleanup are 1×10^{-6} for individual hazardous substances and 1×10^{-5} for cumulative exposures to multiple hazardous substances and routes of exposure. The cumulative hazard index for multiple hazardous substances and routes of exposure is 1. The reasonable maximum exposure assumptions used to derive the MTCA cleanup levels are equivalent or more stringent than the federal Superfund requirements. These standards are within acceptable EPA (NCP) risk criteria.

Groundwater Remedial Action Measures and Goals

The goal of the groundwater remedial action is to restore shallow aquifer waters to support possible future drinking water use. Based on information obtained during the RI and the analysis of all remedial alternatives, the Navy, EPA, and Ecology believe that the selected remedy should be able to achieve this goal. However, the ability to achieve groundwater cleanup levels at all points throughout the shallow aquifer at Site A cannot be determined until a detailed design of the extraction and reintroduction system has been completed, implemented, modified as necessary, and the groundwater plume monitored over time.

The selected remedy will include groundwater extraction, treatment, and reintroduction for an estimated period of 10 years, during which time the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

- Discontinuing pumping at individual wells where cleanup goals have been attained
- Alternating pumping wells to eliminate stagnation points
- Pulse pumping to allow aquifer equilibrium and encourage adsorbed contaminants to partition into groundwater

- Installing additional extraction and/or reintroduction wells in either the perched groundwater zone or shallow aquifer to facilitate or accelerate cleanup of groundwater contaminants

Remedial actions that allow hazardous substances, pollutants, or contaminants to remain on site must be reviewed not less than every 5 years after initiation to ensure the remedy continues to be protective of human health and the environment. Such a review would be conducted in accordance with Part XIX (5-year review) of the FFA for NBK Bangor. These reviews may result in further modification of the treatment process, consideration of other remedial approaches, or revision of the cleanup standards. Changes to the selected remedy or cleanup standards would require formal notification to the public.

The OU 1 ROD has been amended by three Explanations of Significant Differences (ESDs). ESD No. 1 (U.S. Navy, USEPA, and Ecology 1994e) documented the following changes to the OU 1 ROD selected remedy:

- Add sand amendment to leach basin soil and calcium chloride to wash water to improve permeability (calcium chloride reduces swelling of clays in the fine-grained soil).

- Treat leachate using granular activated carbon (GAC) instead of UV/Ox.

- Leave the limited volume of lead-contaminated soil in Debris Area 2 (excavating the soil poses greater risk to human health and the environment than leaving the soil in place), and implement institutional controls (ICs) to restrict access to the area (e.g., fences, blackberry bushes, etc.) and signs.

- Develop and implement a leachate management plan for the closed leach basin to ensure that leachate releases from the treatment basin will be protective of human health and the environment after basin closure.

- Begin treating groundwater by July 1, 1996, rather than 1 year after soil treatment is complete (a 1-year extension of the deadline was subsequently approved).

ESD No. 2 (U.S. Navy, USEPA, and Ecology 1998) documented the following changes to the OU 1 ROD selected remedy:

- Use composting to complete remediation of the leach basin soil (soils from the former Site A "burn mounds" and three localized "hot spots").

- Treat extracted groundwater using GAC instead of UV/Ox.

ESD No. 3 (U.S. Navy, USEPA, and Ecology 2000b) documented the following changes to the OU 1 ROD selected remedy:

- The leach basin leachate was acceptable for discharge to surface water without treatment (based on whole effluent toxicity [WET] testing).

- The remediation cost to date was more than three times greater than that estimated in the ROD.

4.1.2 Remedy Implementation

Abandonment of Older Monitoring Wells

In accordance with the ROD, the following wells were abandoned by pressure grouting in October 1992 (U.S. Navy 1993):

- A-MW01
- A-MW02A
- A-MW03
- A-MW04
- A-MW05
- A-MW06
- A-MW08
- A-MW11
- A-MW12
- A-MW14
- A-MW15
- A-MW16
- A-MW18
- A-MW19B

The abandonment of these wells satisfied the well abandonment remedy component.

Since the signing of the OU 1 ROD, the Navy has maintained an ongoing policy to evaluate older wells during regular monitoring events. Wells are upgraded or abandoned as needed.

All well abandonments have been conducted with the concurrence of Ecology and, more recently, EPA.

Soil Remediation

Excavation and stockpiling of the ordnance-contaminated burn area surface soils, construction of the lined soil-washing leach basin above the excavation area (Figure 4-1), amendment of the stockpiled soils with sand, and placement of the amended soils (approximately 13,000 cubic yards) in the leach basin were conducted in 1993. The passive soil leaching system began operation in December 1994, treating Site A soils containing ordnance compounds, primarily TNT and RDX. Leachate was collected and treated using GAC, and the treated water was recirculated to the basin.

Leach basin soils were sampled semiannually to monitor the progress of the soil-leaching process. The basin was divided into six grids, and each section was 176 by 114 feet. Three composite samples (made up of discrete samples from four locations) were collected from each grid at three depth intervals (totaling 9 per grid and 54 for the entire basin). While the cleanup requirements of the soils in the main basin were achieved by spring of 1997 (with the exception of three localized “hot spots”), the hot-zone soils still contained TNT concentrations above the soil cleanup level of 33 mg/kg.

To accelerate the remediation of the soil, composting technology was used to treat some soil for which the remediation goals were not initially achieved through leaching. The hot zone at the Site A leach basin was approximately 125 by 75 feet, with an average depth of 4 feet (3 feet of soil/sand mix and 1 foot of sand filter layer). Approximately 1,100 cubic yards of material was excavated in 1997. In addition to the large area of contaminated soil that needed treatment, three more small hot spots, totaling 40 cubic yards of contaminated material, were identified in the main basin. These hot spots were excavated with a small backhoe and hand digging. Samples of the sand material placed as part of the original leach basin construction beneath the excavated material were collected and analyzed for ordnance compounds. Analytical results indicated that there was no exceedance of ordnance compounds. The 1-foot filter sand layer was therefore left in place.

After the hot zone soil had been excavated, it was composted at the on-base facility adjacent to Site F by mixing the contaminated soil with four amendments: cow manure, potato/apple waste, wood chips, and alfalfa hay. Composting was performed in six windrows, each of which measured 6 feet high by 14 feet wide by 250 feet long. The windrows were monitored closely for temperature, oxygen, moisture content, pH, and thermophilic bacteria. They were also sampled regularly with TNT field test kits, and status ordnance samples were collected. After the TNT field test kits sampling results were below the cleanup level, confirmation soil samples were collected for ordnance analysis. Each windrow was sampled at 10 random locations at a depth of 3 feet with no more than 40 feet between samples. The windrow was considered clean if more than 90 percent (10 out of 11) of the sampling results were below the cleanup level for each COC, providing that no result exceeded double the cleanup level. Maximum ordnance compound concentrations remaining in soil following composting treatment were as follows:

- RDX: 6.6 mg/kg
- 1,3,5-TNB: 3.2 mg/kg
- 1,3-DNB: not detected above 0.50 mg/kg
- Nitrobenzene: 1.1 mg/kg
- 2,4,6-TNT: 65 mg/kg
- 2,6-DNT: not detected above 0.50 mg/kg
- 2,4-DNT: 0.52 mg/kg
- Nitrotoluene: not detected above 0.50 mg/kg

With the addition of composting technology, the cleanup goals for the burn area soils were achieved by September 1997. The composted soils were returned to Site A and placed just south of the leach basin inside the fenced area.

As established in ESD No. 1, leachate from the treated soil at Site A was to be evaluated and a leachate management plan and leach basin closure plan were to be developed. The plan was to establish whether post-closure leachate could be discharged to groundwater via infiltration or to surface water. The leach basin closure plan, including a section on leachate management, was finalized in August 1997 (U.S. Navy 1997).

Following the soil washing and composting, soils in the basin met the remediation goals (RGs), but the untreated basin leachate contained RDX above the 30-µg/L surface water RG. A comprehensive WET testing program was completed in December 1998, demonstrating that the untreated leachate is not toxic to aquatic organisms and is acceptable for discharge to surface water (as documented in ESD No. 3). Consequently, the leach basin piping was modified such that basin leachate discharges by gravity flow from the leachate collection sump to Hood Canal via an existing stormwater diversion system. Unused components of the existing system were subsequently decommissioned. The treatment facility continues operation for the purpose of groundwater remediation, as discussed under "Groundwater Remediation" below.

Based on the documentation in ESDs Nos. 1 and 3 and the leach basin closure plan, it appears that the toxicity testing program established that leachate could be safely discharged to surface water, but that the leachate was not protective of groundwater. ESD No. 3 stated that leachate RDX concentrations had "leveled off" in the range of 40 to 70 µg/L. Per the leach basin closure plan, the leachate basin liner was left intact and ICs established to protect the liner and minimize leachate infiltration to groundwater until, "it is demonstrated that leachate collecting in the sump consistently meets groundwater cleanup levels." The leach basin closure plan anticipated that ". . . the Site A groundwater remediation system will effectively contain any basin leakage migrating down to the Shallow Aquifer. Therefore, the potential release of leachate exceeding groundwater cleanup levels does not represent a threat to groundwater downgradient of the site."

Debris Area 2 Institutional and Engineered Controls

In 1995, an extensive stand of blackberries was planted along the upper portion of the steep ravine containing Debris Area 2 to restrict access to the ravine. Warning signs were also installed along the top of the ravine as an additional means of restricting access to Debris Area 2 (in accordance with ESD No. 1 for Site A).

Groundwater Remediation

Groundwater restoration at OU 1 began in May 1997 with continuous groundwater extraction from monitoring well A-MW46, located within the leach basin footprint and screened in a portion of the shallow aquifer with high COC concentrations. The extracted groundwater was treated in the Site A leachate treatment system. The leachate treatment system was subsequently expanded when the more comprehensive system became fully operational in early November 1997.

The current Site A groundwater extraction system consists of seven extraction wells: five 8-inch-diameter wells (A-EW4 through A-EW8) spaced at 60- to 70-foot intervals along the downgradient edge of the former burn area along Pintado Road and two converted monitoring wells (2-inch-diameter well A-MW37 and 4-inch-diameter well A-MW46) located inside the leach basin. Each extraction well is equipped with a submersible pneumatic pump operated by compressed air. Extraction from these wells removes ordnance-contaminated groundwater from the shallow aquifer, which is then pumped to the treatment facility for treatment using a solids filtration system followed by two 20,000-pound GAC vessels (U.S. Navy 2008a). Flow totalizers or flow meters have not been incorporated into the system for individual wells. Total flow through the system was highest, at approximately 20 to 50 gpm, during recirculation of the passive soil leach water. The total flow rate dropped to less than 5 gpm in 1999 once recirculation effects had subsided. The 2009 total flow rate through the system was reported at 3 to 4 gpm. Individual well flow was measured on a quarterly basis in 2009, and the sum of flow from individual wells ranged from 3.08 to 4.16 gpm. Well AMW-37 is known to be pumping, but did not cycle during any of the quarterly flow measurement events (U.S. Navy 2010a). The extraction and treatment system is automated for continuous 24-hour-per-day, 7-day-per-week operation through the use of a programmable logic controller.

Treated water was initially reintroduced to the aquifer through well A-IW3, with excess water routed to the stormwater discharge area. Over time, injection of treated water became impractical, because well A-IW3 required substantial maintenance and the required injection pressure became very high. All treated water is currently routed to a drainage ditch located along the west side of the leach basin. Water in this ditch flows northward, enters a culvert at the northwest corner of the leach basin, and is discharged at the stormwater discharge area.

4.1.3 Operation, Maintenance, and Monitoring

Navy contractors have continued regular operation, maintenance, and monitoring (OM&M) of the Site A remediation system and overall groundwater conditions since the last 5-year review in 2005. OM&M of the groundwater extraction and treatment system is performed in accordance with the Site A operations and maintenance manuals (U.S. Navy 2005b, 2006a, 2007a, 2008a, and 2009a).

Treatment system OM&M includes the following (U.S. Navy 2009a):

- Routine inspection and maintenance of equipment
- Weekly, quarterly, semiannual, and annual preventive maintenance of equipment
- Corrective maintenance of equipment as needed
- Monthly treatment system building inspections
- Compliance and performance monitoring and sampling, including recording operating parameters, sampling water at various stages within the treatment process, and water level monitoring in wells

Treatment System OM&M

Site A OM&M and performance data are documented in the 2009 annual groundwater sampling report (U.S. Navy 2010a). Since the last 5-year review in 2005, the extraction and treatment system has generally performed as designed, with periodic maintenance and repair completed as necessary. Response to unplanned shutdowns was sometimes hindered during this 5-year review period because of access limitations. Access restriction issues were resolved and impacts from subsequent unplanned shutdowns have been minimized (U.S. Navy 2010a).

Site A treatment system OM&M and performance data generated during this 5-year review period were difficult to locate within consistently titled periodic reports. Future 5-year reviews and other independent reviewers looking to confirm performance of the system and functionality of the remedy would be better served if these data and evaluations were consistently reported in a document with a readily identifiable title. To ensure that the title can be found in the Navy's electronic document archive, the suggested main title for annual reports that include groundwater monitoring data as well as treatment system OM&M and performance data is "*year* Operations, Maintenance, and Monitoring Report."

Groundwater Monitoring

Two new monitoring wells (A-MW56 and A-MW57) were installed in November 2009 (Figure 4-1, located at the end of Section 4). Well A-MW56 was positioned downgradient of A-MW49 to help delimit the extent of RDX in groundwater between A-MW49 and Tinosa Road. Well A-MW57 was positioned along Tinosa Road as a sentinel well between wells A-MW51 and A-MW52, with a screen interval set high in the saturated zone to intercept potential migration of contaminants at the top of the shallow aquifer. These wells were also installed to assist in assessing whether monitored natural attenuation (MNA) is feasible for the site (U.S. Navy 2010a).

Monitoring and extraction wells in the shallow aquifer and perched groundwater zone at Site A have been monitored since 2005 to assess contaminant distribution, compliance with RGs, and performance of the groundwater extraction and treatment system. Monitoring requirements have been prescribed by two plans during this time (U.S. Navy 2003a and 2007b). The planned monitoring program was optimized in 2007 for 2008 implementation. The planned and actual sampling program over the 5-year review period is summarized in Table 4-1 (located at the end of Section 4). In 2008 there were some apparent minor variances from the plan, as identified in Table 4-1. The five extraction wells and three monitoring wells (A-MW37, A-MW46, and A-MW51) were sampled semiannually instead of annually as planned. This variance represents sampling beyond the planned scope.

The monitoring program over the last 5 years is consistent with the ROD requirements.

Assessment of Extraction System Containment

Assessment of containment was performed as part of routine OM&M and reported during annual reporting. These assessments were based on observed hydraulic heads and downgradient chemical monitoring data (U.S. Navy 2010a). Potentiometric surface data show that current groundwater extraction does alter the potentiometric heads close to the point of extraction, but cannot accomplish sufficient drawdown in the low-permeability aquifer to achieve containment. This is consistent with the previous year's findings (U.S. Navy 2010a).

Chemical monitoring data downgradient of the infiltration wells show that RDX extends beyond the line of extraction wells. The first round of monitoring at new wells A-MW56 and A-MW57 confirms that A-MW49 is positioned near the leading edge of the plume, as RDX concentrations are well below the RG at A-MW56 and A-MW57 (U.S. Navy 2010a).

Natural degradation of ordnance compounds may also contribute to control of the plume at Site A. To assess the MNA potential of the site, groundwater samples were analyzed in 2009 for degradation indicator compounds MNX, DNX, and TNX. These degradation compounds were detected in numerous wells, and their presence provides a strong indication that degradation is active at Site A (U.S. Navy 2010a).

Leachate Basin Infiltration Barrier Repair

Steep and unstable slopes were left within the leach basin as a result of the 1997 soil removal effort. Erosion was identified in this area prior to 2007. There was concern that this erosion could have compromised the integrity of the leach basin liner. An assessment of the impact of erosion damage to the Site A leach basin liner in the previous soil removal area was conducted in May 2007 and reported in June 2007 (U.S. Navy 2007e). The basin liner acts as an infiltration barrier, and protection of the liner is part of the ongoing ICs mandated in the ROD for Site A. The liner's integrity is critical in fulfilling this purpose. A site visit was conducted on May 3, 2007. The integrity of the liner was determined to be in excellent condition and undamaged. The filter sand and liner in the area under the former hot spot excavation were found to be intact and in excellent condition. A small portion of the basin liner was found to be exposed (6- by 8-inch section) along the top of the southern berm, adjacent to the soil ramp. The exposed liner was found to be undamaged. Erosion was found on the unsloped edges of the excavation. Soil had sloughed off, creating unstable cuts, but there was no damage to the underlying liner. A site walk of the entire basin did not identify any other areas of concern (U.S. Navy 2007e).

The following actions were recommended to eliminate any potential damage to the liner and prevent further erosion in the basin (U.S. Navy 2007e):

- The exposed liner should be repaired. An area 3 by 3 feet should be hand dug around the exposed liner, a new section of geotextile installed, and a 6-inch minimum soil cover placed over the area. The area should be contoured to match the existing contours.

- The excavation edges should be graded to a 30-degree slope to prevent unstable banks. Work should be done in a manner to prevent damage to the underlying liner.

- The entire excavation area and sloped excavation should be planted with an erosion control blend of annual grasses or other plants. Sowing should occur at a time of the year that would provide the best survival rate of the new plants, with minimal additional care

These repairs were completed in accordance with the work plan in May 2008 (U.S. Navy 2007e and 2008d).

Institutional Controls Monitoring

ICs are part of the remedy at OU 1. The Institutional Controls Management Plan (ICMP) for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4). IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.2 OU 2 (SITE F)

4.2.1 Remedy Selection

Prior to completion of the RI/FS, a ROD for an interim remedial action (IRA) was signed in September 1991 (U.S. Navy, USEPA, and Ecology 1991b) with the goal of limiting further migration of the highest concentrations of ordnance in groundwater at Site F (i.e., containment of groundwater containing 80 mg/L RDX through pump and treat). The IRA ROD was amended in an ESD (U.S. Navy, USEPA, and Ecology 1994e), selecting GAC instead of UV/Ox for groundwater treatment.

Two primary RAOs were defined in the ROD for final action at OU 2:

- Eliminate the human health risk associated with potential direct contact with contaminated soils at Site F.
- Clean up groundwater contamination in the shallow aquifer at Site F to achieve the most cost-effective reduction in overall site risk.

The ROD (U.S. Navy, USEPA, and Ecology 1991b) states that "no impacts to surface water have occurred at the site." However, the ROD specifies numeric surface water RAOs for RDX, TNT, DNT, TNB, dinitrobenzene (DNB), nitrate, and manganese. These surface water RAOs were specified for protection of aquatic life. The ROD further states that "surface water originating at the seeps is not a current drinking water source." The ROD then specifies numeric RAOs for surface water as drinking water for the same compounds and inorganics.

The primary COCs driving remediation at Site F were TNT, RDX, and DNT in soil and TNT, RDX, DNT, and 1,3,5-TNB in groundwater.

To achieve the RAOs, the following remedial action components were specified in the OU 2 ROD:

- Excavate to a depth of 15 feet those soils with ordnance concentrations above residential soil cleanup levels, and treat them by composting. Monitor the effectiveness of treatment throughout implementation and make operational adjustments as needed.

- Following monitoring to verify that soil treatment is complete, use the treated soils to fill the Site F excavation and overflow ditch.

- Install an infiltration barrier over all soils with concentrations above soil cleanup levels for groundwater protection, and periodically inspect the barrier to ensure its integrity.

- Modify the site IRA groundwater remediation system by adding extraction wells to enhance, to the maximum extent practicable, removal of ordnance contaminants from the shallow aquifer at Site F.

- Treat extracted groundwater by GAC (and ion exchange, if needed for nitrate removal) to meet groundwater cleanup levels, and return the treated water to the shallow aquifer via reintroduction wells.

- Thermally regenerate the ordnance-loaded GAC to provide permanent destruction of the ordnance compounds.

- Monitor the effectiveness of the groundwater remediation, and make operational adjustments to optimize, to the extent practical, removal of contaminant mass from the shallow aquifer at Site F.

- Initiate formal review of the groundwater system operations after one of the following performance evaluation criteria is met:

    - Groundwater cleanup levels are achieved for all constituents of concern in the Site F shallow aquifer.

    - No statistically significant change in constituent concentrations is observed in monitoring wells with concentrations above cleanup levels after reasonable system modifications have been implemented.

- The rates of concentration decline in the Site F shallow aquifer indicate that the cost of continued system operation is substantial and disproportionate relative to the incremental degree of environmental protection being achieved.

Based on this review, the Navy and EPA, in consultation with Ecology, will determine whether system shutdown, continued operation, or another remedial response is warranted.

If the Navy and EPA, in consultation with Ecology, determine that continued operation of the Site F groundwater system is technically infeasible or impracticable, ICs and water quality monitoring of the shallow aquifer will be implemented as required by EPA and Ecology to protect human health and the environment until groundwater cleanup levels are achieved.

4.2.2 Remedy Implementation

Soil Remediation

Site F contaminated soils were excavated in summer 1996. The total volume of contaminated soil excavated was approximately 2,300 cubic yards, several times greater than the original estimate of 660 cubic yards. All excavated contaminated soil was hauled to the on-base treatment facility for screening and composting.

The on-base treatment facility was constructed in spring 1996. It consisted of a composting building and a stockpile/staging area with surface water controls. Soil screening to remove 1.5-inch-plus material was performed in the stockpile/staging area. Screening was necessary to prevent damage to the windrow tiller during the composting process. Approximately 300 cubic yards of oversize material were screened out. This material was rescreened to remove as much soil as possible, then sampled for ordnance contamination. Sampling results indicated that the oversize material exceeded cleanup criteria. Therefore, the rocks were pressure washed, stockpiled, and ultimately backfilled into the Site F excavation.

The screened soil was composted by combining it with four amendments to produce a mix that was approximately 25 percent (by volume) soil and 75 percent amendments. Composting was conducted by forming 6-foot-high by 14-foot-wide by 250-foot-long windrows, four of which could be accommodated in the composting building at the same time. Fifteen windrows were required to process the Site F soils. Windrows were monitored for temperature, oxygen, moisture, pH, and thermophilic bacteria and were tilled as needed based on monitoring results. They were also sampled regularly for TNT using field test kits, with less frequent off-site laboratory analysis for ordnance. Composting of each individual windrow continued until cleanup levels for residential (unrestricted) use were achieved. The average time for a windrow to reach the cleanup criteria was 30 days.

The OU 2 ROD specified that the composted soil be placed back in the Site F excavation (covered by the infiltration barrier). However, NBK at Bangor requested that the infiltration barrier area be paved over and a concrete-floored recycling facility installed to provide a long-term storage site. Because of the physical nature of the composted material, it was not feasible to place it beneath the pavement without severely weakening the pavement by settlement. Therefore, some of the composted soil was used at Site F to backfill areas outside the footprint of the pavement, and some was hauled to Site D and used as part of the restoration material at that site. This change was approved by Ecology. The Site F excavation was backfilled with a variety of materials, including oversize material from the screening of excavated Sites D and F soils and the existing asphalt pad at Site F, which was broken up into small pieces.

The infiltration barrier covers an area of approximately 1.4 acres. Elements of construction included drainage installation, 12 inches of grading fill, a high-strength woven geotextile fabric, a geosynthetic clay liner, a 12-inch soil cushion layer, 6 inches of base course, and the asphalt paving. Construction of the infiltration barrier began in August 1996, with final paving and construction of the recycling facility completed in December 1997.

Groundwater Remediation

The Site F IRA containment system, consisting of six extraction wells (F-EW1 through F-EW6), six reintroduction wells (F-IW1 through F-IW6), a GAC water treatment system with 300 gpm capacity, and associated conveyance piping, began operation in December 1994. Figure 4-2, located at the end of Section 4, depicts the Site F well network. The IRA system was shut down in September 1996 for construction of enhancements to the system, in accordance with the requirements of the OU 2 ROD for final remedial action.

The final action enhancements to the groundwater remediation system included construction of four new extraction wells (F-EW7, F-EW8, F-EW9, and F-EW10), three new reintroduction wells (F-IW7, F-IW8, and F-IW9), treatment plant expansion from 300 to 600 gpm capacity, new conveyance system piping to integrate the new extraction and reintroduction wells into the existing system while increasing conveyance system capacity to 600 gpm, and additional monitoring wells. The enhanced system began operation in January 1997.

The groundwater monitoring results from the second quarter of 2003 indicated that the RDX plume had migrated beyond its historical boundary and toward wells F-MW44 and F-MW64. Attempts to contain the plume by increasing pumping at extraction wells F-EW4, F-EW5, and F-EW6 were unsuccessful because of equipment limitations. As a result, several alternative steps were taken to improve the system performance. Among these were the rehabilitation of the 10 extraction wells, replacement of reintroduction well F-IW2 by F-IW2A, and the addition of two reintroduction wells (F-IW10 and F-IW11) and four monitoring wells (F-MW66 through

F-MW69). In addition, numerical modeling was performed to evaluate groundwater flow patterns at Site F (U.S. Navy 2004f).

Currently, 10 extraction wells are in operation at Site F (F-EW1 through F-EW10) (Figure 4-2, located at the end of Section 4). These wells are 8 inches in diameter and 100 to 200 feet deep, with 20- to 30-foot screen lengths and 0.020-inch screen slot size. The extraction wells can be divided into two categories based on their primary functions. Wells F-EW4, F-EW5, and F-EW6 are situated near the downgradient edge of the RDX plume, and their primary purpose is plume containment. A high operating factor (i.e., minimal downtime) must be achieved for these wells, in particular, in order to attempt to achieve RDX plume containment and to minimize further downgradient migration of RDX. The remaining extraction wells at Site F focus more on contaminant mass removal. Wells F-EW1, F-EW2, F-EW3, and F-EW7 are situated within the TNT plume, which is located immediately downgradient of the former wastewater lagoon and entirely within the much larger RDX plume. Wells F-EW8, F-EW9, and F-EW10 are situated along the approximate centerline of the RDX plume. While these three wells primarily focus on RDX mass removal, they also assist with RDX plume containment. The design flow rate of the system is 700 gpm (U.S. Navy 2008b).

4.2.3 Operation, Maintenance, and Monitoring

The Navy has continued regular OM&M of the Site F remediation system and periodic performance and compliance monitoring since the last 5-year review in 2005. OM&M of the groundwater extraction and treatment system is performed in accordance with the Site F operations and maintenance manuals (U.S. Navy 2005c, 2006b, 2007c, 2008b, and 2009b).

Performance monitoring is conducted to evaluate the effectiveness of the treatment process, and the results are used for the following (U.S. Navy 2009b):

- To track GAC loading and detect breakthrough
- To track total ordnance mass removal
- To document concentration trends in groundwater over time to demonstrate remediation progress
- To evaluate the need for operational adjustments to the treatment system
- To monitor the condition of the infiltration barrier to ensure structural integrity

Compliance monitoring results are used to verify the following:

- The system is limiting the migration of ordnance compounds.
- Ordnance compound concentrations in the shallow aquifer are being reduced to the RGs.
- Treated water meets water quality criteria required for reintroduction.

Treatment system OM&M includes the following (U.S. Navy 2009b):

- Quarterly, semiannual, and annual inspections and preventive maintenance on equipment
- Corrective maintenance of equipment as needed
- Monthly treatment system building inspections
- Compliance and performance monitoring and sampling, including recording operating parameters and sampling water at various stages within the treatment process

OU 2 Treatment System OM&M

Some routine OM&M tasks are performed on a daily basis. Since the last 5-year review in 2005, the extraction and treatment system has generally performed as designed, with periodic maintenance and repair completed as necessary (U.S. Navy 2009d). Treatment system OM&M are generally reported annually in the April quarterly reports.

Site F treatment system OM&M and performance data generated during this 5-year review period were difficult to locate within consistently titled periodic reports. Future 5-year reviews and other independent reviewers looking to confirm performance of the system and functionality of the remedy would be better served if these data and evaluations were consistently reported in a document with a readily identifiable title. To ensure that the title can be found in the Navy's electronic document archive, the suggested main title for annual reports that include groundwater monitoring data as well as treatment system OM&M and performance data is "*year* Operations, Maintenance, and Monitoring Report."

Groundwater Monitoring

Monitoring and extraction wells at Site F have been monitored periodically since December 1994 to assess contaminant distribution, compliance with RGs, and performance of the groundwater extraction and treatment system. Groundwater monitoring has been prescribed from 2005 through 2009 by two plans (U.S. Navy 2005d and 2007b). The planned monitoring program was optimized in 2007 for implementation starting in the fall of 2007. The planned and actual sampling program for Site F over the 5-year review period is summarized in Table 4-3 (located at the end of Section 4).

Table 4-3 identifies a number of sampling frequency variances that represent more sampling than was planned. Table 4-3 also identifies two instances in 2005 when quarterly samples were apparently not collected as planned (two quarterly samples not collected in two wells).

With the possible exception of a minor deviation in 2005, the monitoring program over the last 5 years is consistent with the ROD requirements.

The April 2009 groundwater monitoring report (U.S. Navy 2009d) states that monitoring for Site F is being conducted at sufficient frequencies to monitor trends. However, additional action is necessary to address concerns regarding the north plume edge wells above the RDX cleanup level of 0.8 μg/L. Because the two wells in question do not identify the northern limit of the plume, it was recommended that two new wells be installed to the north in the direction of projected transport. The report recommended that the new wells be located several hundred feet farther downgradient of F-MW67 and F-MW68, where their installation and regular access can be accommodated by existing Navy facilities (U.S. Navy 2009d).

Extraction System Containment Assessment

Assessment of containment was performed as part of routine OM&M, based on observed hydraulic heads and downgradient chemical monitoring data. Potentiometric surface data show that extraction from well F-EW5 and reintroduction in the line of infiltration wells has established a strong reversal of gradient supportive of good containment. Considering the configuration of the potentiometric surface, the limited hydraulic head observation points available between the individual infiltration wells limit the ability to determine with certainty that containment is complete. Fouling may be limiting performance at extraction well F-EW5 (U.S. Navy 2009d).

Chemical monitoring data downgradient of the infiltration wells show mostly decreasing trends, but also include slightly increasing concentrations at F-MW67. With complete containment, the expectation is that all downgradient wells would exhibit stable or decreasing trends. Nearby well F-MW68 does exhibit a decreasing trend. The trend at F-MW67 could be explained by incomplete containment, or the passing of a higher concentration slug whose migration precedes complete containment (U.S. Navy 2009d).

The OU 2 extraction system is also intended to provide containment of Otto fuel constituents in groundwater at Site E/11. The containment assessment for Site F does not explicitly consider Otto fuel at Site E/11.

Institutional Controls

ICs are part of the remedy at OU 2. The ICMP for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4). IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.3 OU 3 (SITES 16/24 AND 25)

4.3.1 Remedy Selection

The OU 3 ROD (U.S. Navy, USEPA, and Ecology 1994a) declared that risks at Sites 16/24 and 25 are within EPA's acceptable risk range and no remedial action is necessary. However, Site 16/24 surface soils had concentrations of antimony, arsenic, and beryllium above MTCA residential soil cleanup levels, and Site 25 groundwater had concentrations of cadmium and manganese above MTCA groundwater cleanup levels.

ICs restricting residential use of Site 16/24 were in place at the time the ROD was signed (included as Attachment 2 to the ROD). Property transfers for Site 16/24 will require a deed restriction to be attached and will have to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440.

The ROD required 5 years of semiannual groundwater monitoring at Site 25 to verify that metals concentrations detected in the shallow aquifer are consistent with natural background concentrations. The Navy, EPA, and Ecology were to compare the monitoring data against federal drinking maximum contaminant levels (MCLs), MTCA Method B groundwater cleanup levels, and representative background concentrations to determine whether additional monitoring or other actions are necessary. The need for residential use restrictions at Site 16/24 and continued groundwater monitoring at Site 25 were to be reevaluated as part of the 5-year review process.

4.3.2 Remedy Implementation

The residential use restrictions for Site 16/24 remain in place. The Navy prepared an ICMP for all of NBK Bangor in 2001 (U.S. Navy 2001a). The 2001 ICMP formalized the land use restrictions for Site 16/24. The ICMP was revised in 2007 (U.S. Navy 2007d), and another revision to the ICMP is scheduled for 2010. Further discussion on ICs is provided in Section 4.7.

Eight post-ROD semiannual groundwater monitoring rounds (March 1994 through September 1997) were completed at Site 25. The initial sampling rounds included analysis for metals, VOCs, semivolatile organic compounds (SVOCs), ordnance, pesticides, and PCBs. Based on the results of the initial monitoring, all analytes except metals were dropped from the sampling program after the second post-ROD sampling event.

Starting at Round 5, the sampling methodology changed from bailers to low-flow sampling with pumps. With this change, detected total metals concentrations decreased, indicating turbidity bias in the initial results for total metals. Following the fifth round, there was no exceedance for dissolved or total metals in any of the Site 25 groundwater samples, excluding a minor exceedance of thallium in one well during the fifth round (U.S. Navy 1999a). In addition, detected metals concentrations in the later sampling rounds were generally below background metals concentrations established for the shallow aquifer (U.S. Navy 1994).

Based on these analytical results, the Navy recommended discontinuation of the groundwater monitoring program for Site 25. Following review of the eight rounds of data and discussions between the Navy and Ecology, Ecology concurred with this recommendation. The Navy and Ecology agreed that the groundwater monitoring completed for Site 25 meets the requirements of the OU 3 ROD and that no additional monitoring is required (U.S. Navy 2000a). The post-ROD groundwater sampling at Site 25 also serves as an empirical demonstration that COC concentrations in soil are protective of groundwater.

ICs are part of the remedy at OU 3. The ICMP for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4). IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.4 OU 6 (SITE D)

4.4.1 Remedy Selection

The following RAOs were established in the OU 6 ROD:

- Prevent unacceptable human health risks posed by ingestion and dermal contact with TNT and DNT in Site D soils

- Prevent migration of metals from Site D surface waters at concentrations that may adversely affect ecological receptors in downstream surface waters

- Prevent potential future human health risks that may be posed by ingestion or inhalation of contaminants in shallow aquifer groundwater

To achieve these objectives, the following remedial action components were specified in the OU 6 ROD:

- Excavate and stockpile all soils at Site D containing TNT concentrations above the MTCA Method B residential soil cleanup level (33 mg/kg).

- Outside the wetland boundary, excavate and stockpile soils containing DNT concentrations above the MTCA Method B residential soil cleanup level (1.5 mg/kg).

- Within the wetland boundary, excavate and stockpile soils containing DNT concentrations above the MTCA Method C soil cleanup level (59 mg/kg). (Cleanup to Method B cleanup levels would result in significant damage to the wetlands.)

- Treat the excavated soils by composting at NBK Bangor to achieve MTCA Method B residential soil cleanup levels for nine designated ordnance compounds.

- Backfill the excavations with the treated soils, covering them with clean soils and revegetating the affected areas with native vegetation.

- Return the treatment area and any access roads to natural contours and revegetate them with native vegetation.

- Conduct one round of confirmation sampling and analysis (for metals and ordnance) in on-site and downgradient surface water samples following soil remediation to determine whether soil remediation activities at Site D negatively impact downgradient surface water. Consider response actions including active remediation if contaminants transported from Site D cause exceedances in downgradient surface waters.

The OU 6 ROD declared that active surface water remediation to address exceedances of MTCA Method B surface water cleanup levels was not practicable because the metals do not pose significant risks, are not being transported, and will attenuate naturally in the wetlands. Additionally, there was no source of the metals identified at Site D (other than stormwater runoff from Escolar Road adjacent to the site), and active remediation would create greater environmental risks than the baseline risks.

- Conduct short-term (one round) monitoring for VOCs in the shallow aquifer, using existing monitoring wells, to confirm exceedances of health-based criteria. If exceedances are confirmed, further characterization of the source and extent of VOCs in the shallow aquifer will be conducted. Once characterized, response action, including active remediation, will be considered.

- Complete a 5-year review to determine whether additional action or monitoring is required.

4.4.2 Remedy Implementation

Soil Excavation and Treatment

Field activities for the OU 6 remedial action began in December 1995. Following construction of the on-base composting treatment facility (also used for OU 2 soils as described in Section 4.2.2), contaminated Site D soils were excavated and hauled to the treatment facility for screening and composting. Three areas of Site D soils had been identified in the RI/FS to require remediation: grids G-1 and M-12 and the former burn trench. To expedite remediation, the two grids were sampled to confirm their locations in the field. The sampling indicated that soils in grid G-1 met soil cleanup levels for the wetland (MTCA Method C) and soils in grid M-12 met MTCA Method B soil cleanup levels. Following site reconnaissance and extensive discussions, Ecology declared these grid areas as requiring no further action.

The burn trench area, approximately 60 by 125 feet in area by 3 feet deep, was not sampled because data from the previous treatability study confirmed constituent concentrations above cleanup levels. Prior to excavation, an unexploded ordnance (UXO) survey was completed for the trench and no UXO was found. During excavation, TNT field test kits were used to delineate the extent of contamination on all boundaries of the excavation. Once the field test kits indicated that contaminated soils had been removed, verification soil samples were collected from the excavation for off-site laboratory analysis for ordnance using EPA Method 8330.

The Site D soils were composted using seven 250-foot-long windrows, which treated a total of approximately 880 cubic yards of contaminated soil. The soil was treated between July and

October 1996, with an average of 53 days per windrow to treat the soils to meet the direct contact soil cleanup levels specified in the ROD. The composting process was essentially the same as that described in Section 4.2.2 for OU 2 soils. The treated soils were returned to the excavation area at Site D between November 1996 and April 1997. In May 1997, the gravel road installed in the wetland during the RI/FS was breached and covered with compost to promote revegetation, and the site was graded to match the existing contours to the extent possible. In December 1997, wetland plants were planted over the former gravel road. In addition, nine monitoring wells were decommissioned as part of the remediation (five before excavation and four after site restoration) (U.S. Navy 1998a).

Surface Water Confirmation Monitoring

Following Site D soil treatment and site restoration, surface water samples were collected from nine locations at Site D in December 1997 and analyzed for target analyte list metals and ordnance. The samples were collected at upstream, midstream, and downstream locations from two ephemeral and one perennial stream. Ordnance compounds were not detected in the nine samples (or field duplicate). No elevated metals concentrations were detected.

Short-Term Groundwater Monitoring

The first round of groundwater sampling and analysis of groundwater was completed for four Site D monitoring wells in May 1996, prior to soil remediation. The samples were analyzed for VOCs and SVOCs. A sample from well MW-33 was also analyzed for heptachlor. The analytical results showed one qualified detection of BEHP above the MTCA Method B groundwater cleanup level (also detected in source and rinsate blanks). VOCs and heptachlor were not detected above cleanup levels. Following soil treatment and placement of the composted soil back on site, a second round of groundwater sampling was completed in June 1997. The second round of data showed no detection above the groundwater cleanup levels. The Site D monitoring wells were decommissioned as of June 2000 (U.S. Navy 2000a). The post-ROD groundwater sampling at Site D also serves as an empirical demonstration that COC concentrations in soil are protective of groundwater.

4.4.3 Operation, Maintenance, and Monitoring

No ongoing OM&M activity occurred at OU 6 during this review period, because none was required. However, OU 6 was included in the December 2005 assessment of potential impacts from perchlorate at NBK Bangor. This assessment resulted from a recommendation included in the second 5-year to conduct monitoring for perchlorate at Sites A and F. OU 6 was included because the area was formerly used for burning and detonation of ordnance.

Two new wells were installed at OU 6 in the area of former ordnance burning and detonation. Groundwater from these new wells was sampled for perchlorate, which was not detected. The two wells were subsequently abandoned (U.S. Navy 2006f).

4.5 OU 7 (SITES B, E/11, 2, 10, AND 26)

The selected remedy for OU 7 includes remedial action for Sites B (Floral Point), 2, and E/11 and no action with monitoring for Sites 10 and 26. The selected remedies for the remedial action sites are discussed below, followed by the monitoring-only sites.

4.5.1 Site B (Floral Point)

Remedy Selection

The RAOs for Site B as specified in the OU 7 ROD are the following:

- Prevent direct contact with and ingestion of soils containing PAH and PCB concentrations above MTCA Method A residential soil cleanup levels.
- Confirm through monitoring of the Hood Canal sediments and tissue that groundwater discharge from Floral Point into Hood Canal is not adversely affecting sediments or clam tissue.

To achieve these objectives, the following remedial action components were specified for Site B in the OU 7 ROD:

- Cover the site with a soil cover and vegetate the soil cover.
- Construct swales to control or reduce rainwater infiltration through the cover.
- Maintain the vegetated soil cover to prevent future contact with underlying soils.
- For Site B groundwater, conduct a 5-year monitoring program of marine sediments and clam tissue.

Remedy Implementation

Remedial action at Site B was completed between June and November 1997. The remedial activities included removal of surficial metal debris from the wetland area and decommissioning of nine monitoring wells used to evaluate site groundwater quality during the OU 7 RI/FS. The wells were decommissioned because they were not needed for future monitoring and they would have interfered with the vegetated soil cover. Contaminated soil areas were covered by 1 foot of soil overlain by a mulch layer. The soil cover was planted with native grasses and a variety of native plant species. The plants provide protection from soil erosion, improve habitat, and reduce infiltration at the site through increased evapotranspiration. A shoreline protection system, consisting of a sand and gravel blend (beach mix) similar to the native beach materials, was constructed along the site perimeter to reduce site erosion. At the time of placement, the slope of the beach mix ranged from 5:1 to 7:1 (horizontal:vertical), further enhancing site habitat quality. Control points were established at the top of the shoreline protection berm to monitor future beach movement. A stormwater drainage system was installed, including erosion controls (gravel in ditches and riprap below outfalls). Finally, a concrete turnaround was constructed at the top of the boat ramp to prevent erosion from vehicles using the ramp. Ecology reviewed the final remedial action report and determined that the Site B remedial action had been completed in accordance with the OU 7 ROD (Ecology 1999a).

Operation, Maintenance, and Monitoring

Sediment and clam tissue monitoring has been conducted in the area of Floral Point for 14 years (1991 through 2004) (Figure 4-3, located at the end of Section 4), and trends in this analytical data set have been analyzed as the data have accumulated. The data trends show that groundwater discharge from Floral Point into Hood Canal is not adversely affecting sediments or clam tissue. This monitoring component of the Site B remedy has functioned as intended by the ROD and is complete. (Ecology 2005). The ROD did not require long-term monitoring after it was demonstrated that groundwater discharge was not adversely affecting sediments or clam tissue (U.S. Navy 2005a).

An inspection and maintenance (I&M) plan for Site B (U.S. Navy 2000c) detailed the inspection procedures for the upland and shoreline components of the remedy and provided general guidance regarding preventive maintenance and repair. The I&M plan included an inspection and maintenance schedule for the soil cover, soil cover vegetation, removal of invasive plant species, shoreline protection system, perimeter road/parking area, stormwater drainage system, boat ramp/turnaround, and the water supply line. Monitoring of the shoreline protection system involved measurement from 10 monuments (hubs) on top of the gravel berm to the edge of the placed beach gravel.

The type and frequency of inspections required by the I&M plan were superseded by the ICMP published in 2001 (U.S. Navy 2001a) and a revision in 2007 (U.S. Navy 2007d). The ICMP requires an annual inspection that includes a systematic site walk with visual observation of the condition of the soil cap and vegetative cover. A form is included to record erosion measurements around the hubs.

During this 5-year review period, the NAVFAC NW Remedial Project Manager (or designee) has been completing and maintaining records of the site inspections, although documentation in the record is not 100 percent complete.

The second 5-year review recommended an engineering evaluation of shoreline erosion at Site B (Floral Point) and assessment of invasive plant species. Between September 11 and September 20, 2006, a maintenance action was conducted at Floral Point to replenish the beach where erosion had occurred and remove the invasive vegetation from the adjacent upland area (U.S. Navy 2006d). A predesign survey was conducted to collect elevation data needed to support a beach replenishment design. A biological assessment was conducted to determine whether implementation of the beach replenishment design was likely to adversely affect species proposed or listed under the Endangered Species Act of 1973. The biological assessment concluded that the project activities would either have "no effect" or "may affect, but not likely to adversely affect" endangered or threatened species located in the project area (U.S. Navy 2006e).

ICs are part of the remedy at OU 7 Site B. The ICMP for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4). IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.5.2 Site E/11

Remedy Selection

The following RAOs were established in the OU 7 ROD for Site E/11:

- Prevent direct contact with and ingestion of stockpiled soil, and underlying soil to a depth of 15 feet, containing dichlorodiphenyltrichloroethane (DDT) concentrations above the MTCA Method B residential soil cleanup level

- Prevent ingestion of groundwater with Otto fuel concentrations above 0.2 μg/L (the PQL)

To achieve these objectives, the following remedial action components were specified for Site E/11 in the OU 7 ROD:

- Transport and dispose of approximately 400 cubic yards of contaminated stockpiled soil at a RCRA-approved landfill.

- Because Site E/11 groundwater is being treated by the OU 2 (Site F) groundwater remediation system, monitor shallow aquifer groundwater at Site E/11 for Otto fuel and evaluate the effectiveness of removing the Otto fuel after 5 years. A groundwater use restriction will be put in NBK Bangor's master plan.

Remedy Implementation

In July and August 1997, approximately 830 cubic yards of stockpiled soils at Site E/11 were sampled for characterization, transported, and disposed of at a permitted landfill. A stockpile of metal debris (compacted drums and banding) was also disposed of at that time. Following disposal of the stockpiled soils, and prior to site restoration, two rounds of confirmation soil samples were collected from beneath the liner on which the soil stockpile was stored. The soil quality data demonstrated soil concentrations below MTCA residential soil cleanup levels. The site was graded and restored as directed by NBK Bangor (U.S. Navy 1998b). The ROD states that following the soil excavation removal actions at both sites, no organic compound was detected in soil or above background concentrations. Therefore, the removal and remedial actions for soil at these sites are protective of groundwater.

The groundwater use restriction component of the remedy was formally satisfied in 2000, with adoption of the base-wide ICMP required by the OU 8 ROD.

Operation, Maintenance, and Monitoring

Monitoring of Site E/11 groundwater has been addressed in various performance monitoring plans. Site E/11 groundwater is being monitored under the current Site F plan (U.S. Navy 2009b). Groundwater samples were initially collected from six Site E/11 monitoring wells in August 1996 and January 1997 (dry and wet seasons, respectively). Because Otto fuel was detected (0.2 to 0.5 mg/L) in only two monitoring wells (EMW-21U and EMW-23U; Figure 4-2, located at the end of Section 4), monitoring for Otto fuel continued for these two wells only. Because Site F extraction well F-EW4 is downgradient of Site E/11, it was also sampled until 1999 for Otto fuel to determine whether the low concentrations detected in the Site E/11 wells would be measurable in the extraction well. Otto fuel was detected in the groundwater samples collected from the extraction well in October 1997 and January 1998 at concentrations of 0.10 and 0.12 µg/L, respectively. Otto fuel was not detected in the five other samples collected from this well between January 1997 and April 1999 at a detection limit of 0.10 µg/L.

Since the first 5-year review in 2000, the Site E/11 monitoring wells EMW-21U and EMW-23U were sampled annually each year except for 2004 (January 2000, 2001, and 2002 and March 2003). Samples have been collected annually from these wells during this review period (Table 4-3).

ICs are part of the remedy at OU 7 Site E/11. The ICMP for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4). IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.5.3 Site 2

Remedy Selection

The RAO for Site 2 was to prevent direct contact with and ingestion of stockpiled soil and underlying soil to a depth of 15 feet containing PCB concentrations above the MTCA Method A residential soil cleanup level.

To achieve this objective, the following remedial action components were specified for Site 2 in the OU 7 ROD:

- Screen approximately 5,000 cubic yards of stockpiled soil for metallic debris, with waste characterization of the metallic debris and screened soil.
- Dispose of the metallic debris (landfill disposal or metal recycling, depending on waste characterization results).
- Dispose of the screened soil (landfill disposal or use as backfill for the disturbed area at Site 2, depending on waste characterization results).

Remedy Implementation

The first action taken at Site 2 was decommissioning of six monitoring wells in August 1995 because they were no longer needed. In fall 1997, the stockpiled materials from Containment Cell Nos. 1 and 2 (approximately 2,500 cubic yards each) were loaded into a screened plant hopper to mechanically segregate the metallic debris from the soil. The screened soils from the two containment cells were stockpiled separately pending analytical results.

During the screening of Cell No. 2, metal objects were observed that appeared to be potential UXO items. One item was confirmed to be a potential UXO object and was turned over to the Explosive Ordnance Disposal Unit. A UXO specialist was on site to oversee the screening of the remaining stockpiled materials. No live ordnance was discovered during the remaining screening.

In addition, asbestos-containing material (ACM) was discovered in bags during the screening of Cell No. 1 materials. Inspection of the screened material revealed small pieces of ACM mixed with the soil placed at the lower end of the site. The ACM-containing soil was rescreened and the ACM pieces removed by hand. Analysis of the screened soil did not indicate the presence of asbestos fibers. The ACM was drummed and disposed of by NBK Bangor.

Following stockpile segregation, samples of the screened soils from Cell Nos. 1 and 2 were sampled and analyzed for PCBs for disposal characterization. Remediation was completed in December 1995, and the screened soils and metal debris were properly disposed of by NBK Bangor at a permitted landfill. Ecology reviewed the final closeout report and determined that the Site 2 remedial action had been completed in accordance with the OU 7 ROD (Ecology 1998).

ICs are not required at OU 7 Site 2.

4.5.4 Site 10

Remedy Selection

The RAO for Site 10 was to prevent ingestion of groundwater containing TPH concentrations above the MTCA Method A groundwater cleanup level of 1 mg/L throughout the aquifer.

To achieve this objective, the following remedial action components were specified for Site 10 in the OU 7 ROD:

- Conduct confirmatory groundwater monitoring.
- Establish ICs to restrict groundwater use.

If TPH contamination in Site 10 groundwater was confirmed, further investigation would be undertaken.

The OU 7 ROD also states that the existing asphalt pavement will be maintained to protect human health and the environment.

The OU 8 ROD amended the Site 10 remedy by stating that it was not necessary for the pavement to remain in place. This amendment was based on a finding that the cancer and noncancer risk for future residents from chemicals in soil at Site 10 were acceptable, based on EPA criteria, and that the concentrations of these chemicals in soil passed the applicable MTCA criteria.

The Site 10 remedy was again amended in 2008, through a memorandum to the administrative file (U.S. Navy 2008e). This memorandum established asphalt capping as a component of the remedy for an area of Site 10 soil that was found to contain arsenic, lead, cadmium, and PCBs at concentrations above the MTCA Method A soil cleanup level for unrestricted land use (U.S. Navy 2009h, Appendix J). These contaminants in soil at Site 10 were identified during a construction project to add a new warehouse and parking lot to a previously unpaved portion of Site 10.

Remedy Implementation

The first 5-year review (U.S. Navy 2000a) found that the two original remedy components for Site 10 had not been completed and listed this as a deficiency. In response to that finding, the Navy conducted two groundwater sampling events, on November 6, 2000, and July 17, 2001 (U.S. Navy 2002). Groundwater samples were collected from well 10MW01 and analyzed for diesel- and oil-range (residual-range) petroleum hydrocarbons using Ecology method Northwest Total Petroleum Hydrocarbon—diesel (NWTPH-Dx). Petroleum hydrocarbons were not detected in the groundwater samples collected on either date at concentrations above the MTCA Method A groundwater cleanup level of 1.0 mg/L (U.S. Navy 2002). This sampling event satisfied the first component of the remedy for Site 10 as established in the OU 7 ROD, and no further groundwater sampling has been conducted at Site 10. Ecology concurred with the decision to not continue groundwater monitoring at Site 10. The post-ROD groundwater monitoring provided an empirical demonstration of protection of groundwater for any TPH in soil. However, post-ROD groundwater samples were not analyzed for metals and PCBs, which were added as COCs in 2008. The addition of an asphalt cap reduces infiltration through soil containing these COCs, providing protection of groundwater. Concentration ranges of COCs added in 2008 and remaining in soil at the site are as follows (U.S. Navy 2009h):

- Arsenic: 5.8 to 510 mg/kg
- Cadmium: 4.0 to 15 mg/kg
- Lead: 39 to 1,100 mg/kg
- PCBs: 0.8 to 5.3 mg/kg

The asphalt capping component of the remedy, as added by the memorandum to the administrative file (U.S. Navy 2008e), was constructed between September 22 and November 7, 2008 (U.S. Navy 2009h). Amendments to the ICMP to expand the footprint of Site 10 subject to ICs and to require maintenance of the asphalt cap are part of the 2010 update to the ICMP.

Because of the proximity of Site 10 to OU 8, Site 10 is included in the area covered by the groundwater use prohibition IC for OU 8. The IC for OU 8 meets the requirements of this component of the remedy for Site 10 as established in the OU 7 ROD. The 2010 update to the ICMP will add the asphalt pavement maintenance requirement. Restricted media, ICs, and engineering controls based on the current ICMP (U.S. Navy 2007d) are summarized in Table 4-2, located at the end of Section 4.

IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion of ICs is provided in Section 4.7.

Operation, Maintenance, and Monitoring

After completion of the final groundwater sampling round in July 2001, no further active OM&M has been required beyond periodic IC inspections and reporting.

4.5.5 Site 26

Remedy Selection

The RAO for Site 26 was to confirm that chemical concentrations in the biologically active zone of the Hood Canal sediments are not increasing. No COCs were established for Site 26.

To achieve this objective, the following remedial action components were specified for Site 26 in the OU 7 ROD:

- Complete at least two sediment sampling and analysis events over a 5-year period at Service Pier, Keyport/Bangor (K/B) Dock, and Marginal Wharf. In addition, sediment and clam tissue monitoring will be completed at Floral Point to confirm that chemicals in groundwater from Site B are not adversely affecting the marine environment.

- Evaluate trends in detected chemical concentrations. If contamination is observed to increase in concentration and/or areal extent, the need for additional source control activities, additional sediment sampling, and/or implementation of engineered sediment controls will be assessed.

Remedy Implementation

The original Site 26 sediment and tissue monitoring program (U.S. Navy 1996) was developed based on review of the RI data (1991 to 1992) and discussions at a March 1996 meeting of interested parties.

The overall monitoring program for Site 26 has been modified as portions of the site have met the RAOs in the OU 7 ROD. During the RI/FS phase, Site 26 consisted of eight marine areas, including the area offshore of Floral Point (Figure 1-2, located at the end of Section 1). The OU 7 ROD required future sampling at four of these areas: Floral Point, Marginal Wharf, K/B

Dock, and Service Pier. In 1996, sediment samples were obtained from multiple stations at each of these four marine areas (U.S. Navy 1996). At Floral Point, clam tissue samples were collected in addition to the sediment samples.

For the 1998 sampling effort, sampling at some marine areas was eliminated entirely and the number of sampling stations at other marine areas was reduced based on the results from the 1996 analysis. The eliminated stations and/or marine areas were those where COCs were not detected at concentrations exceeding the SQS. The modifications to the Site 26 sampling program were made by the Navy with the concurrence of Ecology. Completion of the 1998 monitoring event fulfilled the OU 7 ROD requirement for monitoring at Site 26. However, Ecology requested continued monitoring at some marine areas (including Floral Point) as part of the 5-year review process, stating the following (Ecology 1999b):

- No further monitoring is required for Service Pier and Marginal Wharf to satisfy the OU 7 ROD requirements.

- An additional surface sediment sample should be collected at MS70 near K/B Dock to confirm the 1998 BEHP detection (108 mg/kgoc). If BEHP in the additional sample exceeds the CSL, additional source control, additional sampling, and/or engineered sediment controls will be assessed, in accordance with the OU 7 ROD.

- Because hazardous substances have been left in place at Floral Point, long-term monitoring of sediment and clam tissue near Floral Point is required (once every 5 years for the 5-year review) and should be included as a component of the Final OM&M plan for Floral Point.

To fulfill Ecology's request, samples were collected from Floral Point and K/B Dock in October 2000 in support of the first 5-year review (U.S. Navy 2001b). Following this sampling event, future sampling was required only for Floral Point (U.S. Navy 2001b).

During these modifications to the overall Site 26 monitoring program, the number of sediment and clam tissue sampling locations for Floral Point was unchanged (U.S. Navy 2001b). A fourth sampling event was conducted in October 2004 at Floral Point in support of the second 5-year review. This sampling event is discussed in the following section.

Operation, Maintenance, and Monitoring

The only OM&M tasks conducted at Site 26 since the first 5-year review in 2000 consist of sediment and clam tissue sampling at Floral Point. One sampling event was conducted in fall

2004 in support of the second 5-year review, and no sampling was conducted during this 5-year review period.

Sediment and tissue samples were collected in 1996, 1998, 2000, and 2004 as part of the remedy for both Sites 26 and B (Floral Point). Based on these results, the second 5-year review (U.S. Navy 2005a) concluded that the monitoring component of the Site B/Site 26 remedy was complete, fulfilling all required monitoring at these sites. The second 5-year review recommended that sediment and clam tissue monitoring be discontinued because the RAOs had been met. Ecology concurred in 2005 (Ecology 2005).

ICs are not part of the remedy for OU 7 Site 26.

4.6 OU 8

4.6.1 Remedy Selection

The following RAOs were established in the OU 8 ROD:

- Minimize the migration of VOCs from LNAPL beneath the PWIA into groundwater at concentrations that would cause adverse noncancer health effects or unacceptable cancer risks.
- Minimize human exposure to COCs in site-wide groundwater that would result in adverse noncancer health effects or unacceptable cancer risks.

The compounds 1,2-DCA and benzene are the primary VOCs present in OU 8 groundwater and were the COCs driving remediation at the site.

The following remedial action components were selected to meet the RAOs:

- Monitor natural attenuation of COCs in groundwater.
- Consider phased contingent actions if MNA is shown to be insufficient, including the possible use of oxidation reduction potential (redox) manipulation, pumping and treating groundwater using the existing system, or new technologies.
- Remove LNAPL using a free-product recovery system until the recovery rate reaches the practicable endpoint of an average 0.5 gallon per month for a 1-year period.

- Establish ICs for OU 8, both on and off base, to prevent the use and consumption of untreated groundwater.

In addition to these remedy components for OU 8, the OU 8 ROD formally established ICs for other sites at NBK Bangor to comply with recent EPA guidance regarding ICs (USEPA 2002). The formalization of ICs for other sites was incorporated into the OU 8 ROD in lieu of preparing ESDs for each of the previously signed RODs. The ICMP was updated in 2007 (U.S. Navy 2007d).

4.6.2 Remedy Implementation

The Navy developed "general requirements and procedures to implement two of the selected remedies specified in the Final OU 8 Record of Decision" in January 2001 (U.S. Navy 2001d). The two components of the remedy addressed were MNA and passive LNAPL recovery. Detailed project plans for conducting MNA were also prepared in late 2000 and early 2001 and amended in 2002 (U.S. Navy 2004b). The MNA component of the remedy was initiated in October 2000.

Phased contingent actions were included as part of the selected remedy for OU 8 and were to be implemented only if MNA was shown not to be meeting the cleanup goals. Based on the reappearance of LNAPL (described below) and increasing petroleum constituent concentrations (described in Section 6.4), the Navy has deployed Oxygen Release Compound socks at the site. The conclusion of a recent groundwater recovery system inspection is that the system is no longer serviceable.

The Navy began the LNAPL removal component of the OU 8 remedy in January 2001, when a passive LNAPL skimming pilot test was conducted. Passive skimmers were installed in wells VS2, VS7, VS8, VS10, VS12, MW05, and 8MW49 (Figure 4-4, located at the end of Section 4) and serviced at 1- to 3-day intervals over a 16-day period. LNAPL was also bailed from the wells with the greatest LNAPL thickness (including VS4, in which a skimmer could not be installed because of a constriction near the top of the well casing). Nearly 15 gallons of LNAPL were recovered during the pilot test, 9 by bailing and 6 by skimming (U.S. Navy 2001c).

Based on the success of the pilot test, the Navy began continuous operation of the eight passive skimmers on April 24, 2001 (U.S. Navy 2003b) and implemented an operation and maintenance plan for the skimming system (U.S. Navy 2001c). Further discussion of LNAPL recovery efforts is included in Section 4.6.3.

The Navy prepared an ICMP for all of NBK Bangor in 2001 (U.S. Navy 2001a). The ICMP satisfied the IC remedy component for OU 8, as well as addressing ICs for other OUs where ICs were not originally included in the RODs. The ICMP was updated in 2007 (U.S. Navy 2007d), and a revised ICMP is scheduled for 2010. Institutional and engineering controls are summarized by OU in Table 4-2 (located at the end of Section 4) and discussed further in Section 4.7 (U.S. Navy 2007d).

4.6.3 Operation, Maintenance, and Monitoring

MNA monitoring was initially conducted quarterly, with the frequency decreased to semiannually after November 2001. The monitoring well network is shown on Figure 4-4, located at the end of Section 4. Table 4-4 (located at the end of Section 4) summarizes the planned versus actual monitoring program from 2005 through 2009. Table 4-4 shows that the MNA monitoring plans have been successfully implemented.

The operation and maintenance (O&M) manual for the passive LNAPL recovery system (U.S. Navy 2001c) specified periodic maintenance and monitoring with frequency such "that the collection chambers are not completely filled at the time of servicing." Performance monitoring results were to be reported on a monthly basis.

In September 2004, the Navy reviewed the overall performance of the LNAPL recovery system and concluded that the ROD goals for LNAPL recovery had been met. The September 2004 point paper also notes that "optimization of product recovery was routinely conducted on a well-specific and site-wide basis in efforts to maximize the rate at which LNAPL is removed from the subsurface" (U.S. Navy 2004c). The Navy ceased LNAPL recovery efforts in June 2004, but continued LNAPL thickness measurements (U.S. Navy 2004c). Ecology concurred with the conclusion that the endpoint criteria had been reached in a letter dated November 2, 2004.

Product was observed in well 8MW47 during 2007. Groundwater sample collection was terminated at that time, and a dedicated bladder pump was installed to recover the product. Oil sorbent socks have since replaced the bladder pump and are changed out on a monthly basis. Monthly free-product monitoring was resumed at the site.

The Navy finalized an evaluation of remedial action operations for OU 8 in 2010 (U.S. Navy 2010c). The goal of the evaluation was to provide recommendations and develop an optimized strategy that can be implemented to achieve site closure in the shortest amount of time, while maximizing cost effectiveness and maintaining a high level of data quality. Specific objectives included the following:

- Evaluate the RAOs to determine if they are appropriate and achievable.
- Evaluate the effectiveness and suitability of the existing remedy to meet the RAOs.

- Evaluate opportunities to reduce O&M costs.
- Evaluate potential modifications to improve the effectiveness of the overall remedy and to identify and evaluate the costs associated with alternate remedial approaches.
- Provide recommendations for an optimization strategy at OU 8.

The evaluation concluded that the existing monitoring well network consists of reasonably spaced, centerline monitoring wells that adequately characterize the plume both vertically and horizontally. The list of geochemical MNA indicators is appropriate for characterizing whether the subsurface conditions are amenable to biodegradation of petroleum hydrocarbons and chlorinated solvents. As a result, changes to the current monitoring program were not recommended (U.S. Navy 2010c).

The evaluation identified three “target treatment areas”: the PWIA source area, 1,2-DCA hot spots, and the base boundary.

The Navy is currently evaluating a reactive barrier of emulsified vegetable oil (EVO) with bioaugmentation using KB-1 on a pilot scale to determine whether anaerobic biodegradation can effectively address 1,2-DCA hot spots. Results of the planned pilot study will be used to determine whether a reactive barrier of EVO with bioaugmentation using KB-1 could be effective for full-scale implementation. However, the results of the pilot study would need to be thoroughly evaluated prior to full-scale implementation of EVO with bioaugmentation using KB-1. Based on the evaluation, MNA, with this enhancement as an accelerant, would function as the final remedy at OU 8. This final remedy would be consistent with the final remedy for 1,2-DCA stipulated in the OU 8 ROD, and a ROD amendment will likely not be required.

Because a reactive barrier of EVO with bioaugmentation using KB-1 would do little to address residual benzene mass in the PWIA, the enhanced MNA strategy includes a contingency to implement active treatment within the PWIA source area. Currently, the benzene plume is stable and contained on Navy property. However, significant residual hydrocarbon mass remains in the subsurface within the PWIA source area, and it is expected that the benzene plume will persist in groundwater at elevated concentrations for an extended period of time. Active treatment within the PWIA source area would likely reduce the overall time required for MNA to achieve cleanup goals. Based on the cost benefit analysis in the evaluation, active remediation is recommended within the PWIA to remove benzene mass, decrease the time necessary for MNA to decrease dissolved benzene concentrations in groundwater, and achieve cleanup goals. Air sparging with SVE is recommended because the effectiveness is anticipated to be greater than other options considered. This alternative is favorable because it will effectively treat contaminant mass in groundwater as well as residual contamination in the smear zone. Air sparging with SVE represents a fundamental change in the remedy and therefore would require a ROD amendment prior to implementation.

Remediation within the 1,2-DCA hot spots is expected to reduce 1,2-DCA concentrations at the base boundary. However, sufficient time will be required for the effects of treatment to be realized in wells at the base boundary. Therefore, a reactive barrier of EVO with bioaugmentation using KB-1 will be considered as a contingency if 1,2-DCA concentrations increase above the cleanup level in samples from wells outside of the base boundary. This will be similar to the approach to the hot-spot area, in that it could be implemented under the existing ROD-specified MNA remedy for OU 8, and a ROD amendment will likely not be required.

ICs are part of the remedy at OU 8. The ICMP for NBK Bangor was updated in 2007 (U.S. Navy 2007d). Restricted media, ICs, and engineering controls are summarized in Table 4-2 (located at the end of Section 4) and the OU 8 IC boundary is shown on Figure 4-5 (located at the end of Section 4).

ICs for OU 8 can be broken down into two categories. For the off-base portion of OU 8, the Navy connected residences located within or near the contaminated plume to a municipal water supply in 1995. In addition, negotiated water use agreements were prepared between the Navy and affected residents that prohibited household use of the groundwater. These agreements also state that residents are not to install new wells in the contaminated aquifer. Restrictions on well use and installation throughout the off-base portion of the plume are enforced by the Bremerton/Kitsap County Health District. Local requirements for new wells on developed or undeveloped land require individuals to go through an approval process administered by the Bremerton/Kitsap County Health District. Because the Health District discovered the first contaminated well off base, they have full knowledge of contaminants in site groundwater. They have stated that they will keep abreast of cleanup actions for OU 8 and will not certify new drinking water wells until the Health District has reviewed the water quality data and determined that groundwater is safe for human consumption.

The water use agreements mentioned above are recorded with the Kitsap County Auditor's office. They are legal agreements that "run with the land" and are legally binding to subsequent private property owners. The Navy provides monitoring data to the Bremerton/Kitsap County Health District so they can determine when the off-base groundwater is safe for human consumption.

The IC for the on-base portion of OU 8 prohibits construction of drinking water wells within the area shown on Figure 4-5. This IC is enforced via the NBK Bangor environmental review process for proposed new construction projects on the base. The specific objectives of the OU 8 ICs include the following:

- No well drilling, except for monitoring and remediation wells authorized in the EPA- and State-approved compliance and performance monitoring plans.
- Protect existing monitoring wells.
- Ensure land use does not jeopardize the integrity of the monitoring and/or remediation system.
- No use of groundwater except for monitoring, unless otherwise approved by EPA and/or the State.
- Ensure that on-base restrictions apply now and in the future, even if the Navy no longer has control of the property.
- Ensure that these restrictions are included in deed restrictions applied at the time that property is transferred to a non-federal entity.

IC inspections are required periodically and are generally conducted and reported on an annual basis. Further discussion on ICs is provided in Section 4.7.

4.7 INSTITUTIONAL CONTROLS MANAGEMENT

ICs are currently managed under the ICMP that was updated in 2007 (U.S. Navy 2007d). The ICs instituted at NBK Bangor are summarized by OU in Table 4-2. IC requirements are described for each site within the ICMP. The Navy is currently updating the NBK Bangor ICMP for regulatory review and comment.

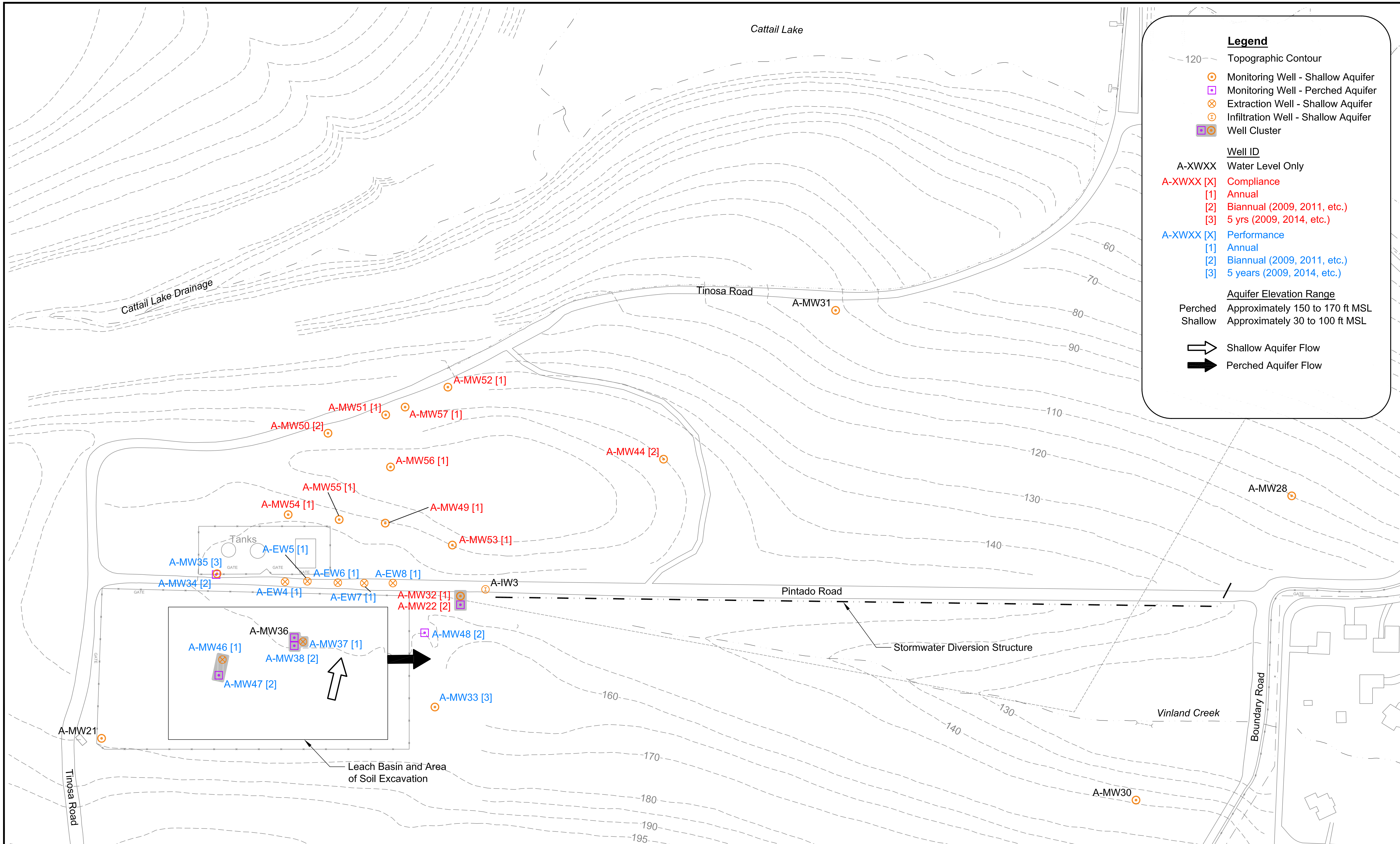
Under the ICMP, the Navy established ICs as part of the Navy Installation Restoration Program. The procedures in the ICMP require the following:

- Notifying planners and other Navy personnel about the environmental conditions of the property that is encumbered by ICs
- Limiting land use to nonresidential and outdoor recreational uses in designated areas
- Providing a process for inspection and maintenance of institutional and engineering controls

- Providing tracking information to regulators that the land use remains consistent with restrictions placed upon them by selected ICs

The ICs for each area covered under the ICMP are described in detail in the ICMP and the boundaries of each area are shown on figures in the ICMP. The ICMP established procedures for annually inspecting each area subject to ICs and documenting the inspections using a checklist provided in the ICMP, field notes, and photographs. Contingency inspections were also required in the event that information indicated that an IC might have been compromised at an IC area. Any deficiencies (such as damaged signs) were to be noted and corrected through the NBK Bangor work-order process. The ICMP provided for updates to the ICs as necessary over time, with the concurrence of Ecology and EPA.

IC inspections are carried out annually, document site conditions, and specify corrective actions as appropriate.



U.S. NAVY

NBK Bangor
THIRD 5-YEAR REVIEW

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SCALE IN FEET

Figure 4-1
Site A Long-Term
Monitoring Well Network

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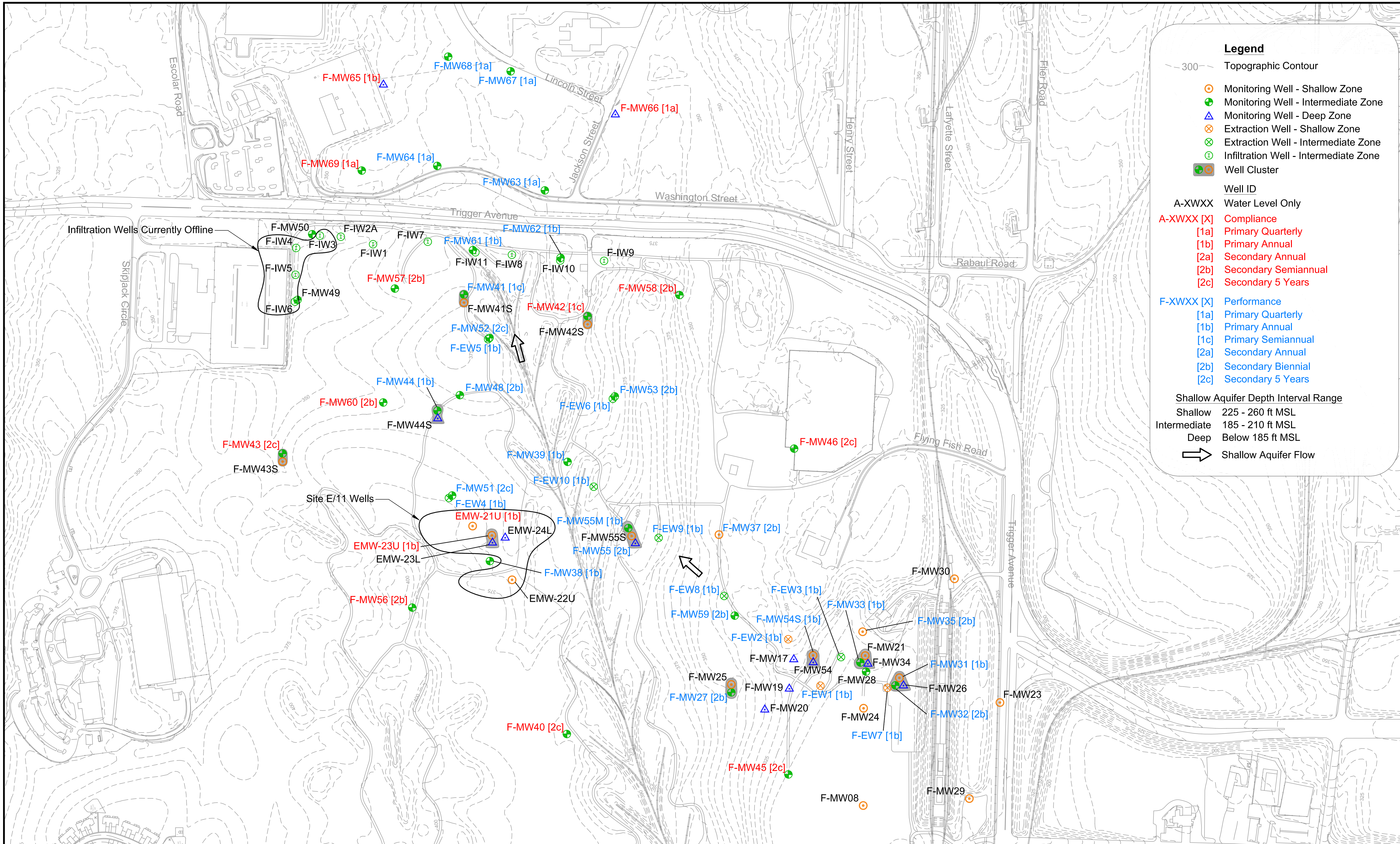

U.S. NAVY

NBK Bangor
THIRD 5-YEAR REVIEW

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Figure 4-2
Site F Compliance and Performance Monitoring Well Network

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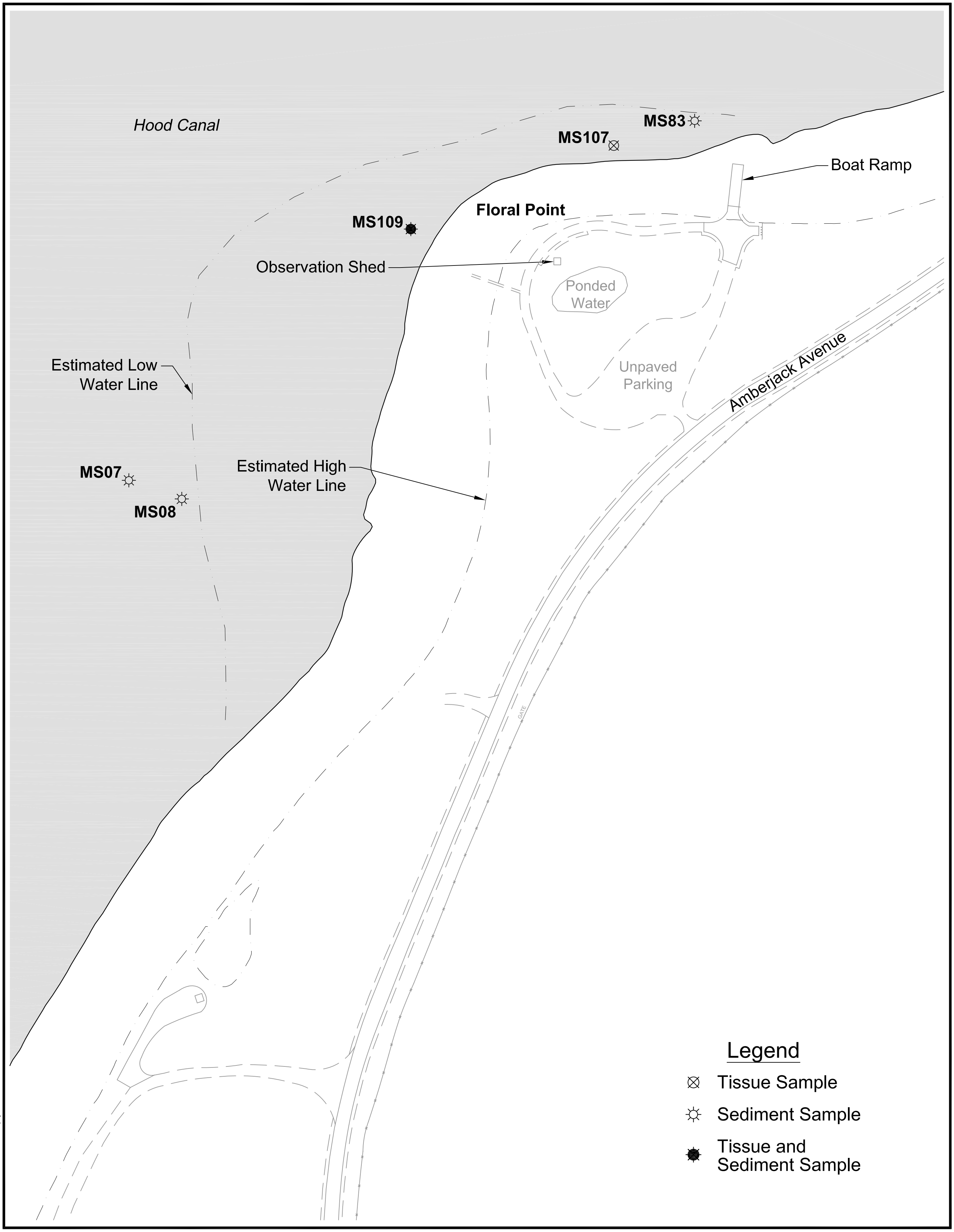

U.S. NAVY

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Figure 4-3
Floral Point Marine Sediment and Tissue Sampling Locations

NBK Bangor
THIRD 5-YEAR REVIEW

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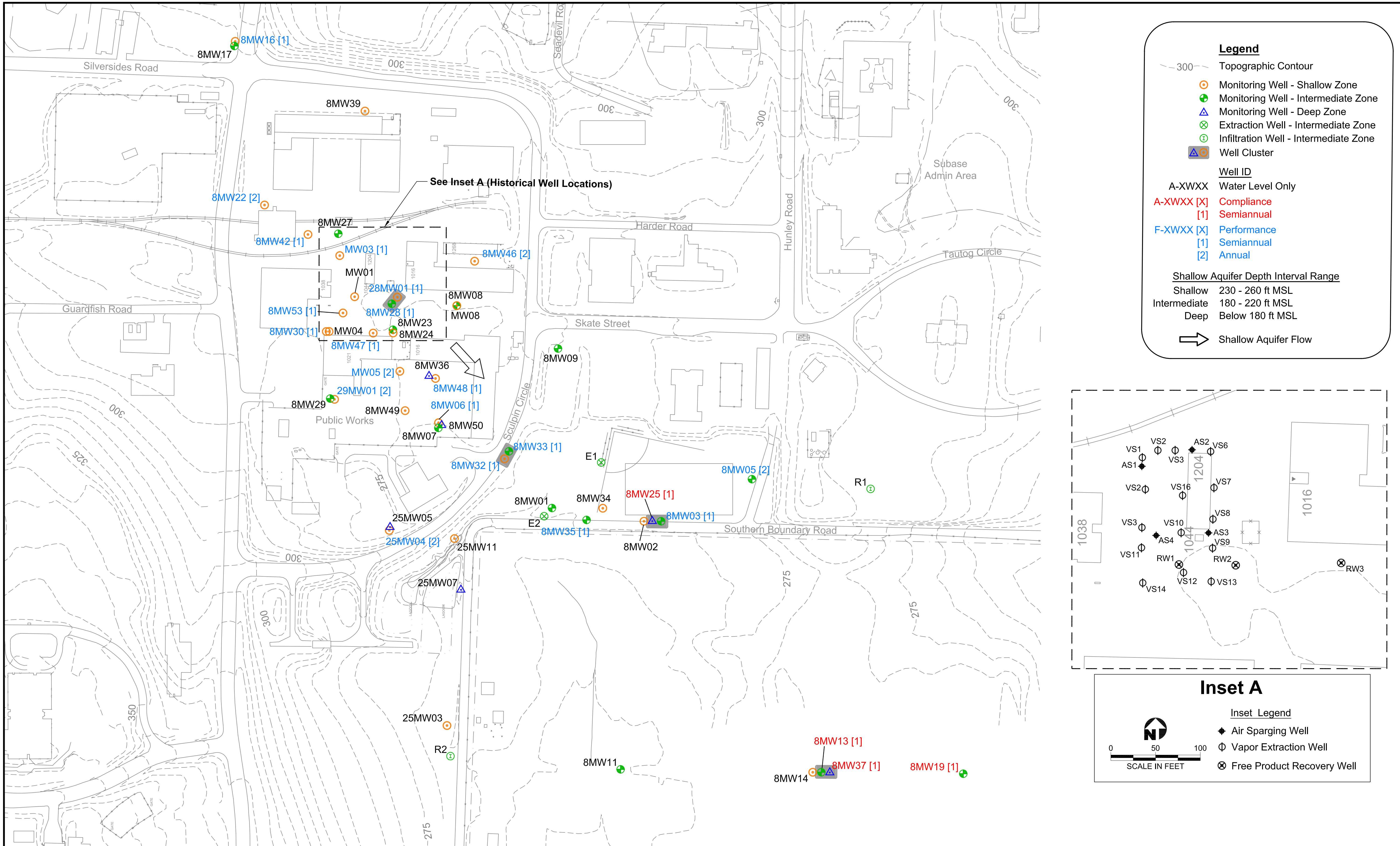

Figure 4-4
Operable Unit 8
Compliance and Performance
Monitoring Well Network

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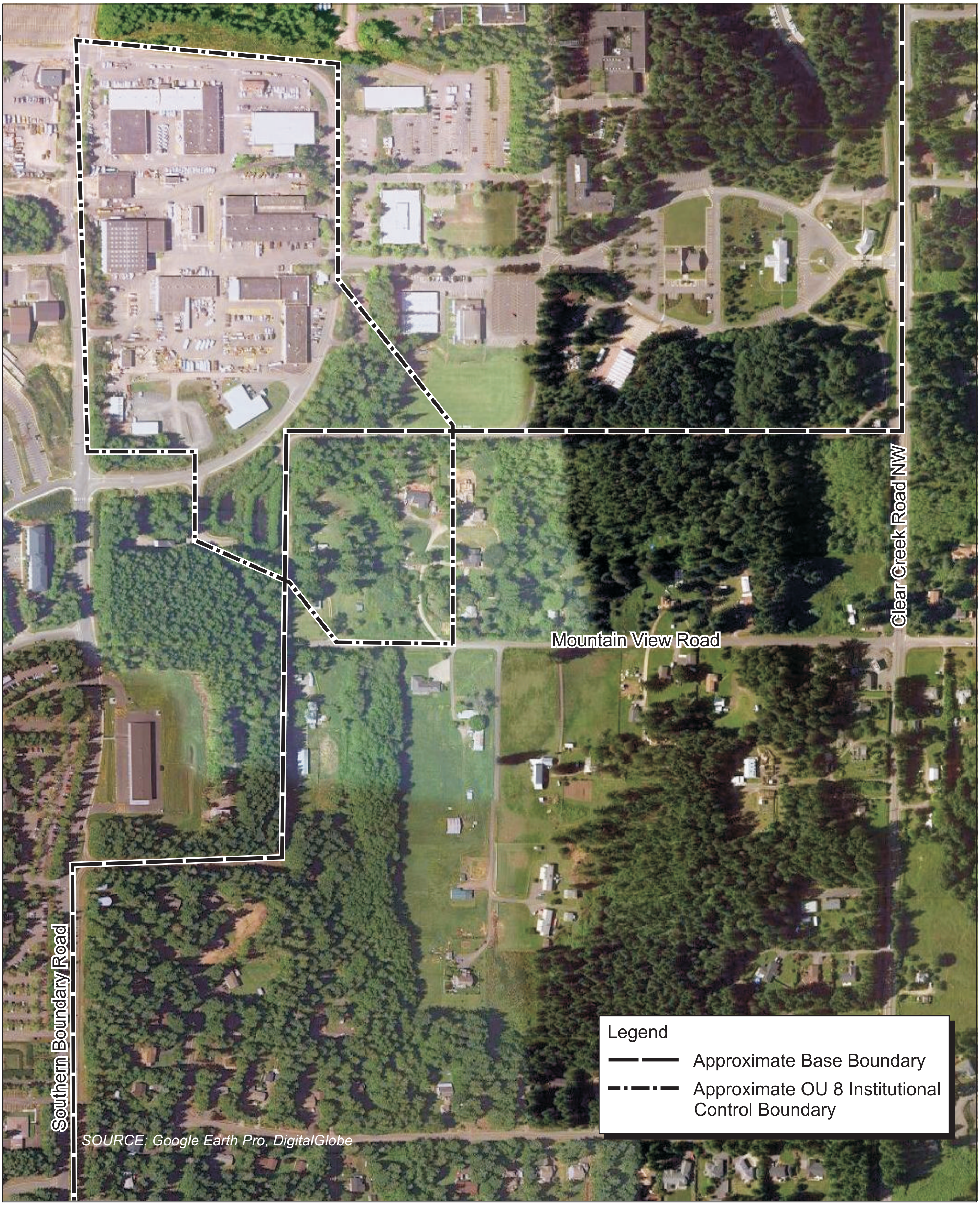


U.S.NAVY	**Figure 4-5** **OU 8 Institutional Control Boundary**	NBK Bangor THIRD 5-YEAR REVIEW

Table 4-1
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Site A

Well ID	Planned Sampling Frequency		Planned Analytes		Actual				
	2003 to 2007	2008 to 2009	Nitrate/ Nitrite	Ordnance Analytes	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
A-EW4	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-EW5	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-EW6	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-EW7	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-EW8	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW22	NP	Biennial	X	X	NP	NP	NS	NS	Biennial
A-MW28	Annual	NP	X	X	Annual	Annual	Annual	NS	NP
A-MW30	Annual	NP	X	X	Annual	Annual	Annual	NS	NP
A-MW32	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW33	Semiannual	Every 5 years	X	X	Semiannual	Semiannual	Semiannual	NP	**Annual**
A-MW35	Semiannual	Every 5 years	X	X	Semiannual	Semiannual	Semiannual	NP	**Annual**
A-MW34	NP	Biennial	X	X	NP	NP	NP	NS	Biennial
A-MW37	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW38	NP	Biennial	X	X	NP	NP	NP	NS	Biennial
A-MW46	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW47	NP	Biennial	X	X	Annual	Annual	Annual	NS	Biennial
A-MW48	NP	Biennial	X	X	Annual	Annual	Annual	NS	Biennial
A-MW44	Semiannual	Biennial	X	X	Semiannual	Semiannual	Semiannual	NS	Biennial
A-MW49	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual

Table 4-1 (Continued)
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Site A

Well ID	Planned Sampling Frequency		Planned Analytes		Actual				
	2003 to 2007	2008 to 2009	Nitrate/ Nitrite	Ordnance Analytes	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
A-MW50	Semiannual	Biennial	X	X	Semiannual	Semiannual	Semiannual	NS	Biennial
A-MW51	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW52	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW53	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW54	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW55	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual
A-MW56	Semiannual	Annual	X	X	Semiannual	Semiannual	Semiannual	Semiannual	Annual

Notes:
Bold entry represents more frequent sampling than planned.
NP - not planned
NS - not sampled

Table 4-2
Summary of Institutional and Engineering Controls by Operable Unit

Site Name (Associated OU)	Restricted Media	Institutional Control	Engineering Control
Site A Burn Area (OU 1)	Groundwater and leach basin liner	• Groundwater use prohibition • Land use inconsistent with remedy • Excavation permits required	• Maintain leach basin liner • Treatment system protection
Site A Debris Area 2 (OU 1)	Soil	• Outdoor recreational land use only • Construction cover is prohibited • Excavation permits required	• Maintain signs • Maintain barberry or similar thorny bush
Site F (OU 2)	Groundwater and infiltration barrier	• Groundwater use prohibition • Land use inconsistent with remedy • Excavation permits required	• Maintain infiltration liner barrier • Treatment system protection
Site E/11 (OU 7)	Groundwater	• Captured as part of Site F	• Captured as part of Site F
Site 16/24 (OU 3)	Soil	• Residential land use restriction • Excavation permits required	None
Site B (OU 7)	Soil	• Residential land use restriction • Excavation permits required	• Maintain vegetative soil cover
Public Works Industrial Area (OU 8 on base)	Groundwater	• Land use consistent with cleanup activities • Groundwater use prohibition • Excavation permits required	None
Mountain View Neighborhood (OU 8 off base)	Groundwater	• Groundwater use prohibition	None

Note: OU - operable unit

Table 4-3
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Sites F and E/11

Well ID	Planned Sampling Frequency		Planned Analytes			Actual				
	2005 to 2006	2007 to 2009	Otto Fuel	Nitrate/ Nitrite	Ordnance Analytes	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
Site F										
F-MW27	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW31	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW32	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW33	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW35	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW36	NP	NP		X	X	NP	NP	NP	NP	NP
F-MW37	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW38	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW39	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW40	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW41	Semiannual	Biennial		X	X	X	X	**Semiannual**	**3 times**	**Annual**
F-MW42	Biennial	Biennial		X	X	**Semiannual**	**Semiannual**	**Semiannual**	**3 times**	**Annual**
F-MW43	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW44	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW45	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW46	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW48	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW51	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW52	Biennial	Every 5 years		X	X	X	NP	X	NP	**Annual**
F-MW53	Biennial	Biennial		X	X	X	NP	X	NP	X

Table 4-3 (Continued)
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Sites F and E/11

Well ID	Planned Sampling Frequency		Planned Analytes			Actual				
	2005 to 2006	2007 to 2009	Otto Fuel	Nitrate/ Nitrite	Ordnance Analytes	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
F-MW54	NP	NP		X	X	NP	NP	NP	NP	NP
F-MW54S	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW55	Biennial	Biennial		X	X	X	NP	X	NP	X
F-MW55M	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-MW56	Semiannual	Biennial		X	X	X	X	X	NP	X
F-MW57	Semiannual	Biennial		X	X	X	X	X	NP	X
F-MW58	Semiannual	Biennial		X	X	X	X	X	NP	X
F-MW59	Semiannual	Biennial		X	X	X	X	X	NP	X
F-MW60	Semiannual	Biennial		X	X	X	X	X	NP	X
F-MW61	Quarterly	Annual		X	X	X	X	X	**Semiannual**	X
F-MW62	Quarterly	Annual		X	X	X	X	X	**Semiannual**	X
F-MW63	Quarterly	Quarterly		X	X	X	X	X	X	X
F-MW64	Quarterly	Quarterly		X	X	X	X	X	X	X
F-MW65	Quarterly	Annual		X	X	X	X	X	**3 times**	X
F-MW66	Quarterly	Quarterly		X	X	**Twice**	X	X	X	X
F-MW67	Quarterly	Quarterly		X	X	X	X	X	X	X
F-MW68	Quarterly	Quarterly		X	X	X	X	X	X	X
F-MW69	Quarterly	Quarterly		X	X	**Twice**	X	X	X	X
F-EW1	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW2	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW3	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X

Table 4-3 (Continued)
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Sites F and E/11

Well ID	Planned Sampling Frequency		Planned Analytes			Actual				
	2005 to 2006	2007 to 2009	Otto Fuel	Nitrate/ Nitrite	Ordnance Analytes	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
F-EW4	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW5	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW6	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW7	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW8	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW9	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
F-EW10	Semiannual	Annual		X	X	X	X	X	**Semiannual**	X
Site E										
EMW-21U	Annual	Annual	X	X		X	X	X	X	X
EMW-23U	Annual	Annual	X	X		X	X	X	X	X

Notes:
Bold entry represents more frequent sampling than planned.
Bold shaded entry represents less frequent sampling than planned.
NP - not planned
NS - not sampled
X - sampled as planned

Table 4-4
Summary of 2005 to 2009 Planned Groundwater Monitoring Program Versus Actual for Operable Unit 8

Location ID	Planned Sampling Frequency 2005 - 2009	Planned Analytes			Actual				
		VOCs	Ethane/ Ethene Methane	Mn	Sampled 2005	Sampled 2006	Sampled 2007	Sampled 2008	Sampled 2009
MW03	Semiannual		X	X	X	X	X	X	X
MW05	Annual		X	X	X	NR	X	X	X
8MW03	Semiannual	X	X	X	X	X	X	X	X
8MW06	Semiannual	X	X	X	X	X	X	X	X
8MW13	Semiannual	X			X	X	X	X	X
8MW16	Semiannual		X	X	X	X	X	X	X
8MW19	Semiannual	X			X	X	X	X	X
8MW25	Semiannual	X			X	X	X	X	X
8MW28	Semiannual	X	X	X	X	X	X	X	X
8MW30	Semiannual		X	X	X	X	X	X	X
8MW32	Semiannual		X	X	X	X	X	X	X
8MW33	Semiannual	X	X	X	X	X	X	X	X
8MW35	Semiannual	X	X	X	X	X	X	X	X
8MW37	Semiannual	X			X	X	X	X	X
8MW42	Semiannual	X	X	X	X	X	X	X	X
8MW47	Semiannual	X	X	X	X	X	X	X	X
8MW48	Semiannual		X	X	X	X	X	X	X
8MW53	Semiannual		X	X	X	X	X	X	X
28MW01	Semiannual		X	X	X	X	X	X	X

Notes:
Mn - manganese
NR - data report notated as NR; NR not defined in report
NS - not sampled
VOCs - volatile organic compounds
X - sampled as planned or planned

5.0 PROGRESS SINCE LAST 5-YEAR REVIEW

This section summarizes the status of recommendations and follow-up actions from the last review, the results of implemented actions, including whether they achieved the intended purpose, and the status of any other prior issues (Table 5-1). The Navy has completed most of the actions recommended by the last 5-year review. Outstanding issues include the ongoing evaluation of treatment system optimization and groundwater plume containment at Sites A and F.

Table 5-1
Actions Taken Since Previous 5-Year Review

Recommendations/ Follow-up Actions	Completion Date	Notes Regarding Completion	Reference
Finalize optimization recommendations for treatment systems at Sites A and F.	Not completed	Some of the recommendations from the optimization studies for these sites have been implemented. However, optimization or revision of these treatment systems is still under review.	Navy RPM interview response, Appendix A
During plume containment evaluations for Site F, include analysis of Otto fuel containment and ensure annual sampling.	Annually since January 2005	Following the second 5-year review, Otto fuel was included in the groundwater analyte list as required, with analysis annually from 2005 through 2009. However, the containment assessment for Site F extraction system does not explicitly consider Otto fuel.	Site F monitoring reports
Perform engineering evaluation of shoreline erosion at Site B (Floral Point) landfill and assess invasive plant species.	September 2006	Following predesign surveys, design, and consultation, the Navy replenished the beach and removed invasive vegetation in September 2006.	U.S. Navy 2006c and 2006d
Continue monitoring focus on benzene concentration trends in the plume core at OU 8. Evaluate in future monitoring reports whether new exposure pathways have been created at the site and whether benzene concentrations exceed those evaluated in the original risk assessment.	Semiannually, 2004-2009	Monitoring reports prepared since the second 5-year review have included analysis of spatial and temporal trends in COC concentrations, including benzene. The reports have also compared current COC concentrations to pre-ROD concentrations. The reports have not specifically addressed potential new exposure pathways (such as vapor intrusion).	OU 8 monitoring reports 2004-2009
Maintain copies of annual IC inspection reports at both NBK Bangor and NAVFAC NW to ensure complete records.	Annually since 2006	Records are available for each year since the second 5-year review, except 2005.	NAVFAC NW files
Expand the IC boundary for Site F to include the larger area of the groundwater plume.	2009	The IC boundary for Site F was expanded in the GIS database for NBK Bangor, and the ICMP was being updated at the time of this review.	Navy RPM interview response, Appendix A

Table 5-1 (Continued)
Actions Taken Since Previous 5-Year Review

Recommendations/ Follow-up Actions	Completion Date	Notes Regarding Completion	Reference
Conduct groundwater monitoring for perchlorate at Sites A and F	December 2005	Perchlorate was included in the analyte list during the December 2005 monitoring for Sites A and F. New groundwater monitoring wells were installed at Site D (OU 6) and sampled for perchlorate. Perchlorate was not detected in groundwater at any of the three sites.	U.S. Navy 2006

Notes:
COC - chemical of concern
GIS - geographic information system
ICs - institutional controls
ICMP - Institutional Controls Management Plan
NAVFAC NW - Naval Facilities Engineering Command Northwest
NBK - Naval Base Kitsap
OU - operable unit
ROD - Record of Decision
RPM - Remedial Project Manager

6.0 FIVE-YEAR REVIEW PROCESS

6.1 FIVE-YEAR REVIEW TEAM

The Navy is the lead agency for this 5-year review, which covered the period August 2004 through October 2009. Personnel from NAVFAC NW and NBK Bangor represented the Navy in this 5-year review. Project managers and other staff from the EPA and Ecology have participated in the review process. Both the EPA and Ecology are cosignatories of the RODs for NBK Bangor. All team members had the opportunity to provide input to this report. Comments received from EPA and Ecology, together with the Navy's responses, are included in Appendix A.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

There are specific requirements pursuant to CERCLA Section 117(a), as amended, that require certain reports to be released to the public and that the public be notified of proposed cleanup plans and remedial actions. The community notification and involvement activities are described in the paragraphs below.

A notice was published by the Navy on July 19, 2009, in the *Kitsap Sun* informing the public that the site is currently undergoing a 5-year review; when, where, and how they could receive information; and how to provide comments on the protectiveness of the remedy. Also, interested community members were interviewed as part of the site interview process described in Section 6.6. Other than interview responses (Appendix A), the Navy received no comments or inquires as a result of the public notification.

The Navy has maintained an ongoing commitment to community involvement since the time of the first investigations at NBK Bangor. The Navy has a written community relations plan, which was updated in 2009, that is available for public review (U.S. Navy 2009c). The community has been informed of progress at the site through fact sheets, published public notices, and public meetings. The proposed plans were circulated for public comment before the RODs were finalized. Key documents have been made available for review at NAVFAC NW and the Central Kitsap Regional Library on Sylvan Way in Bremerton.

A Restoration Advisory Board (RAB) for NBK Bangor was established in 1995 to provide community input to remediation activities at NBK Bangor. The RAB members included representatives of the Navy, regulatory agencies, civic groups, private citizens, tribal governments, local governments, and environmental activist groups. The NBK Bangor RAB was active from 1995 to 2005. It was disbanded in May 2005 since there was no longer sufficient, sustained community interest and the RAB had achieved the installation's desired end goal.

A number of newsletters and fact sheets have been produced in the past by environmental project managers associated with NBK Bangor and/or by the Deputy Public Affairs Officer assigned to specific projects.

6.3 DOCUMENT REVIEW

Documents reviewed during this 5-year review were those describing the construction and monitoring of the selected remedies, the RODs describing the selected remedies, and the ICMP for NBK Bangor.

The primary documents that were reviewed are listed below:

- The signed RODs (OUs 1, 2, 3, 6, 7, and 8) (U.S. Navy, USEPA, and Ecology 1991a, 1994d, 1994a, 1994c, 1996, and 2000a)
- The first and second 5-year reviews for NBK Bangor (U.S. Navy 2000a and 2005a).
- OM&M plans and monitoring reports prepared during this 5-year review period were reviewed for OUs 1, 2, 7, and 8. The current O&M plans reviewed are U.S. Navy 2009a, 2009b, and 2009g. The monitoring or annual reports that provided historical summaries of data collected at the sites and assessments of remedy performance are U.S. Navy 2009d, 2009f, and 2010a.
- IC implementation/monitoring documentation provided by NBK Bangor environmental department (unpublished)
- Updated cost data documented in the NAVFAC NW cost database (unpublished)

Review of these documents provided much of the information included in Sections 3 and 4 regarding the description of the OUs, the RAOs and selected remedy components for each OU, and the status of remedy implementation and monitoring at each OU.

6.4 DATA REVIEW

This section summarizes trends in data collected through the various monitoring programs at NBK Bangor, with emphasis on data collected since the last 5-year review. The monitoring programs are described in Section 4, and the implications of the data for the functionality and protectiveness of the remedies are discussed in Section 7.

The data trends are discussed in the sections that follow by OU, area, and medium.

6.4.1 Groundwater Contaminant Trends at OU 1 (Site A)

Results of ordnance constituent concentrations in groundwater samples collected at the site since 1994 are summarized in Appendix B (U.S. Navy 2010a). TNT, 2,6-DNT, and 2,4-DNT were not measured at concentrations greater than their respective cleanup levels in the August 2009 samples collected from 14 monitoring wells and 7 extractions wells. RDX was measured at concentrations greater than the cleanup level of 0.8 µg/L in groundwater samples from 5 extraction wells and 5 of the 14 monitoring wells sampled in August or November 2009. RDX concentrations in groundwater samples from extraction wells ranged from 1 to 180 µg/L. RDX concentrations in groundwater samples from monitoring wells ranged from 5.3 to 110 µg/L. The August 2009 distribution of RDX in groundwater is shown on Figure 6-1, while potentiometric surface contour maps are provided on Figures 6-2 and 6-3 located at the end of Section 6. The highest August 2009 extraction well RDX concentration was measured in the sample from A-EW7 (Figure 6-1). The highest August 2009 monitoring well RDX concentration in the perched zone was in A-MW48, located just north of the burn area. In the shallow aquifer, the highest August 2009 concentration was in A-MW49, located approximately 140 feet downgradient of A-MW7 (Figure 6-1). No shallow aquifer monitoring well is located within the burn area. RDX was not measured at concentrations greater than the reporting limit of 0.14 and 0.079 µg/L in the two new monitoring wells A-MW56 and A-MW57, respectively. These wells were installed and sampled in November 2009 to assist in the assessment of RDX extent in groundwater and the feasibility of MNA for the site (U.S. Navy 2010a).

Statistical trend analysis was conducted for the 2009 annual groundwater data report (U.S. Navy 2010a). A screening process was used to assess which data sets were suitable for a Mann-Kendall statistical analysis to identify an increasing, decreasing, or no concentration trend (stable or not stable). As a result of the screening, data sets for the following monitoring wells were determined to be suitable for statistical evaluation of RDX concentration trends in groundwater (U.S. Navy 2010a): A-MW22, A-MW34, A-MW47, A-MW48, A-MW32, A-MW37, A-MW46, A-MW49, A-MW54, A-EW4, A-EW5, A-EW6, A-EW7, and A-EW8.

A summary of the Mann-Kendall evaluation is provided in Table B-2 of Appendix B (reproduced from U.S. Navy 2010a) and discussed in the following subsections. The discussion is organized by extraction wells and monitoring wells.

OU 1 (Site A) Extraction Well RDX Concentration Trends

A Mann-Kendall statistical evaluation was conducted for data from the seven operating extraction wells at the site for the 2009 annual report. Data collected through 2009 show that RDX concentrations have shown an increasing trend in extraction wells A-EW5 and A-EW6. RDX was measured at 6.1 µg/L in the 1997 sample from A-EW5. RDX concentration increased to a maximum of 130 µg/L in 2007 and have since decreased to 29 µg/L in the 2009 sample. RDX was measured at 17 µg/L in the 2004 sample from A-EW5, indicating a 12 µg/L increase in RDX concentration in samples from extraction well A-EW5 between 2004 and 2009.

RDX was not measured at a concentration greater than the estimated reporting limit of 0.98 µg/L in the 1997 sample from A-EW6. RDX concentration increased to a maximum of 48 µg/L in the 2007 and 2008 samples. The RDX concentration has since decreased to 1 µg/L in the 2009 sample from A-EW6. RDX was not measured at a concentration greater than the reporting limit of 0.48 µg/L in the 2004 sample from A-EW6, indicating a modest 0.52 µg/L increase in RDX concentration in samples from extraction well A-EW6 between 2004 and 2009.

RDX concentrations show a decreasing trend in groundwater samples from extraction wells A-MW37 and A-MW46. These wells are located in the center of the leach basin. RDX has decreased in A-MW37 samples from a high of 220 µg/L during 1998 to 130 µg/L in 2009, while RDX has decreased in A-MW46 samples from 200 µg/L in 1998 to 80 µg/L in 2009.

RDX concentrations have remained relatively stable from 2004 to 2009 in samples from extraction wells A-EW4, A-EW7, and A-EW8. These wells flank A-EW5 and A-EW6 along Pintado Road.

Of the seven operating extraction wells, two showed increasing trends. The magnitude of these increases from 2004 to 2009 were approximately 5-fold at A-EW5 and 2-fold at A-EW6. A-EW5 and A-EW6 are interior extraction wells in the line of extractions wells along Pintado Road. Two extraction wells (A-MW37 and A-MW48) showed decreasing trends. RDX concentrations in the remaining wells have remained relatively stable with no statistically significant trends.

OU 1 (Site A) Monitoring Well Concentration Trends

Trend evaluation was conducted for RDX results from four perched zone wells (A-MW22, A-MW34, A-MW47, and A-MW48). RDX concentrations at three of these wells (A-MW22, A-MW34, and A-MW47) show no trends and stable conditions. A-MW22 has not been sampled since 1997, and RDX concentrations in groundwater from this well were stable at around 140 µg/L. Groundwater samples collected from well A-MW34 have remained below reporting limits since 1996. The statistical analysis indicates a decreasing trend for RDX concentrations in groundwater from AMW-48, as RDX concentrations have decreased from 160 µg/L in 1995 to 74 µg/L in 2009.

Trend evaluation was conducted for RDX results from three shallow aquifer wells (A-MW32, A-MW49, and A-MW54) for data from 2004 through 2009. RDX concentrations in groundwater samples from all three wells show decreasing trends. RDX has decreased in A-MW32 samples from a high of 23 µg/L in 2001 to 5.3 µg/L in 2009, in A-MW49 samples from a high of 550 µg/L in 2002 to 39 µg/L in 2009, and in A-MW54 samples from a high of 2.5 µg/L in 2002 to 0.65 µg/L in 2009.

OU 1 (Site A) Ordnance Constituent Distribution in Groundwater

There have been sporadic detections of TNT, 2,6-DNT, and 2,4-DNT in groundwater at the site. However, the primary ordnance constituent in groundwater is RDX. Figures 3-2 (U.S. Navy 2005f) and 3-3 (U.S. Navy 2010a) in Appendix B show the 2005 and 2009 lateral RDX distribution in groundwater, respectively. The estimated lateral distribution appears to have decreased slightly from 2005 to 2009. The biggest difference is the decrease in the lateral extent of the plume core, which is represented by the 100 µg/L contour on both of these figures. Based on the result for well A-MW49 (180 µg/L), the plume core was estimated to extend approximately 200 feet west (downgradient) of Pintado Road in 2005. Once again considering the A-MW49 (39 µg/L) result, the 2009 estimated lateral extent of the plume core has receded to just west of Pintado Road. The southern plume core lobe has also receded approximately 200 feet to the north, based on the 2005 (130 µg/L) and 2009 (80 µg/L) results for A-MW46.

As previously stated, wells A-MW56 and A-MW57 were installed in November 2009. Well A-MW56 was positioned downgradient of A-MW49 to assist in the assessment of RDX extent in groundwater between A-MW49 and Tinosa Road. Well A-MW57 was positioned along Tinosa Road as a sentinel well between wells A-MW51 and A-MW52, with a screen interval set high in the saturated zone to intercept potential migration of contaminants at the top of the shallow aquifer. These wells were also installed to assist in assessing whether MNA is feasible for the site (U.S. Navy 2010a). Initial sampling results indicate that groundwater samples from these wells did not contain RDX, TNT, 2,6-DNT, or 2,4-DNT at concentrations above their respective reporting limits.

Over the past 13 years, monitoring of two Site A shallow aquifer monitoring wells (A-MW28 and A-MW30) located near the northern base boundary has shown no detectable RDX. The monitoring data demonstrate that the plume is not approaching the northern base boundary and that drinking water wells in Vinland are not threatened by Site A contaminants.

Trend Evaluation Conclusion

RDX concentrations are stable in three of the four perched monitoring wells (A-MW22, A-MW34, and A-MW47). RDX concentrations are decreasing in the general source area perched monitoring well (A-MW48). These trends suggest that the RDX in the perched zone is stable under pumping conditions in the upgradient area and stable or decreasing in the downgradient area under pumping conditions. In addition, the overall decline in the lateral extent of the plume in the shallow aquifer and the overall decrease in shallow aquifer COC concentrations over the years appear to indicate that any residual source present in the perched aquifer is not contributing enough contaminant mass to the shallow aquifer to increase the plume extent or concentrations.

RDX concentrations are decreasing in the three shallow aquifer monitoring wells (A-MW32, A-MW49, and A-MW54). These trends suggest that RDX concentrations are decreasing in the downgradient portion of the shallow aquifer.

The trend evaluation suggests that RDX concentrations are stable at either end of the line of extraction wells along Pintado Road (A-EW4, A-EW5, and A-EW8) and increasing in two of the interior extraction wells along this line (A-EW5 and A-EW6). RDX concentrations are decreasing in the general source area wells A-MW37 and A-MW46. Increasing RDX trends in A-EW5 and A-EW6 likely are attributable to sampling methods over the previous 3 years that did not isolate the well being sampled from water from other extraction wells (U.S Navy 2010a).

Treatment System Performance

Cumulative contaminant mass removal over time for the Site A pump and treat system is plotted in Appendix B. The system has removed approximately 49 pounds of total ordnance since operations began in May 1997. Approximately 27 pounds of the total is RDX and approximately 2 pounds of the total is TNT. Approximately 8 pounds of RDX has been recovered during this review period (2005 to 2009). From 2005 through 2009, the average cost per pound of RDX removed was $250,000, which is consistent with the cost per pound reported during the previous 5-year review period. The treatment system treated approximately 1.2 million gallons of water in 2009 (U.S. Navy 2010a).

6.4.2 Groundwater Contaminant Trends at OU 2 (Site F)

Groundwater data for OU 2 (Site F) is evaluated for statistical trends on an annual basis for the April quarterly report (U.S. Navy 2009d). A historical summary of groundwater analytical results are presented in Tables C-1, C-2, and C-3 in Appendix C.

OU 2 (Site F) April 2009 RDX Distribution in Groundwater

The April 2009 limits of RDX in groundwater are shown on Figure 6-4, while groundwater elevation contour maps are provided on Figures 6-5 and 6-6 located at the end of Section 6. The limits of RDX in groundwater appear to be adequately delimited with, the exception of that part of the plume north of Washington Street (Figure 6-4). It appears that a low concentration portion of the plume has migrated beyond the line of infiltration wells just south of Washington Street. The northern extent of this low concentration area is not bounded.

The core of the RDX plume is identified by results from wells F-MW48 (2,900 µg/L) and F-MW39 (1,400 µg/L) (Figure 6-4). This core has migrated approximately 2,500 feet from the source area. A residual high concentration area has been defined by results from wells F-MW35 (590 µg/L) and F-MW33 (160 µg/L).

OU 2 (Site F) RDX Concentration Trends in Groundwater

Concentration trends were evaluated using a Mann-Kendall analyses. Results of the analyses are summarized by well in Table C-5 (Appendix C) (U.S. Navy 2009d).

The northern portion of the plume was assessed using wells F-MW61 through F-MW69. RDX has not been measured at concentrations greater than reporting limits in samples from four of these wells (F-MW61, F-MW62, F-MW65, and F-MW66). Decreasing trends were identified in samples from F-MW63 and F-MW68. Increasing trends were identified in samples from wells F-MW67 and F-MW69. RDX was measured at a concentration of 4.6 µg/L in the April 2009 sample from F-MW67 and 4.7 µg/L in the August 2009 sample from this well. RDX was not measured at a concentration above the reporting limit of 0.49 µg/L in the April 2009 sample from F-MW69 and was measured at an estimated concentration of 0.23 µg/L in the August 2009 sample from this well.

The main body of the plume was assessed using 27 monitoring wells. RDX has not been measured at a concentration greater than the reporting limit in samples from well F-MW60. Decreasing trends have been identified in 19 of these wells. No trend and stable conditions were identified in samples from wells F-MW54S and F-MW37. Decreasing conditions were identified in samples from F-MW52. Increasing trends were identified in samples from wells F-MW35, F-MW48, and F-MW55. These wells are positioned along the centerline of the identified plume extent from the source area (F-MW35) to the core of the plume (F-MW48). RDX concentrations in samples from F-MW35 have increased from 33 µg/L in 1994 to 160 µg/L in April 2009. RDX concentrations peaked at 790 µg/L in the 2001 sample from F-MW35. RDX concentrations in samples from F-MW55 have increased from 7.8 µg/L in 1994 to 220 µg/L in April 2009. RDX concentrations peaked at 910 µg/L in the 1998 sample from F-MW55 and have fluctuated since that time. RDX concentrations in samples F-MW48 have increased from 22 µg/L in 1994 to 2,900 µg/L in April 2009. The April 2009 RDX concentration is the peak concentration for samples from F-MW48 and F-MW44.

RDX concentration trends in groundwater were also evaluated for the 10 pumping wells at the site. Decreasing RDX concentration trends were identified in samples from all 10 wells. RDX concentration trends in groundwater samples collected between 1994 and August 2009 from extraction wells are plotted versus time on Figure C-1 in Appendix C (U.S. Navy 2009d). These plots show that RDX concentration in samples from extraction wells over time have or are approaching asymptotic conditions.

Trend Evaluation Conclusion

RDX concentrations are decreasing in 20 of the 46 monitoring wells used to monitor plume conditions at the site. No trend and stable conditions were identified in three monitoring wells. Increasing RDX concentrations were identified in samples from six of these wells. It can be concluded that RDX mass in the shallow aquifer is generally decreasing. The increasing concentrations are primarily along the centerline of the plume and not the outer limits. RDX concentrations have decreased in samples from all extraction wells and the trends indicate that RDX concentrations have reached or are approaching asymptotic conditions.

The Mann-Kendall analysis currently being used to evaluate data trends may not be the best available method given the data set available. Relying solely on the Mann-Kendall statistic for trend analysis can be misleading, in that the method provides an overall trend for the entire data set evaluated and does not readily identify more subtle trends within the data set. For example, the Mann-Kendall analysis shows an increasing concentration trend for RDX in wells FMW-35 and FMW-55. However, a plot of concentration over time for samples from well FMW-35 (Appendix C, Figure C-1) shows RDX concentrations starting out low in 1994, increasing around 1998, and beginning a decreasing trend in 2001 that bottoms out in 2005. This is followed by an increasing trend. The same plot for FMW-55 (Figure C-1) shows RDX starts out at low concentrations and experiences a short lived increase with a subsequent decrease. This decrease is followed by a longer term increase followed by a decreasing trend. The Mann-Kendall statistic accurately identifies an overall increasing trend for RDX in samples from both of these wells over time, but does not provide the types of details that could potentially be used for optimization or other interpretive purposes. As a result of this observation, it is recommended that a more robust statistical tool or tools be considered for future evaluations.

TNT has not been measured above reporting limits in samples from 35 of the 46 wells used to monitor plume conditions (Appendix C, Table C-5). TNT concentrations are decreasing at an 80 percent confidence level in samples from seven wells and at an 80 to 90 percent confidence level in samples from one well. No trend and stable conditions have been identified in samples from two wells. An increasing TNT concentration trend is identified in samples from one well, FMW-35. Well FMW-35 is located near the source area, and concentrations have increased from 10 µg/L in 2003 to 57 µg/L in April 2009.

DNT has not been measured above reporting limits in samples from 41 of the 46 wells used to monitor plume conditions (Appendix C, Table C-5). DNT concentrations are decreasing at an 80 percent confidence level in samples from three wells and at an 80 to 90 percent confidence level in two wells.

Treatment System Performance

Treatment system performance for April 2008 through March 2009 is summarized in Table C-6 of Appendix C. Cumulative volume pumped and mass removal by well is also summarized on Table C-6 of Appendix C for treatment system operations since August 1996. From April 2008 through March 2009, the system extracted and treated approximately 251 million gallons of water, removing approximately 93 pounds of RDX. This is an average of approximately 575 gpm from April 2008 through March 2009 and approximately 0.78 pound of RDX removed per month. The treatment system has extracted and treated approximately 2.9 billion gallons of water since August 1996 and removed approximately 2,600 pounds of RDX during this time. From April 2008 through March 2009, the average cost per pound of RDX removal was approximately $6,000.

As noted in Section 4.2.3, the 2009 containment assessment (U.S. Navy 2009d) concluded that some ordnance constituents in groundwater had extended beyond the infiltration wells and that containment is not currently complete. The Navy is currently working to address this issue.

6.4.3 Contaminant Trends at OU 7 (Site E/11)

Site E/11

Except for the January 2000 sampling event, Otto fuel has been consistently detected in wells E-MW21U and E-MW23U at concentrations up to 1.0 mg/L, marginally above the 0.2 mg/L RG (Table C-4, Appendix C) (U.S. Navy 2009d). In January 2000, Otto fuel was not detected in either well above 0.10 µg/L. Since the first 5-year review in 2000, Otto fuel concentrations have ranged from 0.40 to 1.4 µg/L. The April 2009 samples from wells E-MW21U and E-MW23U both contained 0.42 µg/L of Otto fuel.

6.4.4 MNA and LNAPL Recovery Trends at OU 8

Historical COC concentrations in groundwater samples from select wells at OU 8 are summarized in Table D-1 of Appendix D. Select sampling locations are shown on Figures 6-7 and 6-8, while groundwater elevation contours are shown on Figure 6-9, located at the end of Section 6.

Current Distribution of Petroleum Constituents in Groundwater and General Trends

Benzene was measured in groundwater from one of the 11 monitoring wells sampled in April 2009 at a concentration above the reporting limit. The April 2009 groundwater sample from well 8MW06 contained benzene at a concentration of 11,000 µg/L. Toluene and ethylbenzene were also detected only in the sample from well 8MW06 at concentrations below their respective RGs (U.S. Navy 2009f).

The current distribution of petroleum hydrocarbon constituents in groundwater versus the pre-ROD distribution is shown on Figure 6-8, located at the end of Section 6. It shows that the lateral extent of benzene in groundwater has decreased over time from the pre-ROD levels.

Historically, groundwater samples from well 8MW47 have contained benzene at concentrations ranging from a low of 2,000 µg/L in the March 2000 sample to a high of 12,000 µg/L in the October 2005 and October 2006 samples. Benzene concentrations have since decreased to 2,100 µg/L in the April 2007 sample from 8MW47, the last time this well was sampled. This well has not been sampled since April 2007 when free product reappeared. Free product has not been reported in any of the other wells monitored during this review period. Benzene concentrations have fluctuated in samples from well 8MW47 with no clear trend. Toluene concentrations in groundwater samples from 8MW47 have also been elevated, ranging from 2,500 µg/L in March 1999 to 22,000 µg/L in November 2000. Toluene concentrations have steadily decreased to 11,000 µg/L in the April 2007 sample (U.S. Navy 2009f).

Benzene concentrations have generally increased in samples from well 8MW06 from 73 µg/L in the March 1998 sample to 11,000 µg/L in the April 2009 sample. Benzene concentrations have fluctuated in samples from this well over time but the overall trend is increasing. Toluene concentrations in samples from well 8MW06 have generally increased, but remained below the RG of 1,000 µg/L (U.S. Navy 2009f).

Benzene and toluene have not been measured at concentrations greater than their respective cleanup levels in the groundwater samples from the remaining wells routinely monitored during this review period (U.S. Navy 2009f).

Current Distribution of Halogenated VOCs in Groundwater and General Trends

1,2-DCA was measured at a concentration greater than the RG of 5 µg/L in three of the 11 wells monitored in April 2009. The highest concentration of 940 µg/L was measured in the sample from well 8MW06. A sample was not collected from 8MW47 because of the presence of free product. DCA was measured at 51 µg/L in the April 2009 sample from well 8MW33 and at 10 µg/L in the April 2009 sample from well 8MW03. 8MW33 and 8MW03 are approximately 200 and 680 feet downgradient of 8MW06. Minor RG exceedances of dichloroethene (DCE) were reported in April 2009 samples from well 8MW33 and 8MW03. The current distribution of halogenated VOCs in groundwater versus the pre-ROD distribution is shown on Figure 6-8, located at the end of Section 6.

Historically, DCA concentrations in groundwater from 8MW47 have decreased over time with the March 1998 sample containing 700 µg/L and the April 2007 sample not containing DCA at a concentration above the reporting limit of 0.5 µg/L. DCA concentrations have also generally decreased in groundwater from 8MW06, with the March 1998 sample containing 1,100 µg/L and the April 2007 sample containing 940 µg/L. DCA concentrations did increase to a maximum of 2,400 µg/L in the October 2005 sample from 8MW06. DCA concentrations have also decreased in samples from wells routinely monitored during this review period (U.S. Navy 2009f).

Summary

Monitoring results since implementation of the remedy for OU 8 in 2000 indicate that the lateral and vertical boundaries of the petroleum and chlorinated solvent plumes have decreased (U.S. Navy 2009f).

The petroleum plume is generally confined to the shallow aquifer in the vicinity of the PWIA, although benzene has been detected at low concentrations in recent rounds at the base boundary. Monitoring data results define a plume that is relatively stable in an aquifer system that is still reaching equilibrium. There have been fluctuations of contaminant concentrations within the plume—most notably, increases in benzene concentrations in source area wells 8MW47 (that now has a thin layer of free product) and 8MW06 compared to March 2000. Spotty detections of benzene at low concentrations at base boundary wells 8MW35, 8MW25, and 8MW03 from 2005 through 2009 may result from source area increases, while a relatively high degradation rate currently keeps the plume from extending its downgradient edge (Figure 6-7, located at the end of Section 6) (U.S. Navy 2009f).

The halogenated VOC plume extends farther horizontally than the petroleum-related plume (Figure 6-8, located at the end of Section 6). The halogenated VOC plume exhibits slightly decreased distribution, compared to pre-ROD monitoring, with a downgradient plume extent reaching beyond the base boundary and occasionally showing trace estimated detections at Mountain View Road (as recently observed during Round 20 in wells 8MW13 and 8MW19). Monitoring data indicate that the plume is essentially stable, although the potential exists that DCA may reoccupy some of its former plume area seen in distributions in the mid-1990s when DCA consistently reached Mountain View Road above the cleanup level. Source well 8MW06 in the PWIA shows an increase in DCA concentrations for Round 20 compared to March 2000.

Base boundary well 8MW03 remains consistently above the cleanup level for DCA and has remained stable since 2004. DCE also exceeds the cleanup level at base boundary well 8MW03 with a current concentration of 0.82 µg/L. As observed above for benzene, monitoring data results indicate a plume that is relatively stable in an aquifer system that is still reaching equilibrium (U.S. Navy 2009f).

COC concentrations continue to exceed the RGs in groundwater beneath OU 8. However, only the concentrations of DCA and DCE exceed the RGs within 15 feet of the NBK Bangor property boundary. No COC concentration exceeds the RG in the Mountain View Road area (U.S. Navy 2009f).

Overall, the Round 20 MNA data indicate that the MNA remedy, in conjunction with ICs, continues to make progress in protecting human health and the environment by limiting the migration of the contaminant plume into areas where groundwater is being used. DCA and DCE are the only contaminants that exceeded the ROD-specified cleanup levels at the base boundary. Changes to contaminant concentrations since March 2000 indicate that halogenated VOC compounds and petroleum-related compounds are moving towards a new equilibrium following changes to early 2000 conditions in the shallow aquifer system (shutdown of the PWIA gas station SVE system and cessation of free-product recovery). Because of the persistence of elevated concentrations in the source area, the initial goal as established in the ROD (U.S. Navy 2000a) to attain concentrations below federal drinking water MCLs for COCs in the off-base portion of OU 8 by 2008 has not been met. No contaminants exceeded the cleanup levels at Mountain View Road (U.S. Navy 2009f).

LNAPL Recovery

In 2004, free-product recovery had met the ROD-specified endpoint of 0.5 gallon per month of recovered product for a period of 2.5 years and was discontinued. Free product was present in one well, 8MW47, during the last four monitoring events (Rounds 17 through 20), and was measured at 0.06 foot in April 2009. This is the only free product present at a sampling location since the completion of the free-product recovery activities.

6.4.5 Annual Institutional Control Inspections

Annual inspections are conducted at each of the OU sites in accordance with the previous and current ICMPs. (U.S. Navy 2007d). These inspections have been conducted during each of the 5 years that comprise this review. The most recent annual IC inspection was conducted October 19 through 26, 2009 (U.S. Navy 2010b). The sites inspected and general conditions observed during the inspection are as follows:

- Site A burn area (OU 1) – No deficiency was found.

- Site A Debris Area 2 (OU 1) – No deficiency was found.
- Site F (OU 2) – No major deficiency was found. However, minor cracks were observed in the surface asphalt east of the canopy structure.
- Site 16/24 (OU 3) – No deficiency was found.
- Site E/11 (OU 7) – No deficiency was found.
- Site B (OU 7) – Minor shoreline erosion was noted using the calculations from the ICMP. However, the ICs in place continue to be protective.
- OU 8 (PWIA [on base] and Mountain View Neighborhood [off base]) – No deficiency was found.

The 2009 annual inspection report indicates that the ICs at NBK Bangor were protective and met the intent of the RODs. No site had issues that required contingency inspections, nor did any of the site ICs require immediate maintenance.

It is recommended that the annual inspections continue. The cracks in the Site F asphalt cap do not represent a failure, but should be repaired as soon as it is practical to extend the cap's longevity. The 2009 annual report recommended that the 2007 ICMP be updated to clearly define all ICs, expand and add checklists, and update references (U.S. Navy 2010a). The report noted that field checklists and figures in the current plan (U.S. Navy 2007d) need to be updated. The plan should also be updated with regard to any additional NBK Bangor ICs that may have been identified since 2007, such as additional groundwater/soil restricted areas, expanded sites, and additional signs. The shoreline measurement calculations should be reviewed to assess if these measurements could be improved. It is recommended that the current set of photographs be applied as the baseline for future inspections to establish a visual measure for assessing incremental changes at the sites. The location and view direction of these photographs should be included in the recommended ICMP update (U.S. Navy 2010b).

6.5 RESULTS OF SITE INSPECTION

The site inspection checklists are included as Appendix E. This section contains a summary of the site inspection findings. The site visit, which occurred on September 8, 2009, was conducted by the following personnel:

- Raymond Kobeski, NAVFAC NW Remedial Project Manager
- Michael Meyer, URS Project Manager

- Greg Burgess, URS Hydrogeologist

The site visit included verifying that remedial actions were complete and operational (for those items that could be visually inspected) and inspecting all portions of the site covered by ICs.

At OU 1 (Site A), a visual inspection was made of the treatment plant and the areas where ICs are required. The treatment plant was found to be in good order and operational, with the O&M manual and records available on site. Labels on the valves, treatment equipment, and other components of the Sites A and F treatment systems reflect historical, rather than current, system operation. This creates the potential for error during system operation. It is recommended that the labeling of valves, treatment equipment, and other components of the Sites A and F treatment systems be updated to reduce the potential for error in system operation.

Documentation of O&M activities is performed through monthly technical progress reports. Visual evidence indicated that the IC requirements are generally being met. The "extensive stand of blackberries" that was reportedly planted in Debris Area 2 in 1995 (U.S. Navy 2000a) has apparently not survived. The area is now vegetated with a moderate density of a variety of plant species that somewhat discourage access. Planting a higher density of additional thorny bush types, or fencing the area, would more thoroughly discourage access. Warning signs were observed to be present and in good repair.

Similarly for OU 2 (Site F), a visual inspection was made of the treatment plant and the areas where ICs are required. The treatment plant was found to be in good order and operational, with the O&M manual and records available on site. Documentation of O&M activities is performed through annual reporting. Visual and record evidence indicated that the IC requirements are being met.

At OU 3 (Sites 16/24 and 25), the one site where ICs are required (Site 16/24) was visited and visually inspected. The land use observed was generally consistent with the ROD (parking and general storage), and there was no overt evidence of excavation activities. The site was fenced and locked.

No physical inspection was necessary at OU 6, because all remedy components are complete and ICs are not required.

At OU 7, the landfill cap at Floral Point was visually inspected, and records of Otto fuel sampling at Site E/11 were reviewed. Sediment and clam tissue sampling at Site 26/Floral Point was conducted during the last 5-year review and, based on those results, sediment and clam tissue sampling was terminated. Records of the landfill cap and IC inspections have been documented and were available for this review. The landfill cap appears to be in generally good condition. In response to wave-cut scarps observed along the beach during the last 5-year review, a maintenance action was conducted at Floral Point to replenish the beach where erosion had occurred and remove the invasive vegetation from the adjacent upland area (U.S. Navy 2006d).

Monitoring of Otto fuel concentrations in groundwater at Site E/11 has been conducted annually.

Free-product recovery at OU 8 had met the practicable endpoint and was terminated. MNA is ongoing, and ICs are in place and appear to be effective.

Overall, the IC requirements are being met. As discussed in Section 4.7, IC inspections are being performed and documented yearly, and checklist documentation is available.

6.6 RESULTS OF INTERVIEWS

Interviews were conducted with persons familiar with the CERCLA actions at NBK Bangor. Interviewees were selected from the Navy, EPA, Ecology, Bremerton/Kitsap County Department of Health, and the community. Interview instructions and questions were sent to potential interviewees via e-mail, and responses to questions were returned either by e-mail or telephone (at the discretion of the interviewee). Not all those invited to comment chose to do so. Interview responses are documented in Appendix A. Highlights of the interview responses are summarized in the following sections.

6.6.1 Navy Personnel

Navy personnel expressed the opinion that the Site A pump and treat system was meeting the ROD requirements and remained protective, but was not a cost-effective remedy component. The Navy’s opinion is that MNA can be an effective replacement for the pump and treat remedy component and is installing additional wells and working with EPA to evaluate MNA. The Navy’s opinion is that the Site F pump and treat system has been an effective component of the Site F remedy, but is continuing further evaluation. The mothballed OU 8 pump and treat system is not in a condition to be restarted without substantial capital investment. The Navy reported multiple ongoing actions to evaluate and enhance the OU 8 remedy.

The Navy reported that ICs have been effective to date, with no violations. Navy personnel reported no complaints from the public. One Navy respondent expressed the opinion that more could be done with regard to Navy personnel awareness of ICs. One Navy respondent expressed the opinion that the ROD requirements for OU 8 were not being met, and that a longer timeline for MNA to be effective should have been included in the ROD. Navy personnel expressed the opinion that the monitoring data collected over this 5-year review period have been adequate for meeting the ROD requirements.

6.6.2 Agency Personnel

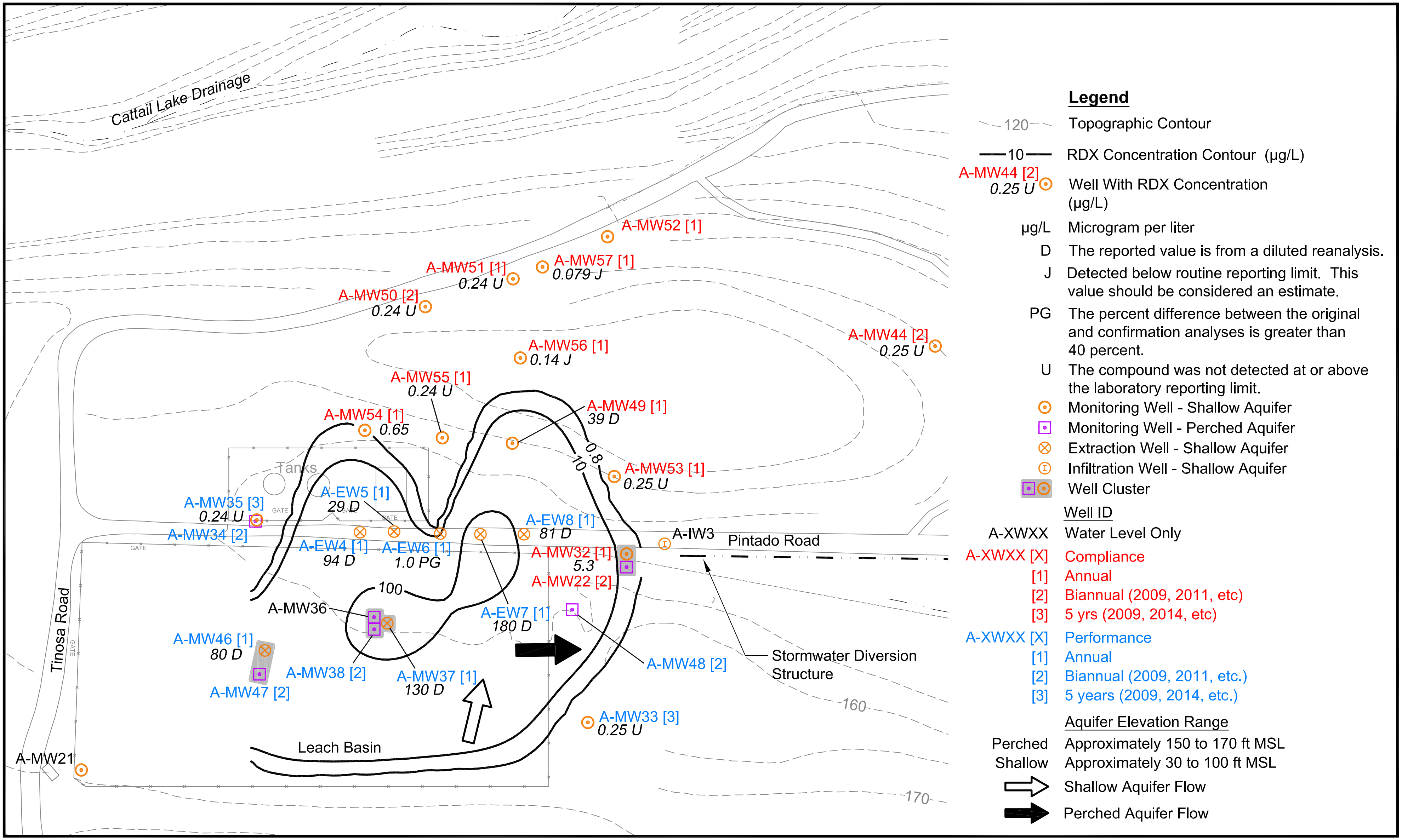
Personnel from EPA, Ecology, and the Kitsap County Health Department responded to the interview request. The respondent from Ecology stated that Ecology was lead agency for OUs 2, 3, 6, 7, and 8 and that lead agency status for OU 1 had been transferred to EPA on October 8, 2007. Ecology considers the remedies for OUs 2, 3, 6, 7, and 8 to currently be protective, including the ICs. Issues at Site F and OU 8 are being addressed by the Navy and the monitoring data are adequate. Ecology received a communication forwarded by Harry Craig of EPA from a contractor regarding heavy metal contamination at a construction site at NBK Bangor. Ecology has otherwise not recorded any complaints, violations, or incidents at the site.

The EPA respondent stated that the remedies at all OUs were currently protective, but that there are questions regarding the future protectiveness of OUs 1 and 2, where additional investigation work (well installation) and potential remedy alteration are needed. The EPA respondent had little current information regarding OUs other than OU 1.

The Kitsap County Health District expressed concern that their agency did not have information regarding the remedies at NBK Bangor and therefore could not comment specifically.

6.6.3 Community

The two community member respondents (both former RAB members) expressed satisfaction with the status of the remedies in 2004, but reported feeling uninformed since dissolution of the RAB. One respondent expressed an explicit desire for an update on the current status, especially for Floral Point. This same respondent expressed a community concern regarding Navy ordnance detonation policies.



U.S. NAVY

0 100 200
SCALE IN FEET

Figure 6-1
2009 RDX Concentrations in Site A Shallow Aquifer

NBK Bangor
THIRD FIVE-YEAR REVIEW

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-1Site A (August 2009 RDX).dwg
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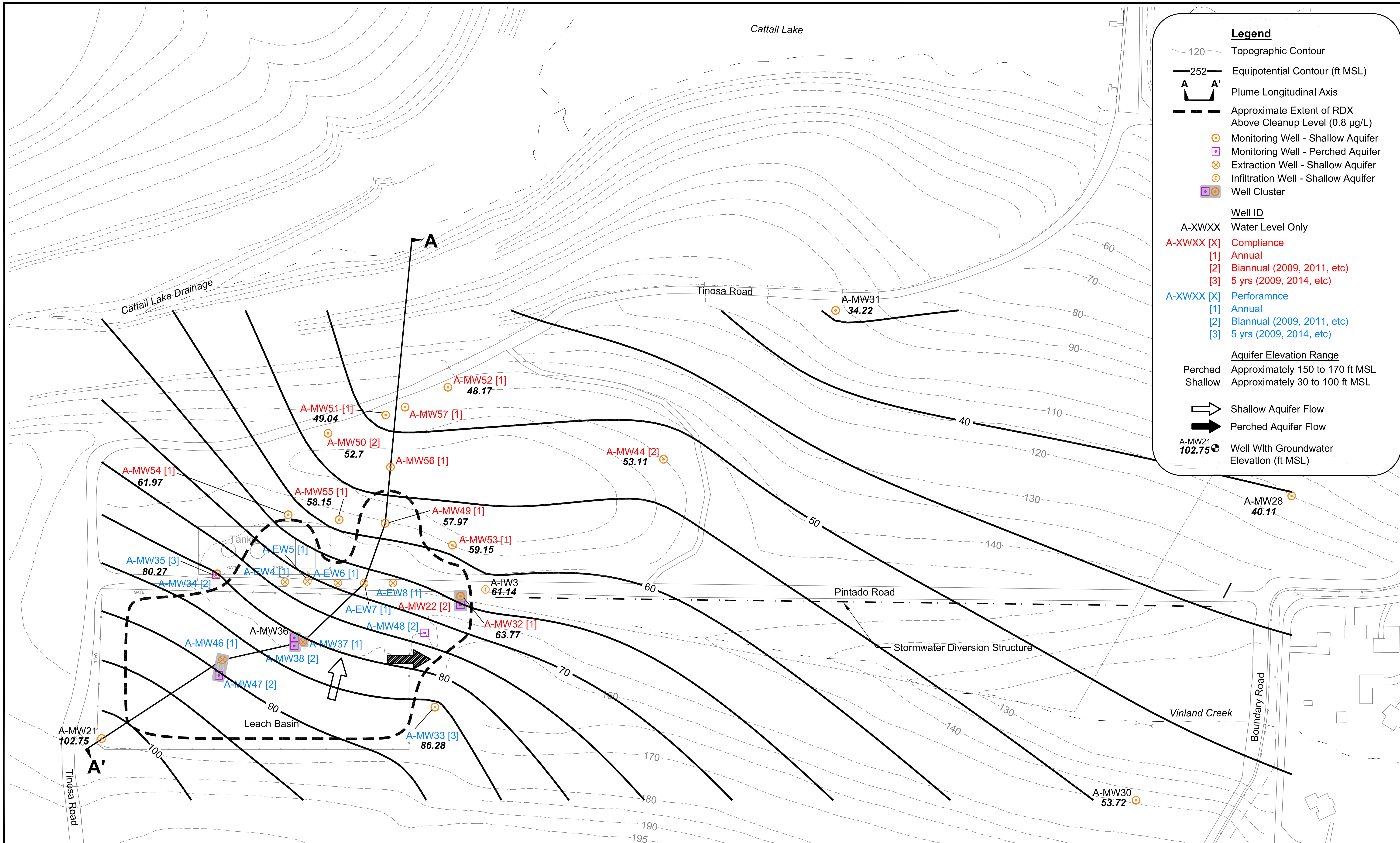

U.S. NAVY

NBK Bangor
THIRD FIVE-YEAR REVIEW

0 100 200
SCALE IN FEET

Figure 6-2
Potentiometric Surface for Passive Wells, Site A, August 2009

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-2 Poten Passive Wells.dwg
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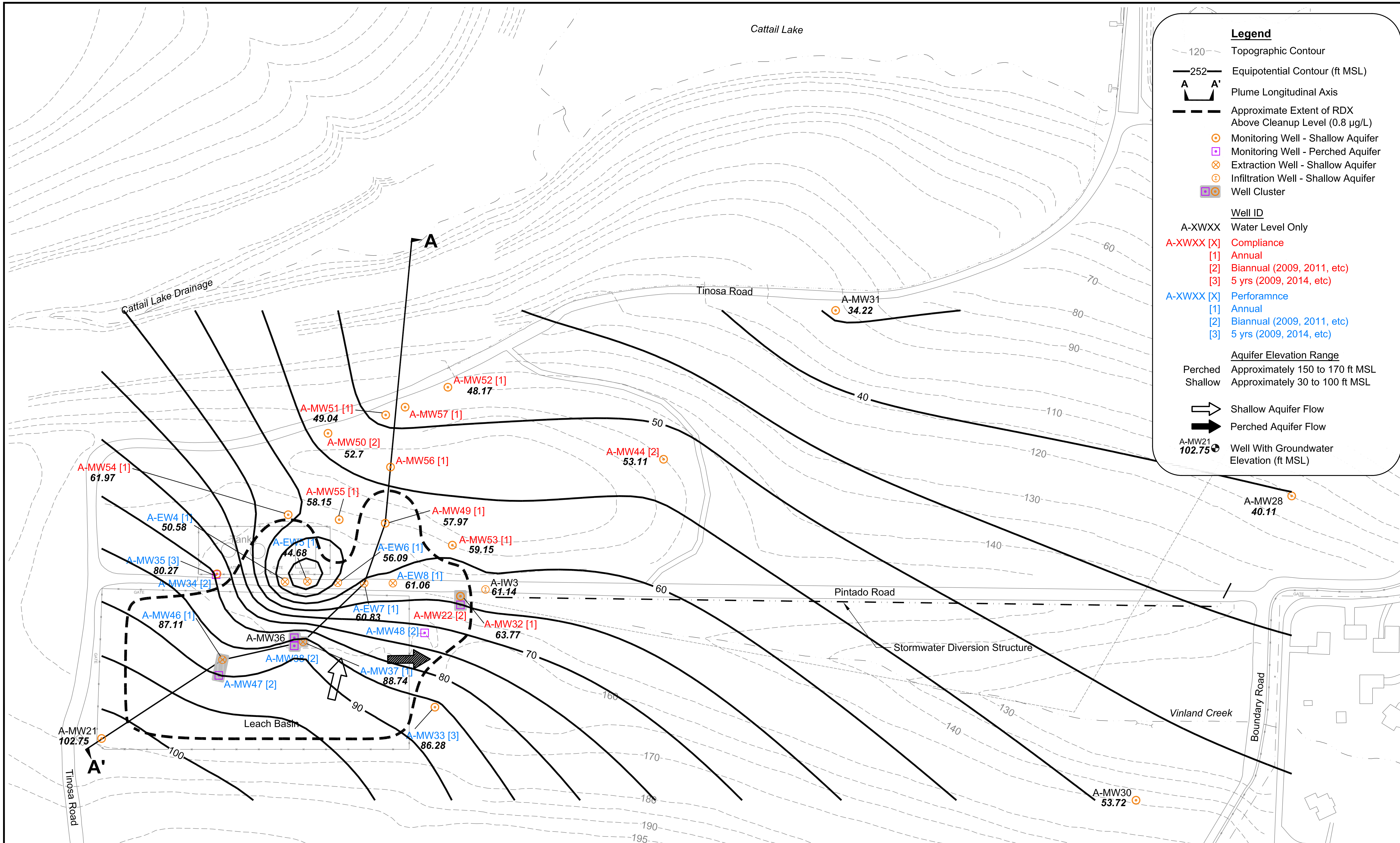

U.S. NAVY

NBK Bangor
THIRD FIVE-YEAR REVIEW

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SCALE IN FEET

Figure 6-3
Potentiometric Surface for All Wells,
Site A, August 2009

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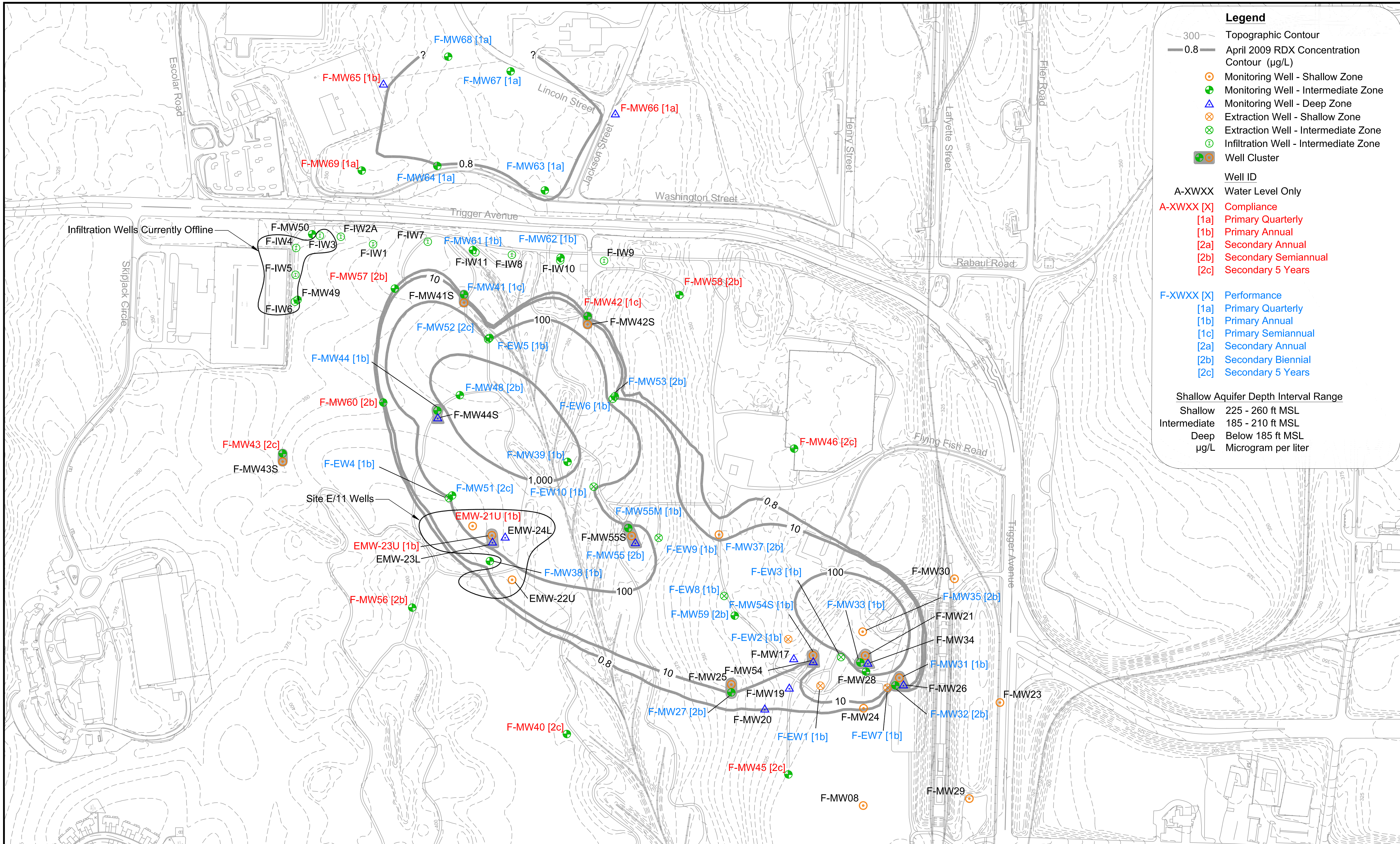
Mod: 08/12/2010, 14:46 | Plotted: 08/12/2010, 14:47 | john_knobbs



U.S. NAVY

NBK Bangor
THIRD 5-YEAR REVIEW

0 250 500
SCALE IN FEET

Figure 6-4
Site F August 2009 RDX Concentration Map

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-4 (Aug 09 RDX Conc).dwg
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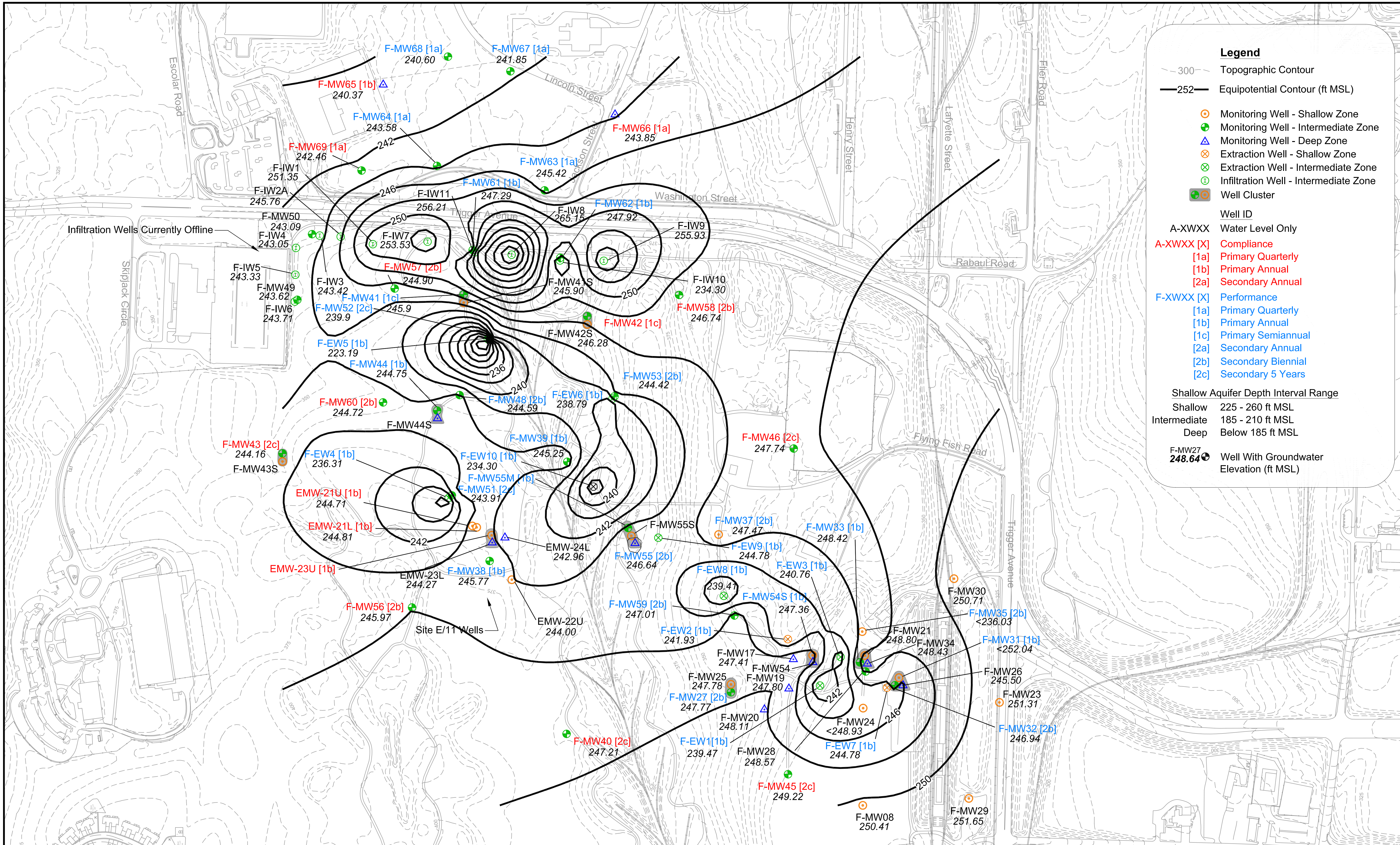

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-5 Aug 09 GW.dwg
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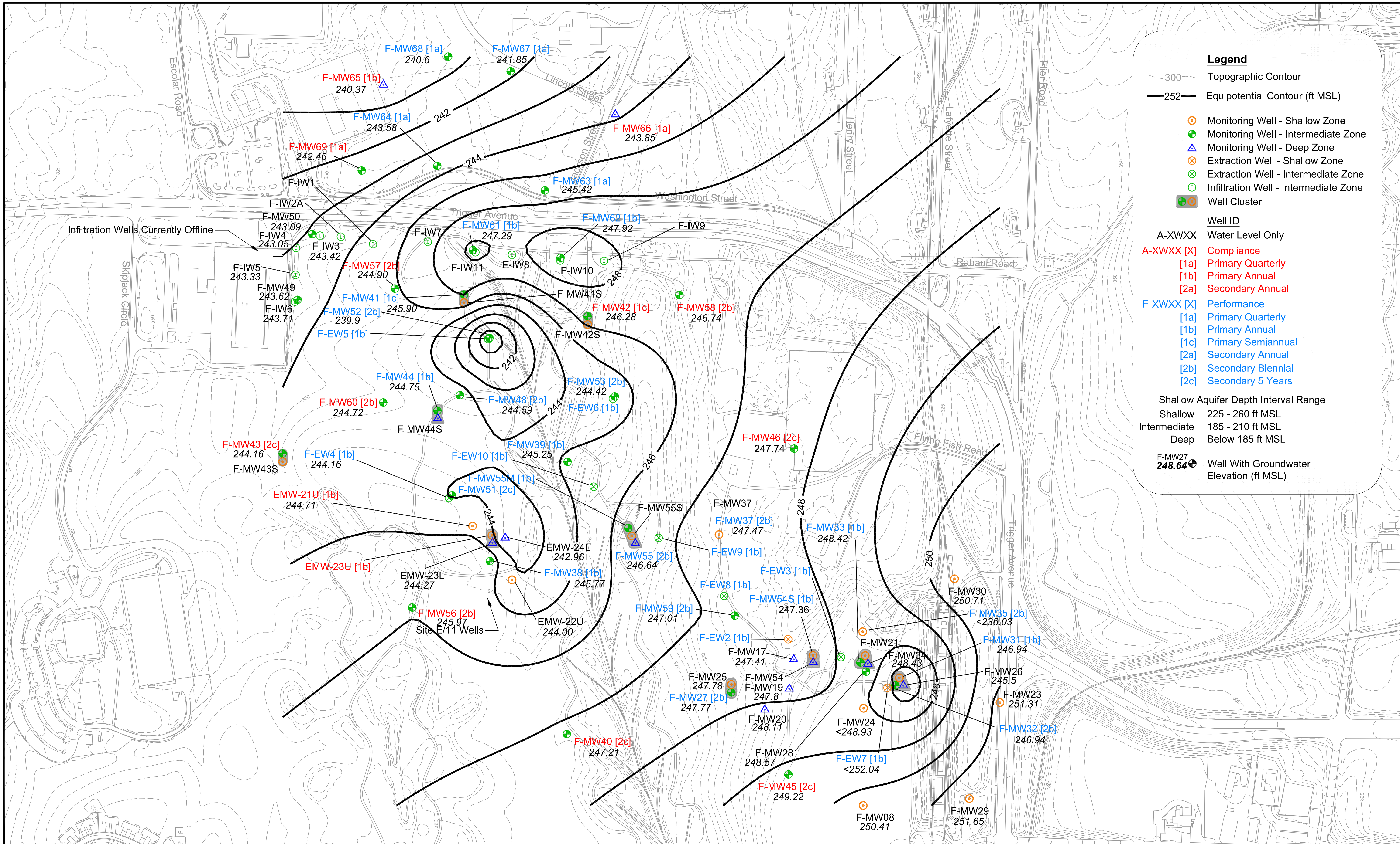
U.S. NAVY

NBK Bangor
THIRD FIVE-YEAR REVIEW

0 250 500
SCALE IN FEET

Figure 6-5
Site F
August 2009 Groundwater Elevation Map
(Monitoring and Active Wells)



U.S. NAVY

NBK Bangor
THIRD FIVE-YEAR REVIEW

0 250 500
SCALE IN FEET

Figure 6-6
Site F
August 2009 Groundwater Elevation Map
(Monitoring Wells)

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-6 Aug 09 MW GW.dwg
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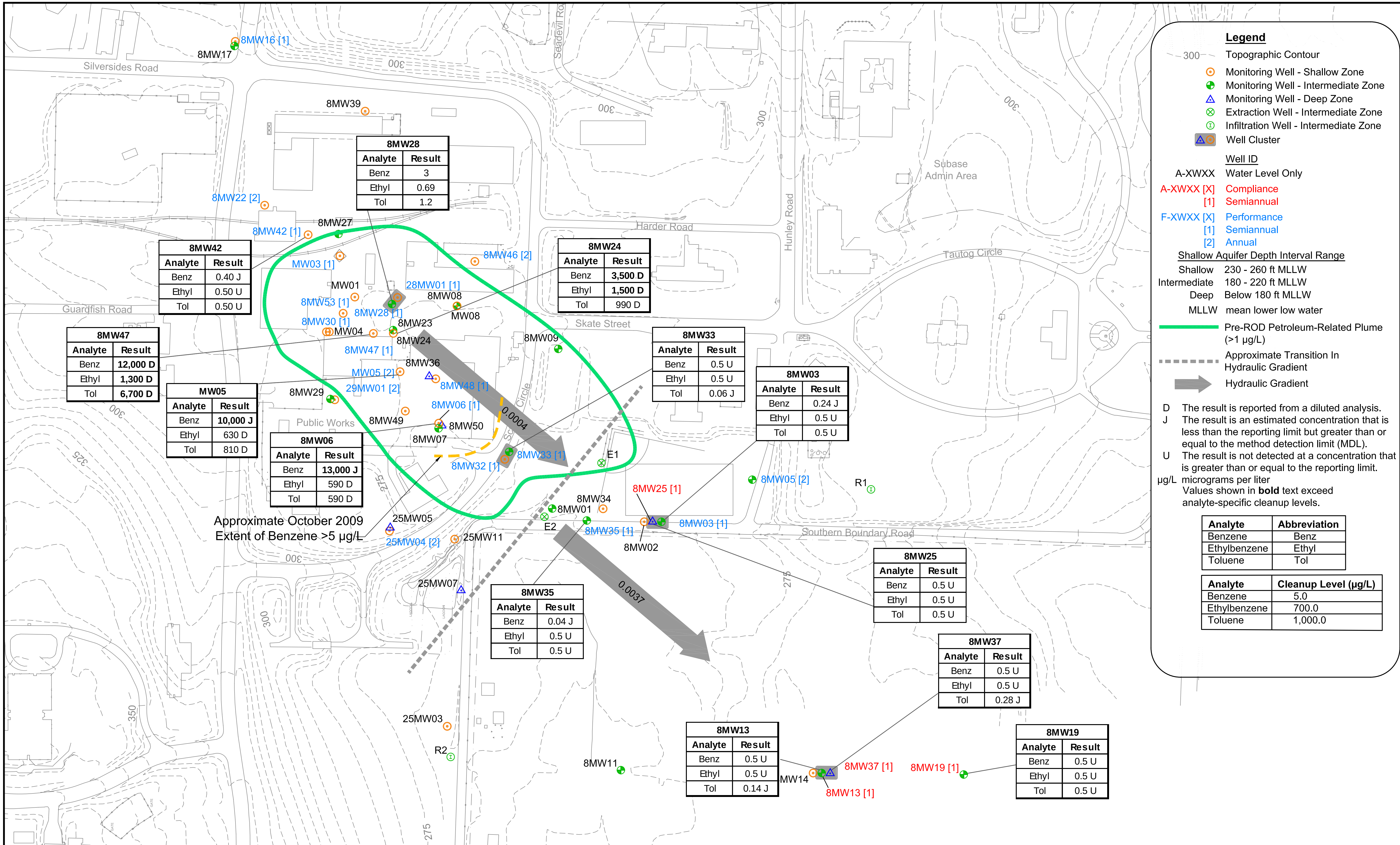


8MW28	
Analyte	Result
Benz	3
Ethyl	0.69
Tol	1.2

8MW42	
Analyte	Result
Benz	0.40 J
Ethyl	0.50 U
Tol	0.50 U

8MW24	
Analyte	Result
Benz	**3,500 D**
Ethyl	**1,500 D**
Tol	990 D

8MW47	
Analyte	Result
Benz	**12,000 D**
Ethyl	**1,300 D**
Tol	**6,700 D**

MW05	
Analyte	Result
Benz	**10,000 J**
Ethyl	630 D
Tol	810 D

8MW06	
Analyte	Result
Benz	**13,000 J**
Ethyl	590 D
Tol	590 D

8MW33	
Analyte	Result
Benz	0.5 U
Ethyl	0.5 U
Tol	0.06 J

8MW03	
Analyte	Result
Benz	0.24 J
Ethyl	0.5 U
Tol	0.5 U

8MW35	
Analyte	Result
Benz	0.04 J
Ethyl	0.5 U
Tol	0.5 U

8MW25	
Analyte	Result
Benz	0.5 U
Ethyl	0.5 U
Tol	0.5 U

8MW37	
Analyte	Result
Benz	0.5 U
Ethyl	0.5 U
Tol	0.28 J

8MW13	
Analyte	Result
Benz	0.5 U
Ethyl	0.5 U
Tol	0.14 J

8MW19	
Analyte	Result
Benz	0.5 U
Ethyl	0.5 U
Tol	0.5 U

Legend

300 Topographic Contour
Monitoring Well - Shallow Zone
Monitoring Well - Intermediate Zone
Monitoring Well - Deep Zone
Extraction Well - Intermediate Zone
Infiltration Well - Intermediate Zone
Well Cluster

Well ID
A-XWXX Water Level Only
A-XWXX [X] Compliance
[1] Semiannual
F-XWXX [X] Performance
[1] Semiannual
[2] Annual

Shallow Aquifer Depth Interval Range
Shallow 230 - 260 ft MLLW
Intermediate 180 - 220 ft MLLW
Deep Below 180 ft MLLW
MLLW mean lower low water

Pre-ROD Petroleum-Related Plume (>1 µg/L)
Approximate Transition In Hydraulic Gradient
Hydraulic Gradient

D The result is reported from a diluted analysis.
J The result is an estimated concentration that is less than the reporting limit but greater than or equal to the method detection limit (MDL).
U The result is not detected at a concentration that is greater than or equal to the reporting limit.
µg/L micrograms per liter
Values shown in **bold** text exceed analyte-specific cleanup levels.

Analyte	Abbreviation
Benzene	Benz
Ethylbenzene	Ethyl
Toluene	Tol

Analyte	Cleanup Level (µg/L)
Benzene	5.0
Ethylbenzene	700.0
Toluene	1,000.0

0 125 250
SCALE IN FEET

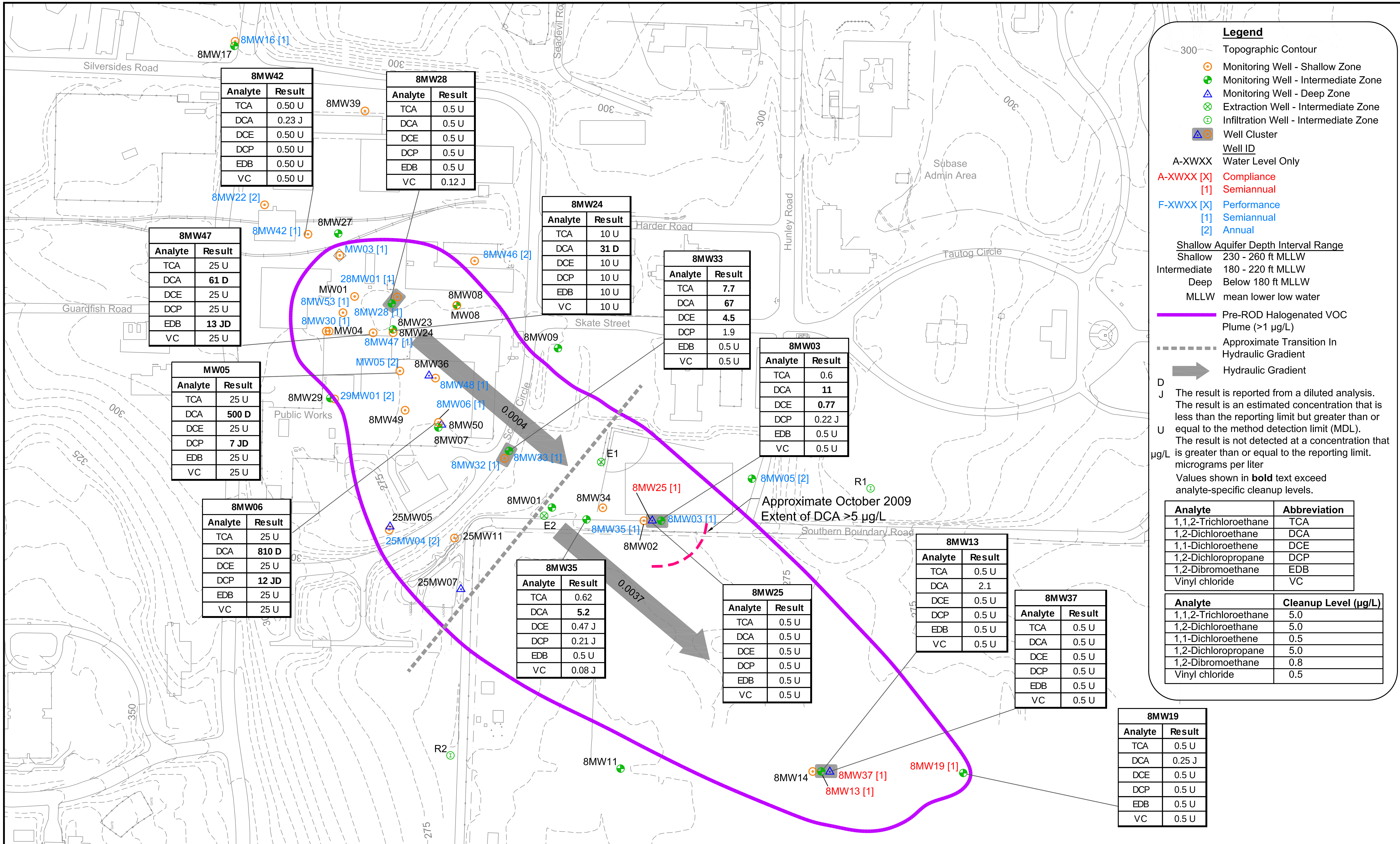
U.S. NAVY

NBK Bangor
THIRD FIVE-YEAR REVIEW

Figure 6-7
Summary of Petroleum VOC Analytical Results, OU 8 Round 21 MNA Sampling Event

T:\NAVY\Bangor\Sub-Tasks\DO 62\3RD 5 yr Review\Fig 6-7 Petro VOC.dwg
Mod: 08/17/2010, 10:05 | Plotted: 08/24/2010, 08:24 | john_knobbs

P:\SEALASKA\T007\DWG\RND 21\ FIGURE 4-1 VOC.dwg
JUNE 22, 2010



U.S. NAVY

NBK Bangor
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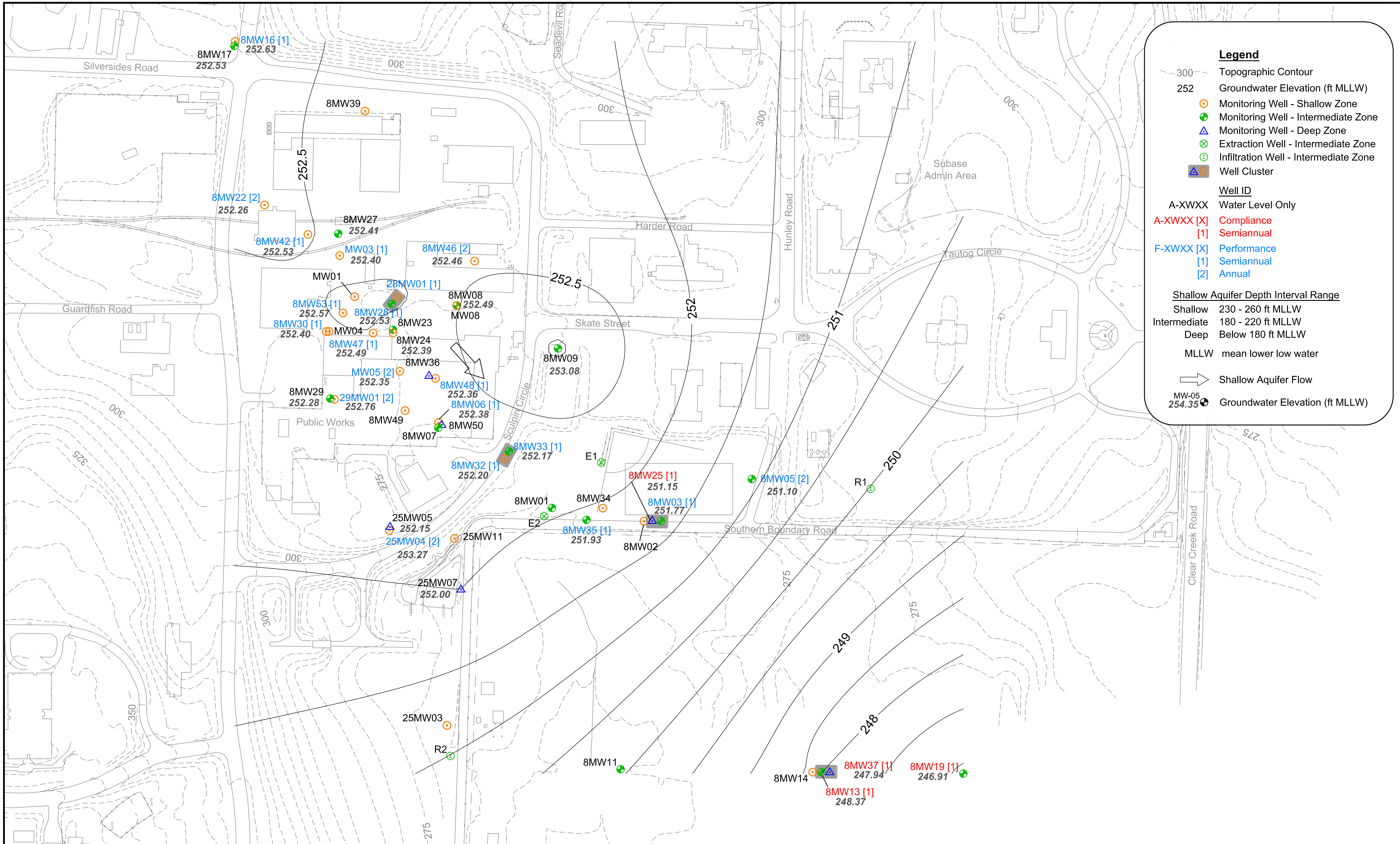
0 125 250
SCALE IN FEET

Figure 6-8
Summary of Halogenated VOC Analytical Results, OU 8 Round 21 MNA Sampling Event



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NBK Bangor
THIRD FIVE-YEAR REVIEW

0 125 250
SCALE IN FEET

Figure 6-9
OU 8 Round 21 Groundwater Elevation Contours

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7.0 TECHNICAL ASSESSMENT

7.1 FUNCTIONALITY OF REMEDY

The functionality of each component of the remedy for each OU is discussed in the sections that follow.

7.1.1 Functionality of Remedy for OU 1 (Site A)

Is the remedy functioning as intended by the decision documents? No.

The groundwater extraction and treatment portion of the remedy for Site A is not functioning as intended by the ROD. All of the remedy components listed in Section 4.1.1 have been implemented, and monitoring and adjustment (optimization) of the groundwater remediation system has been performed as envisioned (Section 11.1 of the ROD). In spite of these efforts, the opinion of multiple technical reviewers (U.S. Navy 2000c, 2004d, 2004e, and 2010a) is that the remediation system will not meet the intended ROD goal of "achiev[ing]" the MTCA groundwater cleanup level for RDX of 0.8 µg/L in the most cost-effective manner within a 10-year period of operation" (U.S. Navy, USEPA, and Ecology 1991a). Available monitoring data indicate that the RDX concentrations in groundwater beneath Site A in 2009 were somewhat lower than in 2005, and the lateral limits of the plume have been reduced slightly (Figures 3-2 and 3-3 in Appendix B). However, the low aquifer transmissivity severely limits the pumping rate of the extraction wells and results in small capture zones and low aquifer flushing rates. In addition, the 2009 annual monitoring report (U.S. Navy 2010a) indicates that the current groundwater extraction does alter the potentiometric heads close to the point of extraction, but cannot accomplish sufficient drawdown in the low-permeability aquifer to achieve containment. The Navy believes that the remediation system is also not cost efficient, with each pound of RDX removed from the aquifer between November 1999 and July 2009 costing an average of $250,000.

As stated in Section 11.1 of the ROD (U.S. Navy, USEPA, and Ecology 1991a), this 5-year review is an opportunity for "consideration of other remedial approaches or revision of the cleanup standards." Assessment of a revised remedial approach for Site A is recommended in Section 8 of this 5-year review report.

The vegetation present at Debris Area 2 is insufficient to effectively discourage access.

Except for the groundwater remediation component of the remedy and the vegetation at Debris Area 2, the other components of the remedy for Site A are generally functioning as intended by the ROD and the three ESDs (as was also found in the first and second 5-year reviews [U.S.

Navy 2000a and 2005a]). The IC inspection process is generally functioning as intended by the OU 8 ROD (wherein IC inspections were required for all OUs).

At this time, total system flow is the only flow measurement readily available. If pump and treat is to continue at the site, assessment of functionality could be enhanced significantly by adding flow totalizers and/or flow meters to individual extraction well pump lines. This recommendation applies only if pump and treat will be continued in the long term and addition of this equipment is possible with the existing infrastructure.

7.1.2 Functionality of Remedy for OU 2 (Site F)

Is the remedy functioning as intended by the decision documents? No.

As found in the first and second 5-year reviews (U.S. Navy 2000a and 2005a), the remedy components for soil at Site F functioned as intended by the ROD. The IC inspection process is also generally functioning as intended by the OU 8 ROD (wherein IC inspections were required for all OUs).

The groundwater extraction system is not functioning as intended by the ROD, because the system does not appear to be consistently achieving hydraulic containment. The treatment system is performing as designed and has been monitored and upgraded throughout its life. However, an optimization review performed in 2004 (U.S. Navy 2004e) concluded that "plume migration may have occurred and . . . hydraulic containment of the plume has not been consistently maintained." The review further concluded that "the extraction wells are generally pumping at their design rates, but do not appear to have established an adequate capture zone." The Second quarter 2009 monitoring report (U.S. Navy 2009d) further illustrates this by indicating that the trend at F-MW67 (downgradient of the containment extraction and reinfiltration wells) could be explained by incomplete containment or the passing of a higher concentration slug whose migration precedes complete containment (U.S. Navy 2009d).

In addition, the system exhibits a decreasing efficiency, with O&M costs increasing and the rate of mass removal decreasing. The cost per pound of contaminant mass removed increased from approximately $1,250 per pound in 2004 (U.S. Navy 2004e) to an average of approximately $6,000 per pound during this review period, which is a 480 percent increase. The optimization review recommendations (U.S. Navy 2004e) have been or are in the process of being implemented. However the concern raised by optimization review that contaminant mass removal will eventually reach an asymptotic recovery rate, with COC concentrations in groundwater remaining above RGs, is still valid.

7.1.3 Functionality of Remedy for OU 3 (Sites 16/24 and 25)

Is the remedy functioning as intended by the decision documents? Yes.

The selected remedy for OU 3 continues to function as intended by the ROD. Inspections of the land use controls at this site have been conducted regularly, and the current land use remains in accordance with the restrictions defined in the OU 8 ROD (which established the base-wide land use controls).

7.1.4 Functionality of Remedy for OU 6 (Site D)

Is the remedy functioning as intended by the decision documents? Yes.

As found during the first and second 5-year reviews, the remedy components for soil removal and treatment, surface water monitoring, and groundwater monitoring at OU 6 functioned as intended by the ROD. No on-going monitoring was required following the first 5-year review, and there is no apparent change in the functionality of the remedy since that time. Monitoring for perchlorate as a new potential contaminant in groundwater did not reveal any contamination. No IC was required for OU 6.

7.1.5 Functionality of Remedy for OU 7 (Sites B, E/11, 2, 10, and 26)

Functionality of Remedy for Site B (Floral Point)

Is the remedy functioning as intended by the decision documents? Yes.

The remedy for Site B (Floral Point) is functioning as intended by the OU 7 ROD. The vegetated soil cover and stormwater management structures have been constructed and maintained. Land use controls are in place, are enforced, and are inspected periodically. IC inspections identified an issue with erosion along the shoreline, and corrective measures were subsequently implemented.

Sediment and clam tissue monitoring has been conducted, and based on results through the second 5-year review (U.S. Navy 2005a), the monitoring component of the Site B remedy has functioned as intended by the ROD and is complete. The monitoring requirement has been terminated.

Functionality of Remedy for Site E/11

Is the remedy functioning as intended by the decision documents? Yes.

As found during the first and second 5-year reviews, the remedy component for soil removal and disposal at Site E/11 functioned as intended by the ROD.

The groundwater use restriction remains in place as part of the base-wide ICMP, and this restriction is functioning as intended.

Recovery of groundwater beneath Site E/11 containing Otto fuel continued during this review period. Recovery is achieved by the Site F groundwater extraction and treatment system, and monitoring for Otto fuel in Site E/11 wells is conducted concurrently with Site F monitoring. Although groundwater extraction by the Site F system is ongoing, there is no apparent decreasing trend in Otto fuel concentration beneath Site E/11.

The OU 7 ROD requires that the effectiveness of Otto fuel removal be assessed during each 5-year review. Based on the stable trend of Otto fuel concentrations in Site E/11 wells, it appears that the remedy is functioning to contain, but not substantially remove, Otto fuel from beneath the site. Containment of groundwater containing Otto fuel, in combination with the groundwater use restriction, functions to meet the RAO of preventing ingestion of groundwater containing Otto fuel at concentrations above the RG. The second 5-year review recommended assessing containment of groundwater with Otto fuel concentrations above the RG in future capture zone analyses for the Site F extraction and treatment system. This recommended assessment has not been conducted.

Functionality of Remedy for Site 2

Is the remedy functioning as intended by the decision documents? Yes.

As found in the first and second 5-year reviews, the soil and debris removal and disposal conducted at Site 2 met the RAOs for this site, and the remedy remains functional. The remedy applied to stockpiled soil, which was removed from the site during remedy implementation. No COCs were identified for in situ soil or groundwater. Future 5-year reviews are unnecessary for Site 2.

Functionality of Remedy for Site 10

Is the remedy functioning as intended by the decision documents? Yes.

The remedy for Site 10 is functioning as intended by the ROD. The confirmation groundwater sampling was completed during the second 5-year review period and resulted in a finding that further sampling is not necessary. Groundwater use restrictions for Site 10 are included in the ICMP as part of the restrictions on OU 8 and are being monitored and enforced.

The asphalt cap remedy component added by the 2008 memorandum to the administrative file was constructed during this 5-year review period and is functioning as intended. The ICMP is being amended in 2010 to include maintenance of the asphalt pavement and expansion of the Site 10 footprint.

Functionality of Remedy for Site 26

Is the remedy functioning as intended by the decision documents? Yes.

The remedy for Site 26 is functioning as intended by the ROD. Periodic sampling has been conducted throughout Site 26, with reductions in sampling requirements (with Ecology's concurrence) as warranted by the data. The only remaining sampling at Site 26 was conducted in 2004 as part of the remedy for Site B, as discussed above. This monitoring component of the Site B/Site 26 remedy has functioned as intended by the ROD and is complete, fulfilling all required monitoring at Site 26.

Ecology has concurred that the monitoring component of the remedy is complete, and no land use or exposure restriction is required. Future 5-year reviews are unnecessary for Site 26.

7.1.6 Functionality of Remedy for OU 8

Is the remedy functioning as intended by the decision documents? Yes.

The remedy for OU 8 is functioning as intended by the ROD. However, the progress toward meeting the RAOs is slower than anticipated. All of the remedy components have been implemented as envisioned by the ROD, including the LNAPL recovery system and the monitoring of groundwater for MNA performance and compliance with RGs. LNAPL recovery met ROD-specified endpoint criteria in 2004. LNAPL reappeared in one well in 2007. A dedicated bladder pump was installed and LNAPL recovery is ongoing. Base-wide IC inspections and management are also being performed and documented in accordance with the ICMP adopted after the OU 8 ROD was signed.

The increasing concentration trend observed for benzene in a well located in the core of the petroleum plume, and the return of free product to one well, suggests that a residual source of petroleum compounds to groundwater is still present at the site.

The extent of the petroleum plume has decreased relative to pre-ROD conditions (U.S. Navy 2009f). This decrease is likely the result of the LNAPL recovery actions taken since the first LNAPL recovery system was installed in 1986 (U.S. Navy 2004c) and natural attenuation. The continued increase in benzene concentrations in the core of the plume was identified during the second 5-year review as well. However, contrary to the speculation of the second 5-year review, it has not resulted in a significant increase in the lateral extent of the dissolved plume.

The ROD anticipated that additional remedial actions (termed "contingent actions" in the ROD) might be necessary. The ROD stated that if LNAPL recovery and MNA did not appear to be making sufficient progress toward meeting RGs, then the following contingent remedial actions would be considered:

- Redox manipulation at the base boundary to enhance biologic activity in groundwater
- Restarting of the groundwater pump and treat system to contain or minimize migration of the off-base plume

The Navy has implemented the first of these contingent actions and is currently assessing additional potential "contingent actions" in conjunction with EPA and Ecology.

7.2 CONTINUED VALIDITY OF ROD ASSUMPTIONS

Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid? Yes.

This section reviews any changes to ARARs used to establish cleanup levels 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 that changes in the exposure and toxicity assumptions of ARARs that have occurred since the RODs were signed do not affect the protectiveness of the remedies at OU 1 (Site A), OU 2 (Site F), OU 3 (Sites 16/24 and 25), OU 6 (Site D), OU 7 (Sites B, E/11, 2, 10, and 26), and OU 8 (Areas 1, 31, and 52).

Concentrations of chemicals in groundwater remain above the cleanup levels at some locations in OU 1, OU 2, OU 7, and OU 8, resulting in the need for continued ICs to prevent exposure, active remediation at some sites, and ongoing monitoring. The results of the ROD assumptions review found:

- Some of the cleanup levels would be higher if calculated today, and groundwater analytical programs may warrant review at OU 2.
- Based on current ARARs, ICs should be revised at OU 3.

- The RG for Otto fuel at OU 7 may require review in light of toxicity changes for the major component of the fuel.
- Investigation of the vapor intrusion pathway is likely warranted within the PWIA of OU 8.

Details of cleanup level analyses are described in the sections that follow and are summarized in Tables 7-1 through 7-12, located at the end of Section 7.

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.

During the first and second 5-year reviews for NBK at Bangor, no substantive changes were found to ARARs that would call into question the protectiveness of the remedy. For this third 5-year review, all of the ARARs identified in the RODs for OUs 1, 2, 3, 6, 7, and 8, as well as any changes as a result of ESD documents approved by the Navy, EPA, and Ecology subsequent to the RODs, were again reviewed for changes that could affect the assessment of whether the remedy is protective. The ROD established RGs at OU1, OU2, OU3, OU6, OU7, OU8, and therefore, those sites are discussed further here. Two additional sites were generally cleaned up to state standards (MTCA cleanup levels). Some of the MTCA cleanup values have changed. Consequently, cleanup levels used at the time of these cleanup actions are reviewed together with the confirmation sampling to assess whether any concentrations remaining at the site would affect land use decisions under current cleanup regulations. This section of the 5-year review shows that the protectiveness of the remedies chosen for the NBK Bangor OUs has not been adversely affected by changes in ARARs since the RODs were signed.

As part of this third 5-year review, all of the ARARs identified in the RODs were reviewed for changes that could affect the assessment of whether the remedy is protective. Based on this review, it was concluded that the following regulations listed as ARARs have changed:

- Washington State MTCA regulations

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

- In addition to establishing risk-based cleanup levels, MTCA also allows for use of background or the laboratory PQL as a cleanup level when the MTCA cleanup level is lower than these values. Based on new analytical techniques, laboratories now are able to readily achieve lower PQLs for some COCs. When cleanup levels are established as PQLs and the PQLs decrease with improved technology, the 5-year review process does not typically recommend revising the cleanup levels 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.

- The result of amendments to 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. This evaluation is discussed below. In other instances, the ARAR remains unchanged or has increased. In these instances, no further discussion is provided, because the protectiveness of the remedy is not affected.

ROD Sites

OU 1 (Site A)

Soil. A risk assessment assuming direct worker contact with soils identified three ordnance compounds (2,4,6-TNT, 2,4-DNT, and RDX) in the burn area, and PCBs in Debris Area 2 with risks greater than the target risk goal of 1 x 10^{-5}. The ROD selected those compounds as COCs in soil. Lead was also added as a soil COC, because lead levels in Debris Area 2 exceeded MCTA Method A in some samples and there was also a potential ecological concern for lead. Soils have been remediated/removed from the burn area such that remaining COCs in soil are at or below the MTCA Method B values for unrestricted land use that were selected as RGs in the OU 1 ROD. Debris Area 2 soils (PCBs and lead) remain in place. However, restricted access (deterrent plantings throughout area), signage warning against exposure, and ICs are being maintained. Table 7-1 (located at the end of Section 7) compares the RGs identified in Sections 8 and 12 of the OU 1 ROD (U.S. Navy, USEPA, and Ecology 1991a) with the cleanup levels that would be calculated today (MTCA Method B cleanup levels current as of February 2010). There are no changes and, consequently, the remedy remains protective.

Groundwater and Surface Water. The risk assessment (based on workers drinking shallow aquifer groundwater) identified three ordnance compounds (2,4,6-TNT, 2,4-DNT, and RDX) in burn area wells as COCs, with RDX being the risk driver and the most persistent chemical. Lead was included as a COC in the ROD because it was identified in soil above MTCA A. However, no concentration of lead has ever exceeded the MTCA A level for drinking water. Total phthalates were also included as a COC in groundwater and surface water, and RGs for BEHP for groundwater and surface water were included in the ROD (Table 1 of OU 1 ROD), likely because there were some exceedances above MTCA Method B levels in both groundwater and surface water. However, no phthalate has been included in the long-term groundwater monitoring program, and the chemicals were not specifically discussed in the ROD. The baseline risk assessment evaluated BEHP in drinking water (using groundwater concentrations), and health risks were less than 1×10^{-5} (U.S. Navy 1991). There were few phthalate detections in groundwater above a drinking water standard during the RI that were not qualified (primarily "B" qualified indicating that it was also present in the laboratory blank). Consequently, it seems unlikely that BEHP is a health concern in groundwater.

Table 7-2 (located at the end of Section 7) compares the groundwater RGs presented in the OU 1 ROD with the current MTCA Method B cleanup values (with the exception of lead, which has a Method A value). There are no changes. Because of the presence of ordnance compounds, the last 5-year review recommended sampling for perchlorate in groundwater as a new chemical at OU 1, OU 2, and OU 6. This one-time sampling event occurred in December 2005 (U.S. Navy 2006f), and no perchlorate was detected at a maximum laboratory reporting limit of 5.0 μg/L. Because perchlorate was a new chemical, no ROD RG was established. However, reporting limits in the 2005 sampling were all well below the current MTCA Method B groundwater cleanup level for perchlorate of 11 μg/L.

Table 7-3 (located at the end of Section 7) compares surface water RGs with current cleanup values (where available) and there are no significant changes. At the time of the ROD, surface water concerns focused primarily on burn area stormwater and leachate discharge to Hood Canal. ESD No. 3 (U.S. Navy, USEPA, and Ecology 2000b) found that untreated leachate from the burn area basin may be discharged directly to surface water, even though it exceeds the surface water quality standards identified in the ROD. This is because WET testing on freshwater and saltwater organisms in six tests using the untreated leachate resulted in no acute or chronic toxicity. Therefore, surface water is not being negatively impacted.

OU 2

Soil. The risk assessment, based on residential land use, identified 2,4,6-TNT, 2,4-DNT, and RDX as COCs in soil. Based on risks in groundwater, an additional six compounds were included on the soil COC list in the OU 2 ROD (manganese, nitrate, nitrite, 2,6-DNT, 1,3,5-TNB, and 1,3-DNB). Soil exceeding the ROD RGs for the nine COCs was removed down to

15 feet bgs. The ROD RGs are presented on Table 7-4 (located at the end of Section 7) together with the values that would be selected today for residential land use. RGs today would be either the same or higher. Therefore, the remedy remains protective.

Groundwater and Surface Water. The baseline risk assessment, based on residents drinking the shallow groundwater, identified nine chemicals as COCs: RDX, manganese, nitrate, nitrite, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, and 1,3-DNB). The ROD developed RGs for all nine COCs. However, the document also indicated that 2,4,6-TNT, 2,4-DNT, RDX, and nitrate were the chemicals of greatest concern, based on toxicity (2,4,6-TNT and 2,4-DNT[1]) and extent of area above RGs (RDX and nitrate). All nine COCs have been included in the long-term monitoring program. However, long-term monitoring report summaries have presented results for only 2,4,6-TNT, 2,4-DNT, and RDX.

Table 7-5 (located at the end of Section 7) lists the ROD RGs for the COCs and the cleanup levels that would be applicable today. Either there is no change, or the current cleanup level would be higher than the level established in the ROD. Therefore, the remedy remains protective. The two chemicals with higher cleanup levels if established today are 1,3,5-TNB and nitrite. No concentration of 1,3,5-TNB that has been detected at the site exceeds today's cleanup level. Long-term monitoring results have been for combined nitrite/nitrate, rather than for separate chemicals. For the combined data, no nitrate/nitrite concentration has been detected above the nitrate ROD RG since 2005. The analytical results for the six COCs not regularly summarized in the long-term monitoring reports should be reviewed against their ROD RGs and potential cleanup level changes to evaluate whether the long-term monitoring program should continue to analyze groundwater for these chemicals.

The new chemical, perchlorate, was sampled and not detected in OU 2 groundwater (see above discussion for OU 1).

The OU 2 ROD also provided RGs protective of surface water (Table 7-5, located at the end of Section 7), for several of the groundwater COCs in the event that the groundwater plume should ever impact surface water. The groundwater plume has not impacted surface water. Therefore, potential changes to surface water RGs if established today were not evaluated as part of this 5-year review. When the removal of groundwater restrictions is proposed, groundwater concentrations for the COCs should be compared to current drinking water and, in the event that groundwater is near a surface water discharge point, current surface water standards at the time of restriction removals.

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[1]The RG for 2,4-DNT is derived using a cancer slope factor based on the toxicity of 2,4-DNT and 2,6-DNT as a mixture.

OU 3 (Sites 16/24 and 25)

Soil. The OU 3 ROD (U.S. Navy, USEPA, and Ecology 1994a) selected a no action alternative that required establishment of ICs for Site 16/24, because soil at this site exceeded antimony and beryllium MTCA Method B concentrations for unrestricted land use and exceeded the arsenic MTCA Method A concentration for unrestricted land use[2]. The risk assessment for the site did not find unacceptable risks from exposures to soil at this site, even assuming a future residential (unrestricted) land use. A comparison of the ROD values with current standards is provided in Table 7-6, located at the end of Section 7). The beryllium cleanup level has increased, and the antimony and arsenic cleanup levels have remained the same. Based on this ARAR review, the land use restrictions for soil at this site may be unnecessary for antimony and beryllium, but not for arsenic, for the following reasons:

The cleanup level for beryllium is currently 160 mg/kg, much higher than the ROD RG of 0.2 mg/kg, and the maximum beryllium concentration detected in soil at this site was only 1 mg/kg.

While the cleanup level for antimony of 32 mg/kg has not changed since the ROD, the maximum antimony concentration detected in soil was only 35.8 mg/kg, less than two times the cleanup level. A statistical analysis of the data indicates that less than 10 percent of sample concentrations exceed the ROD RG, and the 95 percent upper confidence limit (UCL) of the mean is below the cleanup level[3]. The exceedance for antimony was in the surface soil sampling around the incinerator. There was only one exceedance out of 23 samples in this area, and the exceedance was the only detected antimony concentration.

Like antimony, arsenic's ROD RG of 20 mg/kg has not changed. However, EPA has recently published a toxicological update that will likely result in an increase in the toxicity criteria for arsenic (i.e., the chemical will be considered a more potent carcinogen [see Section 7.2.2]). A review of the soil data indicates only one sample exceeded the ROD RG, with a concentration of 82.7 mg/kg. In the RI for the site, this value was coded "NJ" (a tentatively identified, estimated value) on some tables and as "J" (estimated value) on other tables (U.S. Navy 1992). Therefore, there is some uncertainty as to whether the maximum concentration is actually present on the site. Like antimony, the maximum arsenic concentration was found in surface soil samples collected around the incinerator. All other soil samples in this area (total of 23 samples) were below the ROD RG of 20 mg/kg. The next highest arsenic concentration was 13.9 mg/kg

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[2]Although the ROD identifies the arsenic ARAR as originating from Method B, it is a Method A value.
[3]According to WAC 173-340(7)(e)(i), a site can be considered "clean" if no single sample concentration is greater than 2 times the soil cleanup level and (ii) less than 10 percent of the sample concentrations exceed the soil cleanup level. Additionally, under MTCA, an exceedance of a cleanup level at one location may not require action if the rest of the data are lower and include a provision (WAC 173-340-740[7][d]) allowing the statistical evaluation of the data. MTCA specifically allows the use of the 95 percent UCL, where the probability of underestimating the true mean is less than 5 percent.

(potentially a concentration representative of local background). A 95 percent UCL calculated for the surface soil data set results in a concentration of 22.7 mg/kg, driven by the single RG exceedance and only marginally above the ROD RG. While site soils are currently approximately at RG concentrations around the incinerator as a whole, because of the proposed changes in arsenic toxicity and the single high unconfirmed concentration, ICs at this site should be reviewed (see further discussion in Section 7.2.2).

Groundwater. Groundwater monitoring was implemented at Site 25 because metals concentrations in groundwater exceeded MTCA Method B groundwater cleanup levels for cadmium and manganese. Although groundwater monitoring at this site has been discontinued because all cleanup levels were met in several rounds of monitoring, an ARARs comparison was still conducted for this site. Table 7-7, located at the end of Section 7, compares the ROD cleanup levels with current Method B values. Because the standards have either remained the same or been raised (the MTCA Method B groundwater cleanup level for manganese has increased from 50 to 2,240 µg/L), no additional effort at this site is warranted. There does not seem to be any need to retain ICs for groundwater at this site.

OU 6 (Site D)

Human (residential land use) and ecological risks were identified in Site D soils and nine chemicals were selected as COCs. Table 7-8, located at the end of Section 7, compares OU 6 ROD (U.S. Navy, USEPA, and Ecology 1994c) soil ARARs (MTCA Method B and C values) with current MTCA standards for the COCs. The cleanup levels have significantly increased for two of the COCs, TNT, and 2,4-DNT. Cleanup outside the wetland area met unrestricted land use requirements and those requirements continue to be met. Within the wetland area, the 2,4-DNT cleanup level used was MTCA Method C (58.8 mg/kg) because remediation to the MTCA B level of 1.5 mg/kg would have been too damaging to the wetlands. The current Method C value for 2,4/2-6-DNT mixture is 190 mg/kg, higher than the ROD RG. The Method B value has not changed. The maximum detected value of 2,4-DNT exceeded the MTCA Method B level in 1994. The remedy remains protective and if land use restrictions were to be removed from the wetlands, soil/sediment would need to be resampled to evaluate whether current concentrations meet the Method B level. Because there was only 1 sample out of 35 sediment samples that exceeded MTCA Method B in 1994 (only two detections out of 35 samples), and the compound is not persistent in the environment, resampling would likely result in concentrations below MTCA B, indicating that ICs and 5-year reviews could be dispensed with in the future.

The baseline risk assessment did not identify any risks from chemicals in surface water or groundwater and no water RGs were established in the ROD. Short-term groundwater monitoring took place at OU 6 in May 1996 and June 1997. The monitoring wells were decommissioned in June 2000, because no chemical exceeded any ARAR. Surface water monitoring was also conducted post-ROD and no chemical exceeded ambient water quality criteria concentrations. Therefore, an ARAR review of the cleanup levels used to evaluate the post-ROD water data was not conducted as part of this 5-year review.

OU 7 (Sites B, E/11, 2, 10, and 26)

Soil. The baseline risk assessment, assuming residential land use, identified COCs for Sites B, E/11, 2, and 10 (COCs identified only in groundwater in the OU 7 ROD). These COCs are listed in Tables 7-9 and 7-10 (located at the end of Section 7) for soil and groundwater, respectively. No COC was identified for Site 26. Rather, the minor ecological issues with sediments were to be addressed by confirmation that sediment concentrations were not increasing. Table 7-9 compares soil RGs from the OU 7 ROD (U.S. Navy, USEPA, and Ecology 1996) with current ARARs. Specifically, the ROD identified MTCA Method A soil values for unrestricted land use for Sites B (Floral Point) and 2 and Method B soil values protective of direct contact for unrestricted land use for Site E/11. Note that no impacted soil remains at Site 2. Therefore, ARAR changes do not affect the Site 2 remedy, and recommendations will include removal of this site from the 5-year review process (see Sections 7.1.5 and 8). Work on a new parking lot at Site 10 in 2007 and 2008 identified four chemicals in soil above MTCA Method A cleanup levels: arsenic, cadmium, lead, and Aroclor 1254. The soil samples were collected from "grit" material at previously unsampled locations (U.S. Navy 2009h). These four chemicals that were identified post-ROD are also included in Table 7-9.

The only soil ARAR that would be lower today is for carcinogenic polycyclic aromatic hydrocarbons (cPAHs), a COC at Site B. The Method A unrestricted cleanup level for cPAHs is now 0.1 mg/kg, compared to 1 mg/kg at the time of the ROD. In addition, under the November 2007 revision of MTCA (WAC 173-340-708[8][e]), determining compliance with cleanup levels for mixtures of cPAH compounds is now done by calculating a benzo(a)pyrene "equivalent" value for each sample. This toxic equivalent concentration is derived by adjusting the concentrations of the seven cPAHs based on their toxicity compared to benzo(a)pyrene. The sum of the adjusted concentrations is then calculated and compared to the 0.1 mg/kg cleanup level. No soil was removed from Site B. The remedy involved placing clean fill over impacted soils and revegetating. Because the cover is being maintained, the remedy for Site B is still protective. If the cover were to be removed, cPAH soil concentrations would require evaluation using current standards and methodology.

Groundwater. Two chemicals were selected as COCs in groundwater at OU 7 based on the results of the risk assessment and assuming groundwater was used for drinking: TPH at Site 10 and Otto fuel at Site E/11. The MTCA Method A value for TPH of 1,000 μg/L was identified in the OU 7 ROD as the RG for Site 10 (see Table 7-10, located at the end of Section 7). Currently, MTCA does not have a generic TPH value, but provides values for various carbon-chain-length ranges of petroleum fuels (e.g., gasoline, diesel). All the MTCA Method A TPH levels are currently lower than 1,000 µg/L. The risk assessment in the RI (U.S. Navy 1994) assumed that the single sample of TPH used to assess health risks was marine diesel. However, because the last groundwater sampling at Site 10 (in 2000 and 2001) analyzed for diesel and residual-range petroleum compounds, nothing was detected, and reporting limits were below the latest MTCA A levels, the remedy is still protective at Site 10.

The RG for Otto fuel in groundwater at Site E/11 was the PQL of 0.2 µg/L (selected because the calculated risk-based cleanup level listed in the ROD was 0.038 µg/L, below the PQL). Revisions to the toxicity of the major component of Otto fuel, propylene glycol dinitrate (PGDN), are discussed in Section 7.2.2.

OU 8

No soil RG was established at OU 8. Nine chemicals were selected as COCs in groundwater, based on the results of the risk assessment, and the ROD developed RGs for five of these chemicals, assuming the water was used as drinking water[4]. Table 7-11(located at the end of Section 7) compares groundwater RGs from the OU 8 ROD (U.S. Navy, USEPA, and Ecology 2000a) with current ARAR values. The ARARs values are derived from two sources: MTCA Method B cleanup levels for drinking water protection and federal drinking water MCLs. MCLs were chosen as cleanup levels for benzene, 1,2-DCA, and toluene, rather than Method B values. Ecology's Toxics Cleanup Program allows the use of MCLs if the MCL is less than or equal to the 10^{-5} risk level, or has a hazard quotient of 1.0 (Ecology 1993). MTCA Method B values were chosen for the two remaining COCs (1,1-DCE and 1,2-dibromoethane [EDB]). However, the ROD indicated that the Method B values for these two compounds were below PQL concentrations. Therefore, the ROD stated that PQLs would be used as RGs, but did not provide numeric PQL values. The PQL values that have been used in the long-term monitoring reports are 0.8 µg/L for 1,2-EDB and 0.5 µg/L for 1,1-DCE. Changes in toxicity for 1,2-EDB and 1,1-DCE are discussed in Section 7.2.2.

Other Cleanup Action Sites

Pogy Road. Sixteen chemicals were selected as COCs in soil based on the results of the site characterization sampling. Results of the sampling were used to conduct a risk assessment of the contaminants and to present cleanup levels in the DCLP (U.S. Navy 2004g). Soil cleanup levels were determined based on direct contact with soil, which is the only plausible exposure pathway for the Pogy Road site because site conditions are protective of groundwater and surface water. Table 7-12 (located at the end of Section 7) compares the soil ARARs (MTCA Methods B and C values) from the DCLP (U.S. Navy 2004g) and EPA PRGs of the independent remedial action

[4]The four chemicals for which no RG was established were chemicals where the health risks were due to uses of the groundwater for other than drinking (e.g., watering crops or live stock).

report (U.S. Navy 2005e) to current ARARs (MTCA Methods B and C values) and EPA Residential Screening Levels (RSLs). Although current EPA RSLs for 1,3-dinitrobenzene, tetryl, nitroglycerin, and 3-nitrotoluene are lower then the lowest ARARS previously established, confirmatory sampling results of all four chemicals were not detected (detections were below current EPA RSLs). Therefore, the remedy is still protective for Site Pogy Road.

EO300 Small Arms Ranges. As result of the former use of pistol ranges for target practice shooting, lead has been confirmed present in soil at Site EO300. Several site characterization and confirmation sampling rounds have shown lead samples in soil to exceed the MTCA Method A lead value for Unrestricted Land Use of 250 mg/kg. Because of the lead concentrations detected, a time-critical removal action was planned to remove the soil impacted by lead in excess of 250 mg/kg to protect human health and the environment and prevent the potential for lead to migrate. The current MTCA Method A value for Unrestricted Land Use is still current and therefore the remedy is still protective.

7.2.2 Review of Risk Assessment Assumptions

Risk assessment assumptions were reviewed, in addition to ARARs, 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

For those ARAR values that are human health risk-based numbers (e.g., MTCA B groundwater cleanup level), changes to toxicity criteria may raise or lower the current regulatory level. Changes to toxicity criteria that would result in a lowering (i.e., more protective) of an RG require evaluation of the ROD RG, using the new toxicity information, to assess whether the health risks of the ROD RG are still within EPA's target risk range (USEPA 2001). Because the chemicals are now considered less toxic, today's cleanup level would be higher for 1,3,5-TNB, 1,2-EDB, nitrate, and beryllium Therefore, the risks represented by the RGs for those chemicals do not require reassessment. However, the toxicity changes are noted below for each chemical for completeness and because increases in cleanup levels may affect future monitoring activities.

For Otto fuel (COC in groundwater at OU 7) and 1,1-DCE (COC in groundwater at OU 8), the risk-based levels would also be higher today. However, the selected RG was the PQL, because the risk-based levels were so low. Current Otto fuel and 1,1-DCE cleanup levels for groundwater are discussed below. For manganese (soil COC at OU 2 and groundwater COC at OU 3), the RG was based on background levels, or a non-health-based water standard, and today's health-based MTCA B values would be higher (see Tables 7-5 and 7-7, located at the end of Section 7). For benzene (COC at OU 8), the ROD RG is the MCL, which has not changed. However, because of a toxicity change, benzene's MTCA Method B value would be lower today. Therefore, benzene is evaluated below as to whether the MCL is still an appropriate RG for groundwater at OU 8.

Decrease in Toxicity, Increase in Cleanup Level

Nitrate. Nitrate was selected as a COC in both soil and groundwater at OU 2. The noncancer oral reference dose for nitrate of 1.6 mg/kg-day does not appear to have changed since the ROD was signed in 1991. Nitrate was included as a soil COC because it was a COC in groundwater. Thus, the ROD MTCA B value chosen as the RG may have been based on the protection of groundwater, rather than direct human contact with soil. In any case, the maximum nitrate concentration detected in soil samples collected from OU 2 was 17 mg/kg, which is orders of magnitude below both the old and new MTCA Method B cleanup levels. Groundwater concentrations of nitrate may not be a concern at OU 2.

1,3,5-TNB. This chemical was selected as a COC in soil and groundwater at OU 2 and soil at OU 6. The noncancer oral reference dose for 1,3,5-TNB has changed from 0.00005 when the RG was originally calculated to its current value in EPA's Integrated Risk Information System (IRIS) database of 0.03 mg/kg-day. This change to the reference dose does not affect the protectiveness of the remedy because the ROD RGs are lower than would be calculated today. See Tables 7-4, 7-5, and 7-8 (located at the end of Section 7) for a comparison of ROD ARARs and current standards. At OU 2, where 1,3,5-TNB is continuing to be monitored in groundwater, the new MTCA Method B value of 43,000 μg/L has never been exceeded.

Beryllium. This chemical is a soil COC at OU 3. The reference dose for beryllium, as reported in IRIS, changed to 0.002 mg/kg-day in 1998. This change in toxicity is reflected in the current MTCA B soil cleanup level of 160 mg/kg, a significant increase over the ROD RG of 0.23 mg/kg.

Otto Fuel. Otto fuel was selected as a COC in groundwater at OU 7. A risk-based value protective of the drinking water pathway of 0.038 μg/L was reported in the ROD. However, the PQL of 0.2 μg/L was selected as the RG because analytical techniques cannot achieve 0.038 μg/L. The risk-based RG in the ROD was derived for PGDN, the major component of Otto fuel. Currently, EPA does not have a reference dose for PGDN in their IRIS database. However, EPA's regional screening tables list a reference concentration (RfC) of 2.7×10^{-4} mg/m^3, developed by the Agency for Toxic Substances and Disease Registry, as a provisional measure of PGDN toxicity. Thus, the current toxicity assessment indicates that PGDN is less toxic than was understood at the time of the ROD. EPA calculates a tap water regional screening level for PGDN of 0.6 μg/L (http://www.epa.gov/reg3hwmd/risk/human/rbconcentration_table/ index.htm). If a MTCA B level were to be calculated using the same current toxicity criteria assumptions as the EPA regional screening tables, the MTCA B level would be the same as the EPA value when rounded to one significant figure (i.e., also 0.6 µg/L). Many recent Otto fuel detections are below the current risk-based level.

1,2-EDB. This chemical is a COC in groundwater at OU 8. The cancer oral slope factor for 1,2-EDB changed in IRIS from the value of 85 $(mg/kg\text{-}day)^{-1}$ used to calculate the RG in the ROD to 2 $(mg/kg\text{-}day)^{-1}$, a substantial reduction in toxicity. Thus, a cleanup level calculated today using a MTCA risk formula, the latest toxicity information, and the target risk level in the ROD (1×10^{-5}) would change the RG from 0.000515 to 0.2 µg/L. This new cleanup level is still below the PQL of 0.8 µg/L.

1,1-DCE. This chemical is a COC in groundwater at OU 8. 1,1-DCE is no longer considered a carcinogen by the EPA. Therefore, the ROD RG of 0.07 µg/L, based on a carcinogenic endpoint, is not applicable to the current understanding of 1,1-DCE toxicity. The current MTCA Method B level is 400 µg/L (based on noncarcinogenic effects), higher than the RG and the current MCL of 7 µg/L. The use of a PQL of 0.5 µg/L as the RG for this chemical (the risk-based level was not analytically achievable) is no longer necessary to protect health. No groundwater result for 1,1-DCE has exceeded 7 µg/L since 2006.

Increase in Toxicity, Decrease in Cleanup Level

Arsenic. This chemical is a COC in soils at OU 3 (Site 16/24, former incinerator area) and OU 7 (Site B). In addition, arsenic was found above the MTCA Method A value in post-ROD sampling at Site 10. While the MTCA Method A value selected as an RG in the ROD for both OUs has not changed (20 mg/kg), EPA has recently published a draft toxicological review of inorganic arsenic (USEPA 2010) and is currently in a 60-day public comment period on the draft document. EPA indicates that this draft does not represent EPA policy until the document is finalized. After the comment period has closed, EPA will begin preparing the final toxicological review and placing new toxicity criteria in EPA’s IRIS database. The draft is proposing a significant increase in arsenic’s oral cancer slope factor. The draft review categorizes inorganic arsenic as "carcinogenic to humans," using EPA's new classification system (finalized in 2005). Although the chemical was also considered an “A” carcinogen previously, demonstrated to cause cancer in humans, the classification under the new system indicates that there is now additional information on the biological mechanisms inducing cancer.

The proposed new slope factor is based on the same Taiwanese study used to develop the original slope factor (1.75 $[mg/kg\text{-}day]^{-1}$), but is based on tumors in different sites, specifically lung and bladder, rather than skin. The draft toxicological review also continues to use a linear low-dose extrapolation, concluding there is insufficient information to change the linear low-dose default assumption. However, whether there is a threshold for the carcinogenic effects of arsenic is a topic of much scientific debate. The findings of the review recommended an oral slope factor of 25.7 $(mg/kg\text{-}day)^{-1}$, based on the combined internal (lung plus bladder) cancer incidence for women (the more sensitive population). This is a conservative upper-bound estimate, as cancer potency factors were found to range from 6.7 to 25.7 $(mg/kg\text{-}day)^{-1}$ depending on type and gender (USEPA 2010). The new slope factor represents a potential increase in cancer potency by a factor of 17 (and a concomitant lowering of risk-based cleanup levels by a factor of 17). If this slope factor is finalized and placed into EPA's IRIS database, the current MTCA Method B and C values for arsenic in soil and water would drop significantly, calling the remedy into question at OU 3. Because the remedies at Sites B and 10 in OU 7 consist of maintaining clean cover or a cap, the remedy at OU 7 will remain protective even if the proposed slope factor for arsenic is finalized unchanged.

At the former incinerator area of OU 3, there are ICs preventing residential use, but no cleanup actions were undertaken. The findings of "no risk" in the original baseline risk assessment would likely not be the conclusions reached in a risk assessment performed using the new draft slope factor (if arsenic in soil is actually present at concentrations above background). The ICs for this area should be reviewed and potentially made more rigorous. The site is currently vacant and fenced. However, the IC prevents use of the site as residential in the event the property should ever be transferred. The IC should be increased to prevent soil disturbance by any human receptors without resampling soil to confirm or deny the presence of arsenic above background levels. Appropriate precautions should also be taken for the health and safety of any personnel involved in soil contact activities.

Benzene. This chemical is a COC at OU 8. The oral slope factor for benzene, as reported in EPA's IRIS, changed to 0.055 $(mg/kg\text{-}day)^{-1}$ in 2000. This change in toxicity is reflected in the current regulatory groundwater cleanup level of 0.8 µg/L, a decrease from the ROD RG of 5 µg/L. Using this new slope factor, the cancer risk of the cleanup level of 5 µg/L is 6×10^{-6}, below the ROD cancer risk goal of 1×10^{-5}. Because the ROD cancer risk goal is still being met, the remedy designed to achieve the cleanup level is protective, and no RG change is recommended.

Exposure Parameters

The expected land use on or near all OUs as stated in the RODs have not changed. As discussed in Section 7.2.1, in some cases land use restrictions may no longer be warranted because of changes in ARARs.

At OU 8, the vapor intrusion pathway has never been evaluated. Soil gas data were collected beneath the PWIA during the RI. A passive soil gas survey was conducted in 1995, which consisted of sampling 80 vapor probe locations throughout the PWIA. The survey concluded that chlorinated VOCs were present in "significantly high" concentrations in select locations of the PWIA (the RI did not report results [see Figure 1-8 in U.S. Navy 1999b]). In 1996, active soil gas sampling was conducted at 22 locations to test the viability of soil vapor extraction remediation. The 1996 sampling detected relatively low concentrations of chlorinated VOCs, but up to percent levels of volatile petroleum compounds (U.S. Navy 1999). The 1995 and 1996 data are too old to reflect current vapor concentrations, and the 1995 and 1996 samples were not collected using the latest sampling methodology. Current groundwater monitoring indicates at least benzene, 1,2-DCA, and possibly toluene are still present in groundwater above Washington State vapor screening levels (Ecology 2009). Therefore, the vapor intrusion pathway likely warrants further investigation for the following reasons:

- Concentrations of volatile chemicals are present in groundwater within 100 feet of occupied buildings.
- Concentrations in groundwater exceed MTCA screening levels for the vapor intrusion pathway.
- Free product is still present in the vicinity of Building 1021.
- Vadose zone soils are relatively permeable.
- Historical investigations indicated VOCs were present in subsurface soil gas.

The vapor intrusion pathway at OU 8 represents a potential future protectiveness issue, but does not affect the current protectiveness of the remedy. This is because of the current use and configuration of the buildings present above the COC plume in groundwater and above residual COCs in soil. Buildings 1202 and 1021 are automotive repair shops with air handling and bay doors to address indoor air for these COCs. Building 1016 is used for storage, and Building 2011 is used for electronics maintenance.

7.3 NEW INFORMATION

Has any other information come to light that could call into question the protectiveness of the remedy? Yes.

Currently RDX is still being detected above a risk-based cleanup level in groundwater at OU 1 and OU 2. If the slope factor for RDX changes significantly, the risk-based cleanup level in groundwater would also change, potentially impacting the remedy. The RDX cancer slope factor is currently being reevaluated by the EPA's National Center for Environmental Assessment. The document, however, is still in the internal draft phase and it is not clear when a draft document will be released for public comment. This issue should be assessed in the next 5-year review.

No other information reviewed during this 5-year review, apart from what is included previously in this document, affects the protectiveness of the remedy.

7.4 TECHNICAL ASSESSMENT SUMMARY

The groundwater extraction and treatment systems at OU 1 (Site A) and OU 2 (Site F) are not functioning as intended by the respective RODs. Containment of RDX at OU 1 (Site A) and other ordnance compounds was questioned in the 2009 annual monitoring report (U.S. Navy 2010a). However, plume core concentrations have decreased since the last 5-year review, and the lateral extent of RDX in groundwater appears to have decreased somewhat. The Navy is currently assessing the efficacy of MNA at OU 1 (Site A). Containment was also called into question during the annual review of system performance at OU 2 (Site F) (U.S. Navy 2009d). Groundwater monitoring data at this site indicate that the RDX plume has migrated past (downgradient of) the line of extraction and infiltration wells. The Navy is currently assessing possible explanations for this observation and planning enhancement to the monitoring well network at the leading edge of the plume. The other components of the OU 1 and OU 2 remedies are generally functioning as intended by the RODs.

The remedies for OU 3 and OU 6 are functioning as intended by the RODs.

The remedies for OU 7 (Sites B, E/11, 2, 10, and 26) are functioning as intended by the ROD.

The remedy for OU 8 is functioning as intended by the ROD. However progress toward meeting the RAOs is slower than anticipated. Vapor intrusion is identified as a potential concern and an assessment is recommended at OU 8.

There are no changes to ARARs or risk assessment assumptions that adversely affect the protectiveness of the remedies at NBK Bangor. The results of the ROD assumptions review found:

- Some of the cleanup levels would be higher if calculated today, and groundwater analytical programs may warrant review at OU 2.
- Based on current ARARs, ICs should be revised at OU 3.
- The RG for Otto fuel at OU 7 may require review in light of toxicity changes for the major component of the fuel.
- Investigation of the vapor intrusion pathway is likely warranted within the PWIA of OU 8.

7.5 ISSUES

Table 7-13 lists the issues identified as a result of this 5-year review. Those issues that appear to have the potential to affect the protectiveness of the remedies at NBK Bangor are also listed below:

- Labels on valves, treatment equipment, and other components of the Sites A and F treatment systems reflect historical, rather than current, system operation. This creates the potential for error during system operation.

- The Site A groundwater treatment system is not functioning as intended by the ROD.

- The Site F groundwater treatment system is not functioning as intended by the ROD.

- The Site F groundwater plume has expanded beyond the area of ICs. The concentration trend at F-MW67, which is beyond the limits of the extraction system containment, is increasing.

- The thorny brush meant to discourage access to Debris Area 2 is insufficient for its intended purpose.

- There is the potential for vapor intrusion into buildings above the VOC plume at OU 8.

- The current ICMP has outdated field checklists and figures, and shoreline monitoring needs to be reviewed for possible enhancements.

Table 7-1
Soil ARARs for Operable Unit 1

Chemical	ROD Remediation Goal (mg/kg)	Basis of Remediation Goal	Current MTCA Method B (mg/kg)	Change in Cleanup Level If Established Today?
2,4,6-TNT	33	MTCA B	33	No
2,4 and 2,6-DNT	1.5	MTCA B	1.5	No
RDX	9.1	MTCA B	9.1	No
Lead	250	MTCA A	250	No

Notes:
ARARs - applicable or relevant and appropriate requirements
DNT - dinitrotoluene
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision
TNT - trinitrotoluene

Table 7-2
Groundwater ARARs for Operable Unit 1

Chemical	Drinking Water Protection					
	ROD Drinking Water Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA Method B (µg/L)	Current Federal MCL (µg/L)	Current State MCL (µg/L)	Change in Cleanup Level If Established Today?
2,4,6-TNT	2.9	MTCA B	2.9	None	None	No
2,4 and 2,6-DNT	0.1	MTCA B	0.13	None	None	No
RDX	0.8	MTCA B	0.8	None	None	No
Lead	15	MTCA A	None	15	15	No

Notes:
ARARs - applicable or relevant and appropriate requirements
DNT - dinitrotoluene
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision
TNT - trinitrotoluene

Table 7-3
Surface Water ARARs for Operable Unit 1

Chemical	Drinking Water Protection					
	ROD Surface Water Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA SW Method B (µg/L)	Current Federal AWQC Marine (µg/L)	Current State AWQC Marine (µg/L)	Change in Cleanup Level If Established Today?
2,4,6-TNT	31	MTCA B SW	None	None	None	No
2,4 and 2,6-DNT	0.6	MTCA B SW	1,400[a]	3.4	3.4	Yes, higher
RDX	30	MTCA B SW	None	None	None	No
Lead	1	Not listed	None	8.1	None	Yes, higher
Phthalates	3	MTCA B SW	3.6[b]	2.2	2.2	Depends on endpoint (MTCA or AWQC); no significant change

[a]Based on 2,4-DNT, noncancer endpoint; no cancer endpoint listed for 2,4-DNT or a 2,4/2,6-DNT mixture
[b]Based on bis(2-ethylhexyl)phthalate

Notes:
ARARs - applicable or relevant and appropriate requirements
DNT - dinitrotoluene
µg/L - microgram per liter
MTCA - Model Toxics Control Act
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision
SW- surface water
TNT - trinitrotoluene

Table 7-4
Soil ARARs for Operable Unit 2

Chemical	ROD Remediation Goal (mg/kg)	Basis of Remediation Goal	Current MTCA Method B (mg/kg)	Change in Cleanup Level If Established Today?
2,4,6,-TNT	33	MTCA B	33	No
RDX	9.1	MTCA B	9.1	No
2,4 and 2,6-DNT	1.5	MTCA B	1.5	No
1,3,5-TNB	4.0	MTCA B	210,000	Yes, higher
1,3-DNB	8.0	MTCA B	8.0	No
Nitrate-N	29,000	MTCA B	130,000	Yes, higher
Nitrite-N	8,000	MTCA B	8,000	No
Manganese	940	Background	11,000	Yes, higher

Notes:
ARARs - applicable or relevant and appropriate requirements
DNB - dinitrobenzene
DNT - dinitrotoluene
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision
TNB - trinitrobenzene
TNT - trinitrotoluene

Table 7-5
Groundwater ARARs for Operable Unit 2

Chemical	Drinking Water Protection					Surface Water Protection		
	ROD Drinking Water Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA Method B (µg/L)	Current Federal MCL (µg/L)	Change in Cleanup Level If Established Today?	ROD Surface Water Cleanup Level (µg/L)	Basis of Cleanup Level	Current MTCA Method B (µg/L)
2,4,6,-TNT	2.9	MTCA B	2.9	None	No	40	Ryon 1987	Not researched – groundwater plume not reaching surface water
RDX	0.8	MTCA B	0.8	None	No	260	See note a	
2,4 and 2,6-DNT	0.13	MTCA B	0.13	None	No	300	See note b	
1,3,5-TNB	0.8	MTCA B	480	None	Yes, higher	80	See note c	
1,3-DNB	1.6	MTCA B	1.6	None	No	None		
Nitrate-N	10,000	Federal MCL	None	10,000	No	10,000	MCL	
Nitrite-N	100	Federal MCL	None	1,000	Yes, higher	None	-	
Manganese	50	State MCL	746	None	No	None	See note d	

[a]Extrapolated using acute chronic ratio (Stephen et al. 1985 reference not included in RI/FS reference list [U.S. Navy 1994])
[b]Extrapolated using acute chronic ratio (Etnier 1987)
[c]No observable effect concentration (Layton et al. 1987)
[d]The source of the manganese remediation goal is a secondary MCL.

Notes:
ARARs - applicable or relevant and appropriate requirements
DNB - dinitrobenzene
DNT - dinitrotoluene
µg/L - microgram per liter
MCL - maximum contaminant level
MTCA - Model Toxics Control Act
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision
TNB - trinitrobenzene
TNT - trinitrotoluene

Table 7-6
Soil ARARs for Operable Unit 3

Chemical	ROD Remediation Goal (mg/kg)	Basis of Remediation Goal	Current MTCA Method B (mg/kg)	Change in Cleanup Level If Established Today?
Antimony	32	MTCA B	32	No
Arsenic	20	MTCA A	20	No
Beryllium	0.23	MTCA B	160	Yes, higher

Notes:
ARARs - applicable or relevant and appropriate requirements
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
ROD - Record of Decision

Table 7-7
Groundwater ARARs for Operable Unit 3

Chemical	Drinking Water Protection				
	ROD Drinking Water Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA Method B (µg/L)	Current State MCL (µg/L)	Change in Cleanup Level If Established Today?
Cadmium	8	MTCA B	8	5	No
Manganese	50	MTCA B	2,200	50	Yes, higher

Notes:
ARARs - applicable or relevant and appropriate requirements
µg/L - microgram per liter
MTCA - Model Toxics Control Act
ROD - Record of Decision

Table 7-8
Soil ARARs for Operable Unit 6

Chemical	ROD Remediation Goal (mg/kg)	Basis of Remediation Goal	Current MTCA Method B (mg/kg)	Change in Cleanup Level If Established Today?
2,4,6-TNT	33.3	MTCA B	33	No
2,4-DNT (outside wetland)	1.5	MTCA B	1.5	No
2,4-DNT (inside wetland)	58.8	MTCA C[a]	190[a]	Yes, higher
2,6-DNT	1.5	MTCA B	1.5	No
Nitrotoluene (all isomers)	800	MTCA B	800	No
1,2-DNB (ortho-)	32	MTCA B	32	No
1,3-DNB (meta-)	8	MTCA B	8	No
1,4-DNB (para-)	32	MTCA B	32	No
TNB	4	MTCA B	210,000	Yes, higher
Nitrobenzene	40	MTCA B	40	No

[a]MTCA Method C cleanup level is used per Operable Unit 6 ROD to prevent significant damage to wetlands ecosystem.

Notes:
ARARs - applicable or relevant and appropriate requirements
DNB - dinitrobenzene
DNT - dinitrotoluene
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
ROD - Record of Decision
TNB - trinitrobenzene
TNT - trinitrotoluene

Table 7-9
Soil ARARs for Operable Unit 7

Chemical	ROD Remediation Goal (mg/kg)	Basis of Remediation Goal	Current MTCA Method A (mg/kg)	Current MTCA Method B (mg/kg)	Change in Cleanup Level If Established Today?
Arsenic (Sites B and 10[a])	20	MTCA A	20	0.67	No
Total cPAHs (Site B)	1	MTCA A	See Note b	See Note c	Yes, lower
Total PCBs (Sites B, 2, and 10)	1	MTCA A	10 (industrial) 1 (unrestricted)	0.5	No
DDT (Site E/11)	2.94	MTCA B	4 (industrial 3 (unrestricted)	2.9	No
Cadmium (Site 10[a])	None	NA	2	80	No
Lead (Site 10[a])	None	NA	250	None	No

[a]Four chemicals at Site 10 were identified post-ROD during a parking lot expansion. Remediation goals were not established. However, the chemicals are listed here for completeness.
[b]Method A for benzo(a)pyrene is 200 mg/kg industrial and 0.1 mg/kg unrestricted. There is no specified value for other cPAHs.
[c]Individual compounds evaluated based on their toxicity to benzo(a)pyrene

Notes:
ARARs - applicable or relevant and appropriate requirements
cPAHs - carcinogenic polyaromatic hydrocarbons
DDT - dichlorodiphenyltrichloroethane
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
PCBs - polycyclic biphenyls
ROD - Record of Decision

Source: ROD Table 19 (U.S. Navy, USEPA, and Ecology 1996)

Table 7-10
Groundwater ARARs for Operable Unit 7

Chemical	ROD Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA Method A (µg/L)	Current MTCA Method B (µg/L)	Change in Cleanup Level If Established Today?
TPH (Site 10)	1,000	MTCA Method A	500	None	Yes, lower[a]
Otto fuel (Site E/11)	0.2	Practical quantitation limit	None	0.6	Yes, higher[b]

[a]No longer a Method A for TPH. Method A for diesel-range organics, heavy oils, and mineral oil is 500 µg/L. For gasoline-range organics, if no detectable benzene, Method A is 800 µg/L.
[b]A risk-based MTCA B level for the major component of Otto fuel (propylene glycol dinitrate) is not currently available in Washington State Department of Ecology's CLARC database. However, if a MTCA Method B level were calculated using U.S. Environmental Protection Agency toxicity assumptions, it would be 0.6 µg/L. See discussion in Section 7.2.2.

Notes:
ARARs - applicable or relevant and appropriate requirements
µg/L - microgram per liter
MTCA - Model Toxics Control Act
ROD - Record of Decision
TPH - total petroleum hydrocarbon

Table 7-11
Groundwater ARARs for Operable Unit 8

Chemical	Drinking Water				
	ROD Drinking Water Remediation Goal (µg/L)	Basis of Remediation Goal	Current MTCA Method B (µg/L)	Current MCL (µg/L)	Change in Cleanup Level If Established Today?
Benzene	5	MCL	0.8	5	No
1,2-DCA	5	MCL	0.48	5	No
1,1-DCE	0.0729[a]	MTCA B	400	7	Yes, higher
1,2-EDB	0.000515[a]	MTCA B	0.2	0.05	Yes, higher
Toluene	1,000	MCL	640	1,000	No

[a]The ROD indicated that these MTCA B levels were below the PQL. Therefore, the PQL would be used as a remediation goal, but specific PQL concentrations were not listed in the ROD.

Notes:
ARARs - applicable or relevant and appropriate requirements
DCA - dichloroethane
DCE - dichloroethene
EDB - dibromoethane
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
PQL - practical quantitation limit
ROD - Record of Decision

Source: ROD Tables 8-1 and D-1 (U.S. Navy, USEPA, and Ecology 2000a)

Table 7-12
Soil ARARs for Pogy Road

Chemical	MTCA Method B from DCLP (mg/kg)	MTCA Method C from DCLP (mg/kg)	EPA PRG from IRACR (mg/kg)	Current MTCA Method B (mg/kg)	Current MTCA Method C (mg/kg)	Current EPA RSL (mg/kg)	Change in Cleanup Level if established today?
HMX	4,000	175,000	3,100	4,000	180,000	3,800	Yes, higher
RDX	9.09	1,190	4.4	9.1	1,200	5.5	Yes, higher
Picric acid	33–5,400[a]	1,800–230,000[a]	NE				
1,3-Dinitrobenzene	40		6.1	8	350	**6.1**	Yes, lower
Tetryl	800	1,750	NE	800	35,000	**240**	Yes, lower
Nitroglycerin	71.4	9,380	35			**6.1**	Yes, lower
2,4,6-Trinitrotoluene (TNT)	33.3	700	16	33	1,800	19	Yes, both
4-Amino 2,6-Dinitrotoluene	16	700	12			150	Yes, higher
2-Amino 4,6-Dinitrotoluene	16		12			150	Yes, higher
2,6-Dinitrotoluene	80		0.720			0.71[b]	
2-Nitrotoluene	800		0.880	800	35,000	2.9	Yes, higher
4-Nitrotoluene	800		12	800	35,000	30	Yes, higher
3-Nitrotoluene	800		730			**6.1**	Yes, lower
TNX	NDV	NDV	NE			NE	
DNX	0.00182–0.0196[a]	0.239–2.57[a]	NE			NE	
MNX	0.333–9.9[a]	43.8–1,190[a]	NE			NE	

[a]These calculated soil cleanup levels are subject to greater uncertainty than the other soil cleanup levels developed for the remaining explosives-related compounds. See Section 4 of the DCLP for more details (U.S. Navy 2004g).
[b]Current RSL based on the carcinogenicity of a 2,4/2,6-dinitrotoluene mixture.

Notes:
DCLP - Determination of Cleanup Level Plan
EPA - U.S. Environmental Protection Agency
IRACR - independent remedial action closure report (U.S. Navy 2005e)
mg/kg - milligram per kilogram
NDV - no defensible value
NE - not established
PRG - preliminary remediation goal
RSL - Residential Screening Level

Table 7-13
Issues

Item No.	Issue	Affects Protectiveness	
		Current	Future
OUs 1 and 2			
1	Labels on valves, treatment equipment, and other components of the Sites A and F treatment systems reflect historical, rather than current, system operation. This creates the potential for error during system operation.	No	Yes
2	There is no mechanism to gauge the flow rate from individual extraction wells.	No	No
3	Treatment system operation, maintenance, and monitoring data for Sites A and F are difficult to locate within consistently titled periodic reports.	No	No
4	EPA is currently reevaluating the RDX cancer slope factor, and changes to this slope factor could affect the protectiveness of Sites A and F.	No	Yes
OU 1			
5	The potential contaminant contribution to the shallow aquifer from the perched aquifer and residual soil contamination is unclear, as is the quantity of contaminant mass removed from the shallow aquifer by the pump and treat system as compared to natural attenuation.	No	Yes
6	The Site A groundwater treatment system is not functioning as intended by the ROD.	No	Yes
7	The thorny brush meant to discourage access to Debris Area 2 is insufficient for its intended purpose.	No	Yes
OU 2			
8	The Site F groundwater treatment system is not functioning as intended by the ROD.	No	Yes
9	The Site F groundwater plume has expanded beyond the area of ICs. The concentration trend at F-MW67, which is beyond the limits of the extraction system containment, is increasing.	No	Yes
10	The containment assessment for Site F does not explicitly consider Otto fuel at Site E/11.	No	No
11	The current groundwater monitoring program does not take into account the higher cleanup levels that would be calculated today for some compounds.	No	No
12	Six of the OU 2 COCs are not regularly summarized in the LTM reports and may not need to be part of the LTM program any longer.	No	No
OU 3			
13	Results of the EPA evaluation for arsenic could impact OU 3. If, as anticipated, the cleanup level for arsenic decreases significantly, the ICs for OU 3 should be reviewed and potentially made more rigorous if arsenic is actually present above local background levels.	No	Yes
14	Groundwater ICs do not appear to be necessary at OU 3.	No	No
OU 6			
15	Five-year reviews may no longer be necessary for Site D.	No	No
OU 7			
16	Five-year reviews are no longer necessary for Sites 2 and 26.	No	No

Table 7-13 (Continued)
Issues

Item No.	Issue	Affects Protectiveness	
		Current	Future
OU 8			
17	Benzene concentrations in the core of the plume at OU 8 exhibit an increasing trend over at least the last 4 years, and free product is again observed in one monitoring well.	No	Yes
18	The OU 8 remedy is taking longer to meet the remedial action objectives than anticipated in the ROD.	No	Yes
19	There is the potential for vapor intrusion into buildings above the volatile organic compound plume at OU 8.	No	Yes
20	Documentation of COC concentrations remaining in soil following removal actions is not readily available, preventing review of whether residual COC concentrations in soil are protective of groundwater.	No	Yes
General			
21[a]	The current Institutional Controls Management Plan has outdated field checklists and figures, and shoreline monitoring needs to be reviewed for possible enhancements[a].	Yes	Yes
22	The draft Notice of Intent to Delete for soils at Sites A, D, E, F, 2, 11, and 26 has not yet been issued by EPA.	No	No
23	The Mann-Kendall analysis currently being used to evaluate trends may not be the best available method given the data sets available.	No	No

[a]A 2010 update to the Institutional Controls Management Plan is in progress.

Notes:
red - Follow-up action affects both current and future protectiveness.
yellow - Follow-up action affects future protectiveness.
COCs - chemicals of concern
EPA - U.S. Environmental Protection Agency
IC - institutional control
LTM - long-term monitoring
OU - operable unit
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD - Record of Decision

8.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 8-1 summarizes the recommendations and follow-up actions identified as a result of the 5-year review process. Some recommended actions are necessary to ensure the long-term protectiveness of certain remedy components. Other actions do not affect protectiveness, but are necessary to achieve or maintain compliance with the RODs or subsequent approved implementation plans. Still other actions are recommended because RAOs have been met. Finally, some actions are recommended because a remedial component, although protective, is not effective at reducing levels of COCs (Sites A and F).

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
OUs 1 and 2						
1	Update the labeling of valves, treatment equipment, and other components of the Sites A and F treatment systems to reduce the potential for error in system operation.	NAVFAC NW	Ecology, EPA	December 31, 2015	No	Yes
2	If pump and treat will continue in the long term and if it is feasible, consider including individual extraction well line flow totalizers to enhance functionality assessments.	NAVFAC NW	Ecology, EPA	December 31, 2012	No	No
3	Title the annual reports that include both monitoring and treatment system operation data "*year* Operations, Maintenance, and Monitoring Report."	NAVFAC NW	Ecology, EPA	December 31, 2011	No	No
4	Monitor EPA's reevaluation of the RDX cancer slope factor and reassess the protectiveness of Sites A and F when the reevaluation is complete.	NAVFAC NW	EPA	December 31, 2015	No	Yes
OU 1						
5	Update the conceptual site model to portray the latest understanding of contaminant inputs from residual soil and perched aquifer contamination and contaminant removal from natural attenuation and pump and treat.	NAVFAC NW	EPA	December 31, 2015	No	Yes
6	Complete the assessment of an alternative remedy to the current treatment system, and take action based on the results of the assessment.	NAVFAC NW	EPA	December 31, 2015	No	Yes
7	Plant additional thorny bushes to discourage access to Debris Area 2, or fence the area.	NAVFAC NW	EPA	December 31, 2012	No	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
OU 2						
8	Complete the ongoing assessment and optimization of the Site F treatment system to address containment issues, downgradient plume extent, and the portion of the plume downgradient of the current capture zone. Include an assessment of the capture and treatment of Otto fuel from Site E/11.	NAVFAC NW	Ecology	December 31, 2015	No	Yes
9	Expand the IC boundary for Site F to cover the larger area of the groundwater plume.	NAVFAC NW	Ecology	December 31, 2011	No	Yes
10	Review the groundwater analytical program at OU 2, considering the higher cleanup levels that would be calculated today for some compounds, and update the monitoring plan based on the results.	NAVFAC NW	EPA	December 31, 2015	No	No
11	Review the analytical results for the six OU 2 chemicals of concern not regularly summarized in the LTM reports against their Record of Decision remediation goals and potential cleanup level changes to evaluate whether the LTM program should continue to analyze groundwater for these chemicals. Revise the OU 2 LTM program based on the conclusions.	NAVFAC NW	EPA	December 31, 2011	No	No
OU 3						
12	Track EPA's reevaluation of arsenic toxicity and evaluate the need for changes to ICs for soil at OU 3 if arsenic concentrations in soil are confirmed to be above	NAVFAC NW	EPA	December 31, 2015	No	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
	background levels. Revise the ICMP based on the conclusions.					
13	Evaluate OU 3 based on current and historical groundwater monitoring data to determine if groundwater ICs can be removed. Revise the ICMP based on the conclusions.	NAVFAC NW	EPA	December 31, 2015	No	No
OU 6						
14	Collect and analyze soil and sediment samples for 2,4-dinitrotoluene to evaluate whether current concentrations meet the Method B level. Based on the results, consider discontinuing 5-year reviews at OU 6.	NAVFAC NW	EPA	December 31, 2015	No	No
OU 7						
15	Discontinue 5-year reviews at Sites 2 and 26.	NAVFAC NW	EPA	December 31, 2015	No	No
OU 8						
16	Implement the currently planned pilot testing to evaluate potential additional contingent remedial actions at OU 8 to address the slower-than-anticipated remediation progress of the selected remedy, the increasing benzene concentrations, and the return of free product.	NAVFAC NW	Ecology	December 31, 2015	No	Yes
17	Perform an investigation of the vapor intrusion pathway within the Public Works Industrial Area of OU 8 following completion of the current pilot testing program. If the use of the buildings located above the COC plume in groundwater changes, accelerate the vapor intrusion investigation.	NAVFAC NW	EPA	December 31, 2012	No	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
18	Obtain documentation of COC concentrations remaining in soil following removal actions, assess whether residual COC concentrations in soil are protective of groundwater, and update the OU 8 conceptual site model accordingly.	NAVFAC NW	EPA	December 31, 2012	No	Yes
General						
19[a]	Revise the ICMP to include updated field checklists and figures and an enhanced shoreline monitoring procedure[a].	NAVFAC NW	EPA, Ecology	December 31, 2015	Yes	Yes
20	Prepare draft Notice of Intent to Delete for soils at Sites A, D, E, F, 2, 11, and 26.	EPA	EPA	December 31, 2015	No	No
21	Evaluate alternative methods for analyzing data trends.	NAVFAC NW	EPA	December 31, 2015	No	No

[a]A 2010 update to the ICMP is in progress.

Notes:
red - Follow-up action affects both current and future protectiveness
yellow - Follow-up action affects future protectiveness
Ecology - Washington State Department of Ecology
EPA - U.S. Environmental Protection Agency
IC - institutional control
ICMP - Institutional Controls Management Plan
LTM - long-term monitoring
NAVFAC NW - Naval Facilities Engineering Command Northwest
OU - operable unit
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine

9.0 CERTIFICATION OF PROTECTIVENESS

The remedies at the sites included in the RODs for NBK Bangor have been implemented and are currently protective of human health and the environment given the current land use. In order for the remedies to remain protective for the long-term, the recommendations in Table 8-1 must be implemented.

At many of the sites and OUs at NBK Bangor, remedial actions have resulted in COC concentrations below the RGs for specific media. Where RGs have not been met, active remediation systems, OM&M programs, and ICs serve to make progress toward meeting RGs and to control exposure pathways in the interim.

For the remedy at OU 1 (Site A), the MNA evaluation should continue to determine if it is appropriate. For the remedy at OU 2 (Site F), further evaluation is warranted to assess (1) the degree of loss of plume containment and (2) options for reestablishing plume containment and treatment of the downgradient portion of the plume.

For the remedy at OU 8, the potential for vapor intrusion should be evaluated in buildings located above the known extent of the VOC plume and work should continue to assess potential additional contingent remedial actions that could shorten the remediation time frame.

10.0 NEXT REVIEW

The next 5-year review is tentatively scheduled for 2015.

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APPENDIX A

Interview Responses and Responses to Comments

Interview Responses

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 3 Interview – Community Member
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Adkins
Organization: Former RAB member

Contact made by: Deborah Wilson, URS
Response type: Telephone interview
Date: 11/6/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: I was totally involved until the RAB was closed out. I was in the RAB from the beginning, but have not been involved since then.

2. What is your overall impression of the on-going protectiveness of the remedies at NBK Bangor?

   Response: I think the remedies they were working on were very good.

3. Do you feel well informed about the remediation activities and progress at NBK Bangor? Please elaborate.

   Response: Well, not since the RAB closed out. Since then don't know what is going on, but during that time I was very impressed with what was happening and how the cleanup was going.

4. What effects on the community have you observed as a result of on-going remedy implementation?

   Response: None.

5. Are you aware of any community concerns regarding implementation of the remedies? If so, please give details.

   Response: No.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NBK Bangor?

   Response: I just think on-going work is a good thing all the way around.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 2 Interview – Regulatory Agency
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Brower
Title: SHW Program Manager
Organization: Kitsap County Health District

Contact made by: Deborah Wilson, URS
Response type: E-mail/written
Date: 10/30/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: My tenure with Health District began in 1998 as SHW Program Manager, to my knowledge we have not had any direct involvement in the Bangor corrective action implementation. I believe that we have copies of the RI/FS for Bangor as we were a repository for documents during the public comment period. However, since then we have not been provided with reports, summaries, or data pertaining to the site. We do routinely interact with Waste Mgt personnel from Bangor, most usually in regards to off-site disposal of soils or debris removed as part of clean-ups. In those cases we would have had approval authority for off-site reuse of non-hazardous waste disposal or reuse.

2. What is your overall impression of the on-going protectiveness of the remedies at NBK Bangor?

   Response: Since we have not been provided with copies of the 5 year review documents, this agency has no impression with regards any clean up.

3. Do you feel well informed about the remediation activities and progress at NBK Bangor? Please elaborate.

   Response: No. Neither Ecology or EPA has provided information related to clean-up activities at this site.

4. To the best of your knowledge, since August 2004 have there been any new scientific findings that relate to potential site risks that might call into question the protectiveness of the remedies?

   Response: None to out knowledge.

5. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: Since we have not received any reports as to activities at this site, this agency has no impression as to the effectiveness.

6. In your opinion, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response: Cannot comment.

7. Since August 2004, have there been any complaints, violations, or other incidents related to NBK Bangor installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: Not to our knowledge.

8. To the best of your knowledge, has the on-going program of environmental monitoring at NBK Bangor been sufficiently thorough and frequent to meet the goals of the RODs?

   Response: Do not know.

9. Are you aware of any community concerns regarding implementation of the remedies at NBK Bangor? If so, please give details.

   Response: We have received comments from Contractors who work at the site that have questioned us regarding disposal practices at the site.

10. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NBK Bangor?

Response: Concerned that as the local public health regulatory agency overseeing Solid Waste and Drinking Water, that we have received so little information regarding this site and remediation activities.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 3 Interview –Community Member
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Edwards
Organization: Former RAB member

Contact made by: Deborah Wilson, URS
Response type: Written by e-mail
Date: 11/16/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: Familiar during the time of RAB meeting time period – not since August, 2004.

2. What is your overall impression of the on-going protectiveness of the remedies at NBK Bangor?

   Response: I don't know at this point. I'd like an update, particularly on Floral Point.

3. Do you feel well informed about the remediation activities and progress at NBK Bangor? Please elaborate.

   Response: Not at this time – have not received updated reports and would be very interested in knowing what/if there are continued remediation activities.

4. What effects on the community have you observed as a result of on-going remedy implementation?

   Response: None since I'm not now familiar with on-going remedy implementation, other than as stated in response to the next question.

5. Are you aware of any community concerns regarding implementation of the remedies at NBK Bangor? If so, please give details.

   Response: I am aware of several community members' objections to the current methods employed for ordnance detonation, which I consider to be part of the overall environmental arena of on-going clean-up efforts at Bangor. Community members feel there is currently too much and it goes on for too long at one time. A detonation is scheduled for November 19 that is supposed to go on from 7 a.m. – 5 p.m. This is extremely loud, frightens children and pets, and community members have concerns for the wildlife in the refuge in the north end of Bangor as well. They also feel it should not be going on for potentially 10 hours at one time. One member stated that she thought detonation is also being done there for other venues such as the sheriff's and police departments and was very opposed to it if this is the case. If this is the case, I would also be very opposed to it as well. There definitely seems to be have been a large increase in detonation at Bangor lately, and it would seem to be too large a burden for one community to bear if in fact there is detonation being done for other agencies outside of the Navy.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NBK Bangor?

   Response: I would like to know if the natural attenuation has been evaluated for effectiveness in the clean-up Floral Point area of Bangor. I would also like comments about the necessity of the current procedures for ordnance detonation and the effect it is appearing to have on the community.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 2 Interview – Regulatory Agency
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Knadle
Title: Hydrogeologist
Organization: USEPA, Region 10

Contact made by: Deborah Wilson, URS
Response type: Written
Date: 11/09/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: I was EPA's hydrogeologist working on this site during the mid-late 1980's. I stopped working on it about the time the RI/FS came out, so I had no involvement with the remedy selection at any of the OUs. I started being consulted by EPA staff again in the early 2000's on OUs 1 and 2, and have been working on those sites (mainly OU 1) since Harry Craig became EPA Remedial Project Manager. What little involvement I've had with the other OUs is limited to occasional reviews of long-term monitoring data at OU 8. I was not involved with EPA's review of the 2005 Five-Year Review Report (5YR).

2. What is your overall impression of the on-going protectiveness of the remedies at NBK Bangor?

   Response: With regard to current protectiveness, the sites are all protective. There are issues with future protectiveness at OU 1 (we don't know if groundwater migration is naturally under control) and OU 2 (the newer "downgradient" injection wells were installed upgradient of the end of the RDX plume and have apparently pushed contamination further downgradient. It's unclear whether this has resulted in a long-term expansion of the plume. Any expansion may be short-term and/or self-limiting. The larger issue may be whether the monitoring well network is adequate to demonstrate this.

3. Do you feel well informed about the remediation activities and progress at NBK Bangor? Please elaborate.

   Response: For OU 1, yes. For the other OUs, I see occasional reports. However, the State has the regulatory lead for the other OUs, so I wouldn't expect to be very involved except at the 5-Year Review unless some specific issue is raised.

4. To the best of your knowledge, since August 2004 have there been any new scientific findings that relate to potential site risks that might call into question the protectiveness of the remedies?

   Response: The realization that there's a "dogleg" of RDX plume at OU 1 that is downgradient of – and uncontained by – the pump-and-treat system (P&T) pre-dates 2004. The realization that the migration status of this dogleg needs to be understood is more recent. There has also been recent recognition that the P&T is not fully containing even the main portion of the plume and is consequently still feeding RDX to the "dogleg" to some extent.

5. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: These appear to be quite robust for the OUs completely on-base. I'm not familiar with the nature of ICs for the off-base portion of the OU 8 plume, but I'm not aware of any exposure issues.

6. In your opinion, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response: Aside from the poorly-located "downgradient" reinjection wells, I think the OU 2 P&T has been reasonably effective at containing the plume and may eventually restore the groundwater. At OU 1 the P&T has never been a very effective remedy component for 2 reasons:

   1) The ROD groundwater remedial action objective (RAO) is restoration through out the aquifer, and the ROD contained a conceptual P&T design involving around 20 wells to remove mass throughout the source area. However, the actual P&T installed was not designed to remove mass effectively. Instead, it was designed to contain the groundwater plume under the source area (the identified extent at the time), requiring the more contaminated groundwater to flow to about 5 wells on the downgradient edge of the plume (as understood at the time), some of which are just now beginning to pull in contamination. Two monitoring wells within the source plume were later converted to extraction wells, but they've only yielded about half the flow of the extraction wells. Fundamentally, it's a system that was never designed to remove groundwater mass effectively and thus can't

meet the restoration RAO. Furthermore, capture zone analysis indicates that the P&T doesn't even completely contain the source area plume. This is undoubtedly at least partially due to the low hydraulic conductivity of the aquifer, so it's not clear whether simply reconditioning existing wells would establish capture, or whether additional extraction wells would be required.

2) The existence of the "dogleg" downgradient of the P&T was not recognized until shortly before the last 5YR, long after the P&T was installed. As a result, there is no control of this apparently faster-moving portion of the plume. Wells are being installed soon to help determine whether the "dogleg" plume is actually migrating, but that won't be known until after the next 5YR.

7. Since August 2004, have there been any complaints, violations, or other incidents related to NBK Bangor installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: None that I'm aware of.

8. To the best of your knowledge, has the on-going program of environmental monitoring at NBK Bangor been sufficiently thorough and frequent to meet the goals of the RODs?

   Response: Aside from needing more wells to bound the OU 1 plume "dogleg" and to determine whether it's migrating downgradient, I think the monitoring systems are generally adequate.

9. Are you aware of any community concerns regarding implementation of the remedies at NBK Bangor? If so, please give details.

   Response: No.

10. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NBK Bangor?

    Response: For several years, the Navy has argued that the aquifer at OU 1 is too tight (low-permeability) for P&T to work. I recognize that the heterogeneous and low-permeability conditions in the aquifer make it a challenging environment for P&T. However, the failure of the current P&T doesn't necessarily tell us that an appropriately designed or optimized P&T wouldn't be successful, at least for containment. It's not clear to us whether intrinsic bioremediation can contain even the "dogleg," which is why the new wells are so important. If so, monitored natural attenuation could be considered as a potential remedy component. It's also possible that intrinsic bioremediation could be enhanced to perform as well as the current

P&T, or ideally as well as an optimized P&T. It's also unclear how much RDX mass persists in the vadose zone that could recontaminate the shallow aquifer if the leach basin someday begins leaking water.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 1 Interview – Navy Personnel
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Mr. Kobeski
Title: Remedial Project Manger (RPM)
Organization: NAVFAC NW

Contact made by: Deborah Wilson, URS
Response type: Written by e-mail
Date:

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for Operable Units (OUs) 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OU's, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: I assumed my current position as the NAVFAC NW Remedial Project Manager for NBK Bangor February 2009. I am very familiar with the NBK Bangor, Records of Decision (RODs) for OU 1, OU 2, OU 3, OU 6, OU 7, and OU 8. I am the Navy's Project Manager for implementing, monitoring, and maintaining the remedies at each of these OU's.

2. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: My overall impressions of the institutional controls component are that they are working to ensure the remedies are protective of human health and the environment.

3. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No, I am not aware of any violations to the Intuitional Control (IC) requires at any of the OUs.

4. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: To the best of my knowledge regular inspections of the institutional controls for the remedy components have been conducted. Documentation exists that the IC were regularly inspected in 2006, 2007, and 2008 by the Navy RPM. IC inspection for 2009 has been contracted to be performed in October 2009. Documentation for the years 2005 has not been located.

5. To the best of your knowledge are the leach basin barrier at Site A, the infiltration barrier at Site F, and the vegetative cap at Site B intact?

   Response: To the best of my knowledge the leach basin barrier at Site A, the infiltration barrier at Site F, and the vegetative cap at Site B are intact. These areas are inspected at least once a year during the institutional control monitoring.

6. To the best of your knowledge, has the on-going environmental monitoring performed at many of the OUs since August 2004 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response: To the best of my knowledge the on-going environmental monitoring performed at all OUs (since August 2004) have been sufficiently thorough and frequent to meet the goals of the RODs.

   At Site F, it has been determined that additional wells will be installed at to find the leading edge of the plume and are tentatively scheduled for Fiscal Year 10-11 as funding allows.

7. To the best of your knowledge, have the eight recommendations of the previous (i.e., second) five-year review been implemented?

   Response: To the best of my knowledge the 8 recommendations of the previous five year review have been implemented.

   - Optimization studies recommendations for site A and Site F have been implement with the exception of MNA at Site A. MNA was conditionally accepted by Washington State Department of Ecology. In October 2007, US EPA assumed lead regulatory agency role sighting the Site A groundwater treatment system is not functioning as intended by the Record of Decision and would require evaluation/resolution of various issues pending at Site A. These issues include groundwater optimization; alternative treatment technology analysis; and evaluation of technical infeasibility. Evaluation/resolution of these issues will require an increased level of EPA involvement The Navy is currently working with US EPA to resolve the issues at Site A. The remedy is currently protective of human health and the environment.

- An engineering evaluation of the shoreline erosion at Site B has been conducted and a shore stabilization project was completed in 2006 -2007.

- Sediment and clam tissue sampling for Site 26 and Site B have been discontinued. Yearly monitoring during the instructional control inspection for Site B for shoreline erosion is conducted and documented in the annual report.

- Monitoring is being continued at OU 8 focusing on the DCA/Benzene plume. No new exposure paths have been created at the site. Benzene plume is contained within the base boundary and MNA is effective in treating the COCs. A pilot study is currently underway to address DCA plume, which is presently ~125 feet outside the base boundary. MNA continues to be protective of human health and the environment.

- Copies of the 2006-2009 annual Instructional Controls inspection reports are kept at NAVFAC NW Tautog Circle and in an electronic database in acrobat pdf format. Hard copy or electronic versions for the year 2005 have not been located.

- The IC boundary for the Site F has been updated in the GIS mapping database. In addition, the institutional control management plan is currently being updated for NBK Bangor for this change and the expansion of Site 10 IN accordance with the 26 March 2009 Final Closure Report Capping Parking Area at Site 10, NBK Bangor.

- Sampling for Perchlorate at Sites A, F And D at NBK Bangor was conducted in December 2006. Perchlorate was not detected in any of the samples at or above the laboratory's practical quantitation limit (PQL). May 11. 2006 technical Memorandum for PERCHLORATE SAMPLING AT SITES A, D, AND F

8. To the best of your knowledge, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response: To the best of my knowledge the pump and treat systems at OU 1 (Site A) have been meeting the ROD requirements for being protection of human health and the environment, it is not a cost effective part of the remedy.

   - Since the ROD was signed in 1991, a strong base of information has been developed from construction and operation of the existing Site A pump-and-treat system and associated long term monitoring to demonstrate that it is not practicable to restore the shallow aquifer to drinking water standards in a reasonable time frame. ESD No. 3 (July 2000) included the following changes to the Site A ROD that "The remediation cost to date was more than three times greater than that estimated in the ROD."

- In February 1999 the Navy agree with EPA that no reasonable active remediation alternatives to pump and treat exists but also propose that the existing groundwater contamination would not pose an adverse risk to surface water at the point of groundwater discharge.

- An MNA remedy component can be protective of the groundwater to surface water pathway while natural biodegradation acts to clean up the groundwater. Presently, the leading edge of the plume, as defined by the groundwater cleanup criteria, is approximately 900 feet from Cattail Lake. The RI estimates groundwater flow velocity in the shallow aquifer at 9 to 37 feet per year and contaminant migration retardation rates in groundwater can range from 10 to 50 percent.

- The optimization report (October 2004) for OU 1 (Site A) recommended installation of two additional wells and securing the pump and treat system due to cost. The idea to switch remedies to MNA requires additional studying to achieve regulatory acceptance. In 2004, the Navy proposed MNA with institutional controls restricting groundwater use until drinking water standards are achieved; an alternate point of compliance at the location of groundwater discharge to the Cattail Lake drainage area; and alternate concentration limits (ACLs) based on surface water cleanup levels.

- In April 2009, the Navy and EPA conducted a site visit at Site A to discuss the remedy. As apart of that discussion, the Navy scheduled drilling two additional wells to be installed in November 2009. The Navy is working with EPA to start the process of evaluating Plume stability as the first component in accessing the site to switch remedies from the non-cost effective remedy to a more cost effective and protective remedy of MNA.

- To the best of my knowledge the pump and treat system at OU 2 (Site F) has been effective components of the remedies.

- The optimization report (October 2004) for OU 2 (Site F) recommendations have been implemented. Currently the Navy is working with the Navy's Long Term Monitoring contractor to incorporate hydraulic data gathered monthly from the Site F and report on adjustment to plant operations for plume containment and contaminant removal.

9. Do you know of any significant operation and maintenance difficulties with the pump and treat systems that could have impacted the protectiveness of these components of the remedies?

   Response: I know of no significant operations and maintenance problems that could have impacted the protectiveness of the remedies for OU 1 and OU 2. The only know significant maintenance has been identified during the normal LTM reports and is on infiltration well F-IW8 and extraction wells F-EW5, which are being evaluated for cleaning and redevelopment in FY 10-14.

10. Do you have any recommendations for optimizing the pump and treat systems, or for implementing alternatives to the pump and treat systems (such as monitored natural attenuation at Site A as has been previously proposed)?

    Response: The Navy is currently working with US EPA on the remedial system at Site A. The next step at Site A is the installation of additional monitoring wells and gather data over time to evaluate plume stability. The Navy has been in discussions with EPA Region 10 on OU 1 (Site A) with first site meeting in April 2009. During this site visit, the Navy committed to installing two additional wells and redevelopment of 6 extraction wells for the Site. The Navy will be utilizing the monitoring data from the new wells and RDX recovery rates from the extraction wells to evaluate plume stability and cost of RDX recovery while continuing to work with EPA Region 10 to optimize the remedy at OU 1 (Site A) . Navy believes that the plume is stable due to the low hydraulic conductivity of the aquifer and does not have a continuing source of oxygen to the aquifer to maintain aerobic condition indefinitely (USGS). The navy believes that MNA is an option that needs additional exploration. In addition, the third ESD No. 3 (July 2000) changes OU 1 ROD states that the remediation to cost to date was more then three times greater than was estimated in the ROD. Expanding the system is not a feasible alternative due to the technical limitations of P&T systems under the hydro geologic conditions present at the site. Groundwater modeling conducted in 2001 predicted full aquifer restoration would require approximately 120 years to complete if the system was expanded by 15 extraction wells and 4 reintroduction wells. However, the predicted cleanup time is likely underestimated by the model's inherent assumptions of a homogeneous aquifer and instantaneous desorption of contaminants (9 November 2004 Site A Groundwater Remedy Summary Report).

11. To the best of your knowledge, what is the status of this OU 8 groundwater remediation system? What are the current plans for in-situ remediation strategies at OU 8?

    Response: It was identified in FY 2005 that the system is not operational and would require a major capital investment to become operational.

Actions presently being planned by the Navy to improve the remedy at OU 8 include the following:

1. Removing free product from well 8MW47 starting prior to Round 21 for a year and measure and monitor fuel rebound.

2. Conducting free product measurements and free product removal (as required) for wells in the Public works industrial area (PWIA) starting Round 21 (October 2009) to determine whether the presence of free product at 8MW47 is an isolated event.

3. Implementation of the contingency plan in the Data Management Evaluation Plan to install oxygen release compound (ORC) socks at the Base Boundary in existing wells to enhance the biological activity in groundwater. ORC socks will be installed prior to Round 22 April 2010.

4. Conduct a pilot treatability study in the PWIA source area utilizing molecular biological tools (MBTs) and historical analytical chemical data to determine if anaerobic bio-stimulation with/without bio-augmentation is required for improving control of the DCA plume to within the base boundary.

5. Complete the optimization study of treatment options available for OU 8 under the current ROD. This study is being conducted by the Navy Engineering Service Center, with the result to be reported in 2010.

12. To the best of your knowledge, has the monitored natural attenuation component of the OU 8 remedy been fully implemented? Have monitoring data collected to date been adequate for meeting the intent of the ROD?

    Response: The MNA component of OU 8 remedy has been fully implemented. Monitoring data has been collected and is adequate for meeting the intent of the ROD.

13. Are you aware of any community concerns regarding implementation of the remedies at any of the OUs? If so, please give details.

    Response: I am not aware of any community concerns regarding the implementations of the remedies at any of the OUs at NBK Bangor.

14. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NSB, Bangor?

    Response: Presently the effectiveness of the remedies at Operable Units (OUs) 1, 2, 3, 6, 7, and 8 are protective of human health and the environment. The Navy ensures this through monitoring groundwater, operating the treatment systems, implementing and inspecting land use controls and remedies, and reporting status of progress to the regulatory agencies (Partnering Stakeholders).

Currently, the Navy is working with Washington State Department of Ecology on a pilot study on the benefits of augmenting the MNA remedy for OU8 and US EPA on OU 1 Site A to evaluate MNA as a protective and cost effective remedy.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 2 Interview – Regulatory Agency
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Mr. Yee
Title: Environmental Engineer 3
Organization: Washington State Department of Ecology

Contact made by: Deborah Wilson, URS
Response type: Written
Date: 11/9/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: I am familiar with the Records of Decision for Operable Units 1, 2, 3, 6, 7, and 8 and the implementation of the remedies at these operable units. I am the Ecology's staff assigned to provide oversight of cleanup works at NBK Bangor.

   On October 8, 2007, Ecology transferred to EPA Region 10 the lead regulatory status for Operable Unit 1 Area A. Since the transfer, I have not been provided with information on remediation activities and progress at Operable Unit 1 Area A.

2. What is your overall impression of the on-going protectiveness of the remedies at NBK Bangor?

   Response: Excluding Operable Unit 1 Area A for the reason stated in Response 1, the remedies at NBK Bangor are considered to be currently protective.

   Operable Unit 2 Site F monitoring reports identify occurrence of explosive RDX downgradient from containment. This detached northern plume is being monitored and evaluated to ensure continue protectiveness of the containment system.

Operable Unit 8 monitoring data confirm the Record of Decision specified cleanup levels are not being met the base boundary. This issue is being addressed by the Navy.

3. Do you feel well informed about the remediation activities and progress at NBK Bangor? Please elaborate.

   Response: Excluding Operable Unit 1 Area A for the reason stated in Response 1, I am well informed on remediation activities and progress at NBK Bangor.

4. To the best of your knowledge, since August 2004 have there been any new scientific findings that relate to potential site risks that might call into question the protectiveness of the remedies?

   Response: No.

5. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: Effective as implemented.

6. In your opinion, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response: EPA is the lead regulatory agency for OU 1 Site A.

   The northern detached plume at OU 2 Site F may indicate the pump and treatment containment has been compromised. The Navy is evaluating this issue.

7. Since August 2004, have there been any complaints, violations, or other incidents related to NBK Bangor installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: On October 4, 2007, I received an email from Mr. Harry Craig of EPA R10 detailing a telephone call from Mr. Jason Smith of Pacific Tech on heavy metal soil contamination at a construction site at Bangor. I forwarded the email to Mr. Said Seddiki, NAVFAC NW and completed follow-up activities at this construction site (Construction Project P345B adjacent to the Environmental Restoration Site 10). Follow-up activities completed included site visit, reviewing and commenting on work plan and closure report. For the reason stated in Response 1, I am not aware of any complaints, violations, or incidents reported for Operable Unit 1 Area A.

8. To the best of your knowledge, has the on-going program of environmental monitoring at NBK Bangor been sufficiently thorough and frequent to meet the goals of the RODs?

Response: Yes.

9. Are you aware of any community concerns regarding implementation of the remedies at NBK Bangor? If so, please give details.

   Response: No.

10. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NBK Bangor?

    Response: No.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 1 Interview – Navy Personnel
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Yuenger
Title: Public Affairs Officer
Organization: Naval Facilities Engineering Command Northwest

Contact made by: Deborah Wilson, URS
Response type: Written by e-mail
Date: 10/8/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OU’s, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: Have had a minor degree of familiarity with the ROD since March 2005, with an increasing degree of familiarity since November 2006 when I took this position and began reviewing documentation to be made available to the public.

2. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: My impression is that these remedies are successful.

3. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No.

4. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes

5. To the best of your knowledge are the leach basin barrier at Site A, the infiltration barrier at Site F, and the vegetative cap at Site B intact?

   Response:

6. To the best of your knowledge, has the on-going environmental monitoring performed at many of the OUs since August 2004 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response:

7. To the best of your knowledge, have the eight recommendations of the previous (i.e., second) five-year review been implemented?

   Response:

8. To the best of your knowledge, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response:

9. Do you know of any significant operation and maintenance difficulties with the pump and treat systems that could have impacted the protectiveness of these components of the remedies?

   Response:

10. Do you have any recommendations for optimizing the pump and treat systems, or for implementing alternatives to the pump and treat systems (such as monitored natural attenuation at Site A as has been previously proposed)?

    Response:

11. To the best of your knowledge, what is the status of this OU 8 groundwater remediation system? What are the current plans for in-situ remediation strategies at OU 8?

    Response:

12. To the best of your knowledge, has the monitored natural attenuation component of the OU 8 remedy been fully implemented? Have monitoring data collected to date been adequate for meeting the intent of the ROD?

    Response:

13. Are you aware of any community concerns regarding implementation of the remedies at any of the OUs? If so, please give details.

    Response: I am not aware of any community concerns regarding the implementation of the remedies.

14. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NSB, Bangor?

    Response: No.

INTERVIEW RECORD FOR FIVE-YEAR REVIEW
August 2004 through October 2009
Type 1 Interview – Navy Personnel
Naval Base Kitsap Bangor
Kitsap, WA

Individual Contacted: Ms. Vogel
Title: Remedial Program Manager, Environmental Coordinator and Customer Relations Coordinator
Organization: NAVFAC NW

Contact made by: Deborah Wilson, URS
Response type: Telephone interview
Date: 10/30/09

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 Naval Base Kitsap (NBK) Bangor, the Records of Decision (RODs) for OUs 1, 2, 3, 6, 7, and 8, the implementation of the remedies at these OU's, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2004.

   Response: I was the temporary RPM for Bangor for 6 months and am currently the environmental coordinator for Bangor. I am familiar with the RODs, with land use decisions, and LTM.

2. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: We try our best to implement the ICs through inspections, navy community outreach which is training and briefings of different departments. We still have a lot more work to do with awareness of ICs and how important they are for the remedies.

3. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: We don't have any violations currently.

4. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes.

5. To the best of your knowledge are the leach basin barrier at Site A, the infiltration barrier at Site F, and the vegetative cap at Site B intact?

   Response: Yes.

6. To the best of your knowledge, has the on-going environmental monitoring performed at many of the OUs since August 2004 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response: It needs to be addressed and it is currently being addressed by the current RPM.

7. To the best of your knowledge, have the eight recommendations of the previous (i.e., second) five-year review been implemented?

   Response: Not all of them.

8. To the best of your knowledge, have the pump and treat systems at OU 1 (Site A) and OU 2 (Site F) been effective components of the remedies since August 2004?

   Response: Site F is fine. Site A is being reviewed for effectiveness.

9. Do you know of any significant operation and maintenance difficulties with the pump and treat systems that could have impacted the protectiveness of these components of the remedies?

   Response: Site A very difficult to access because of its location. We are impacted by base security and their work at lower base. Site F is also impacted by base security so we are currently dealing with those requirements.

10. Do you have any recommendations for optimizing the pump and treat systems, or for implementing alternatives to the pump and treat systems (such as monitored natural attenuation at Site A as has been previously proposed)?

    Response: When I was RPM, I proposed shutting down the pump and treat system for Site A for a season (quarter) to see if we could boost recovery because based on the amount of product being recovered the pump and treat system is not effective at this time and MNA is the best natural alternative.

11. To the best of your knowledge, what is the status of this OU 8 groundwater remediation system? What are the current plans for in-situ remediation strategies at OU 8?

    Response: OU 8 needs a lot of work. It is currently being reviewed.

12. To the best of your knowledge, has the monitored natural attenuation component of the OU 8 remedy been fully implemented? Have monitoring data collected to date been adequate for meeting the intent of the ROD?

    Response: We have not met the ROD for OU 8. The reason is when you do a ROD you have the intention to follow it, but the remedy is a hypothesis that it will work. The timeline we gave ourselves in the ROD for MNA was probably not long enough.

13. Are you aware of any community concerns regarding implementation of the remedies at any of the OUs? If so, please give details.

    Response: No community concerns. The RAB was disbanded many years ago.

14. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NSB, Bangor?

    Response: The Navy is working hard to ensure that human health and the environment is protected. We do this by frequent reviews of our land use controls and the RPM is constantly looking for new ways through scientific reviews to optimize the remedies.

Responses to Comments

THIRD 5-YEAR REVIEW
NAVAL BASE KITSAP BANGOR
SILVERDALE, WASHINGTON
RESPONSES TO ECOLOGY REVIEW COMMENTS DATED AUGUST 10, 2010
Responses Prepared August 10, 2010

No.	Comments	Responses
1.	Section 4.1.2 Remedy Implementation, page 4-5, line 14: In 1995, an extensive stand of blackberries was planted along the upper portion of the steep ravine containing Debris Area 2 to restrict access to the ravine. Warning signs were also installed along the top of the ravine as an additional means of restricting access to Deb to Debris Area 2." Table 8-1 Item No. 10 recommends "Plant additional thorny bushes to discourage access to Debris Area 2, or fence the area." Are the blackberries planted only along the upper portion of the steep ravine or over the entire Debris Area 2? The Draft 2010 Institutional Controls Management Plan listed outdoor recreational as the allowable land use for this area. This recreational land use appears to be in conflict with Table 8-1 Item No. 10 recommendation. Please clarify.	The planting of blackberries along the upper portion of the steep ravine (not everywhere at Debris Area 2) was required in lieu of fencing by the OU 8 ROD (which established ICs for all of the OUs at NBK Bangor) and by ESD #1 to the OU 1 ROD. The blackberries are not present, and the thorny bushes that are present are too few in number and too small to significantly discourage access. Therefore the 5-year review recommends additional measures to discourage access. The original ICMP prepared in 2000 established recreation land use as allowable, including non-intrusive activities such as hiking, etc. The intent was to discourage access in the relatively small area of contamination but not totally prevent non-intrusive activities. The Navy proposes no change to the 5-year review based on this comment.
2.	Section 6.4.4, Figure 6-3 and Figure 6-4. Please revise titles to identify the site as OU 8 and also in the Table of Contents.	The figure titles and the Table of Contents will be revised as requested.
3.	Section 7.1.6 Functionality of Remedy for OU 8, page 7-5, line 14: "Is the remedy functioning as intended by the decision documents? Yes." Section 4.6.3 Operation, Maintenance, and Monitoring, page 4-33, line 24 reads: "Air sparging with SVE represents a fundamental change in the remedy and therefore would require a ROD	Because the OU 8 ROD anticipated that additional actions might be warranted, the remedy is functioning as anticipated by the ROD, but more slowly than hoped. The Navy believes that the OU 8 remedy meets the definition for functionality under the 5-year review process, but recognizes that contingent remedial action is warranted under the ROD. These contingent remedial actions are addressed in Recommendation 14 of the 5-year review.

NBK BANGOR THIRD 5-YEAR REVIEW
RESPONSES TO ECOLOGY REVIEW COMMENTS
(Continued)

No.	Comments	Responses
	amendment prior to implementation." The failure to remove the benzene mass in the subsurface within the PWIA source area and the recommendation to implement SVE sparging would imply the remedy is not functioning as intended.	The Navy proposes no change to the 5-year review based on this comment.
4.	Section 7.4 Technical Assessment Summary, page 7-13, Item No. 8 and Item No. 9. Given the remedy is not functioning as intended, these two items would therefore affect future protectiveness. Furthermore, Table 8-1 Item No. 14 on remedial actions addressing the slower-than-anticipated remediation progress identified these actions as necessary to ensure future protectiveness.	The Navy will agree to change Issues 9 and 10 to "Yes." However, the potential future protectiveness issue is anticipated to be far in the future and well beyond the next 5-year review cycle. As indicated in the third 5-year review, contingent actions have been taken at OU 8 and others are being evaluated to help expedite site restoration with the effect of reducing life cycle costs. However, the Navy notes that ICs are a valid component of the remedies at NBK Bangor and other Navy facilities. For many OUs, concluding that there is a future protectiveness issue assumes that ICs will fail in the future, for which there is no evidence.
5.	Appendix E Site Inspection Checklists and Operation and Maintenance Cost by Site For OU 1 (Site A), and OU 2 (Site F), where are the as-built drawings for the treatment plants and what in general are the changes made in the operation of the treatment plants that require updating of equipment labels.	The as-built drawings are included as an appendix of the O&M plan. The current valve labeling is an artifact from when the groundwater treatment plant was originally used as a leachate treatment plant. The Navy proposes no change to the 5-year review based on this comment.

THIRD 5-YEAR REVIEW
NAVAL BASE KITSAP BANGOR
SILVERDALE, WASHINGTON
RESPONSES TO EPA REVIEW COMMENTS DATED JULY 29, 2010
Responses Prepared August 10, 2010 and Revised August 23, 2010

No.	Comments	Responses
	General Comments	
6.	This memorandum provides my comments on the draft Five-Year Review (5YR) for the Bangor Base. Many of my comments are editorial, but there are several important issues. One is that the site descriptions are often so sketchy that it's difficult to discern whether there are still contaminants remaining that prevent unrestricted access and use. Two sites (2 and 26) are proposed for elimination from future 5YRs on this basis, but it appears there may be others, especially sites like OU 6, where no monitoring is planned for the future and no ICs are required. Two things I'd like routinely included in the site descriptions are the maximum remaining concentrations of COCs (sometimes mentioned, sometimes not), and for the groundwater sites, maps in Chapter 4 showing water level contours – arrows on the plume maps don't really suffice. Clearly, one major disadvantage I have reviewing the sites besides Site A is that I don't necessarily have a lot of history with those sites and don't get to see the various monitoring reports, so some of my comments will reflect that. However, the report needs to be clear enough that a reader can follow the logic without resorting to the references.	The site descriptions presented in Section 3 are meant to convey the site history and contaminant characteristics that lead to the need for remedial actions described in Section 4. Where readily available, ranges of COC concentrations remaining in soil following removal actions (pre-ROD activities) will be added to Section 3. Where readily available, ranges of COC concentrations remaining in soil following remedial actions will be added to the text of the "remedy implementation" subsections within Section 4. On-going groundwater monitoring results are discussed in Section 6.4. In some cases, the data for older remedial and removal actions may only be available in paper copy reports that have been archived. If the Navy is unable to obtain data to add to the 5-year review, a recommendation will be added to find and assess the data as a follow-up action. The rationale for retaining OU 6 in the 5-year review process, and a path for removing it from the process, is included on page 7-12, lines 24-29. Figures showing groundwater elevation contours will be added to Section 6, where other recent monitoring data are presented.
7.	Another question that applies to all the groundwater sites is whether the "source" areas were cleaned up enough to reduce mass transfer to groundwater enough to allow for restoration to MCLs or MTCA B levels. The cleanups were generally based on meeting Ecology's direct contact values (and only down to 15 feet depth). This has nothing to do with what soil concentrations would be required to prevent leaching from the vadose zone to groundwater at concentrations that would continue to maintain an unacceptable level of contamination long term – no matter what's done to remediate the underlying aquifer. In the case of Site F,	For Site A, the available post-treatment soil confirmation sample results will be added to Section 4 and a discussion of whether the leach basin liner is still needed for protection of groundwater will be added to Section 7.1.1. At Site F the soil remedy specifically addressed protection of groundwater, resulting in placement of the infiltration barrier. The infiltration barrier for Site F is already discussed as a key component of the remedy, with ICs in place to protect the infiltration barrier. With the infiltration barrier remaining intact (based on the IC inspections), no further analysis of soil concentrations protective of groundwater is warranted for this site. At OU 8, protection of groundwater from residual COCs in soil will be included in the optimization study required as part of

No.	Comments	Responses
	groundwater protection levels were developed through site-specific leaching tests (although the one for RDX was based on the soil PQL) to guide the placement of an impermeable barrier over the source area. Both Sites A and F have infiltration barriers, presumably because the soils weren't cleaned up to levels that would protect groundwater via the leaching pathway. As such, they should be discussed as integral elements of those remedies.	Recommendation 14. At the other sites at NBK Bangor where protection of groundwater was a concern, the ROD required an empirical demonstration that groundwater had not been impacted through post-ROD groundwater monitoring. Results of this monitoring concluded that no further monitoring was required and that the remedies were protective of groundwater (e.g., OU 6, Site 25).
8.	Finally, the issues and recommendations don't track well. In particular, the issue that the OU 1 remedy isn't functioning as intended by the ROD is poorly and incompletely addressed by the one recommendation regarding the groundwater remedy – to look only at whether MNA can replace the pump and treat system (P&T) as the sole remedial action. There are at least a few elements of the ROD groundwater remedy that have never been implemented (at least as called for in the ROD) or addressed in an ESD. Beyond that, there are a number of other potential remedial actions to evaluate besides sole reliance on MNA, ranging from installing a P&T designed to restore groundwater to enhancing MNA to formally changing to remedy to plume containment in the source area (requiring a TI waiver), allowing the navy to focus GW restoration on the area outside the source area (perhaps through MNA). The problem is that these options need to be evaluated simultaneously, effectively through an FS-type process, not one at a time in a piecemeal manner.	Although it does not seem necessary to achieve a 1:1 correspondence between the Issues on Table 7-13 and the Recommendations on Table 8-1, the items on both tables will be rearranged and edited to achieve a closer linkage. As discussed in the response to comment 7, the Navy, Ecology, and EPA agreed in 2000 that the Navy had met the ROD requirements for the selected remedy at OU 1. Although the final installed extraction well configuration did not match the conceptual configuration in the ROD, the process of remedy design and implementation was transparent, overseen by the lead regulatory agency, and found to meet the ROD requirements in 1999. Many years of data are now available that characterize the site conditions and nature and extent of contamination at Site A. Many years of data are also now available regarding the performance characteristics of pump and treat technology at the site. The Navy believes that a broad FS-type process is not warranted at this phase of the remedial action. However, the Navy can agree to adjust the wording of the first recommendation of this 5-year review to reflect a somewhat broader focus for the assessment currently underway, "For Site A, complete the assessment of an alternative remedy to the current treatment system, and take action based on the results of the assessment."
9.	Moreover, some of the issues and recommendations that don't affect protectiveness should perhaps be listed in some separate section that isn't formally tracked. They're all helpful recommendations for managing the site, but they can cause reporting problems if they aren't implemented by the next 5YR.	The Navy understands that EPA prefers to only track selected recommendations in EPA's system. For the Navy's purposes, it is important that all of the recommendations appear in a single table that can be easily referenced. The Navy suggests that EPA only enter their desired recommendations from Table 8-1 into EPA's tracking system. The Navy proposes no changes to the 5-year review report based on this comment.

No.	Comments	Responses
	Specific Comments	
1.	Five-Year Review Summary Form, 1st page – It's not clear why the triggering action date is apparently listed as September 2005 in WasteLAN when the last 5YR was signed in late December 2005.	Pursuant to Navy's "Policy for Conducting Comprehensive Environmental Response, Compensation and Liability Act Statutory Five Year Reviews" dated November 29, 2001, the trigger date for the five year review is when the Base Commander signs the document. The second 5-year review was signed on October 24, 2005 and the trigger date on the summary form will be revised to this date.
2.	Page xi, Table of Contents – I recommend including an appendix with all the site well logs. This could be on a CD that accompanies the report. Over time it becomes very easy to lose track of well logs, and routine inclusion of this information in the 5YR (updated with any new wells installed during the review period) would prevent the gradual loss of basic information about the site.	Both EPA and the Navy have expressed a mutual goal of making 5-year review documents as succinct as practical, and it seems that adding all of the well logs to the document would run counter to this goal. Instead, the Navy is providing all of the well logs to EPA as part of the LTM program. The Navy proposes no changes to the 5-year review report based on this comment.
3.	Page 3-1, line 32 – The length of the plume should be noted, either total or from the downgradient edge of the source area.	To better match the flow of Section 3.1, the Navy proposes to add this information after Line 6 on page 3-2, after the text that describes the investigation performed to assess the plume.
4.	Page 3-9, lines 11 and 12 – Ecology cleanup levels for soil are mentioned for OU 8, but there's no table listing them in Chapter 7 so it's unclear what level soils were cleaned up to.	Neither soil cleanup levels or soil RAOs were established in the OU 8 ROD; therefore, a table of soil cleanup levels was not included in Section 7. The Ecology cleanup levels mentioned in this section were in reference to the Public Works Gas Station cleanup under the base's UST program. The ROD indicated that the selected remedy of LNAPL removal was intended to reduce residual contamination remaining in soil at depths greater than 15 feet bgs. The results of confirmation soil samples collected after operation of the SVE system at the Public Works Gas Station will be summarized on Page 3-9, if readily available. If the data are not readily available, a recommendation to find and assess the historical data will be added.
5.	Figure 3-2 – The aerial photo base for this map should be shifted north to encompass the entire downgradient plume.	The photo base will be shifted as suggested.

No.	Comments	Responses
6.	Pages 3-7 through 3-9, Section 3.6; and Pages 4-30 and 4-31, Section 4.6.2 – Figure 6-4 shows two intermediate zone extraction wells (E-1 and E-2) in the plume near the base boundary, and the 2nd bullet on page 7-6 mentions restarting a groundwater P&T system as a contingency action. The installation and operation of this system should be discussed in these sections.	Additional discussion of the P&T removal action will be added to Section 3.6.
7.	Page 4-2, 4th bullet – This remedy element apparently calls for restoration of the perched aquifer to protect the shallow aquifer. It was clearly envisioned that the soils cleanup would allow the perched aquifer to cleanup within 5 years, but that didn't happen. As a result, the second part of the element was triggered but never implemented or modified by any ESD, as far as I can tell. As long as the perched aquifer remains contaminated above cleanup levels and continues to feed contamination to the shallow aquifer, restoration can't happen, no matter what we do in the shallow aquifer. This adds some urgency to effectively monitoring the perched zone, which is currently monitored infrequently and inconsistently.	This bullet will be clarified by replacing the text with the exact text from the ROD, which states that monitoring of the perched aquifer is intended to verify that protection of ground has been achieved by the soil treatment component of the remedy. The third ESD for Site A states that, "Ecology conducted the final inspection of Site A on February 11, 1999, and determined that the Navy had constructed the remedial action in accordance with cleanup action design documents required by the Site A Record of Decision (ROD) dated December 10, 1991, and modified by two Explanation of Significant Differences (ESDs) on July 12, 1994 and March 20, 1998." EPA, Ecology, and the Navy all signed this third ESD in July 2000, indicating that in 2000 the parties were in agreement that the ROD remedy requirements had been met by the Navy. Also in 1999 the Navy proposed that further groundwater treatment using pump and treat technology be found technically impracticable based on the system performance to that point. The Navy's assessment was that that the data were sufficient to conclude that manipulation or modification of the pump and treat system as envisioned in the cited 4th bullet on page 2 would not be effective. The hydrogeology of the site was concluded to not be conducive to pump and treat technology. EPA's opinion was that additional pump and treat system modifications and optimization were warranted. The Navy lacks funding to increase perched zone sampling for August 2010, but discussion should continue regarding additional monitoring of the perched aquifer. The discussion should be based on additional perched aquifer seasonal groundwater elevation data (discussed further below in this response) and EPA's

No.	Comments	Responses
		feedback on the Navy's 2008 request to delete soils at Sites A, D, E, F, 2, 11, and 26 from the NPL. Site A soils presently are above the perched water tables separated and separated from it by a liner. The overall decline in the size and of the plume in the shallow aquifer, and the overall decrease in shallow aquifer COC concentrations over the years appears to indicate that any residual source present in the perched aquifer is not contributing enough contaminant to the shallow aquifer to increase the plume extent or concentrations. As a part of the effort to determine what is occurring in the perched aquifer, the Navy will be collecting depth to groundwater data from all perched aquifer wells during the upcoming quarterly sampling events. At least 1-2 years of groundwater data will be needed to support the discussion of changing the perched aquifer monitoring well sampling schedule and assessing the potential impact of COC migration from the perched aquifer to the shallow aquifer. Presently, the Navy's focus is filling the data gap in groundwater levels for the perched water aquifer. A recommendation will be added to the 5-year review report to update the CSM for Site A based on the new data collected.
8.	Page 4-2, 5th bullet– This is an artfully edited version of what the ROD really called for: approximately 8 wells installed "within the vicinity of the Burn Area" (and shown on a figure as being distributed across the area – not just along the downgradient edge). In addition, it called for the treated water to be reintroduced on site through reinjection wells to facilitate flushing of the aquifer. Neither of these elements was done this way, and they weren't modified through an ESD like the change in extracted water treatment was. Nor were the potential modifications/optimizations to the P&T that were spelled out in the ROD (alternating pumping wells to eliminate stagnation zones, pulsed pumping, installing additional extraction/reintroduction wells in either the perched or shallow aquifer) ever seriously considered. I think it is fine to evaluate other potentially more cost-effective remedies, and it may be appropriate to question the	The text in the 5-year review that describes the Site A remedy components will be replaced with the exact text from the ROD. As discussed in the response to comment 7, the Navy, Ecology, and EPA agreed in 2000 that the Navy had met the ROD requirements for the selected remedy. Although the final installed extraction well configuration did not match the conceptual configuration in the ROD, the process of remedy design and implementation was transparent, overseen by the lead regulatory agency, and found to meet the ROD requirements in 1999. After initial system operation, the Navy concluded that the hydrogeology of the site was not conducive to pump and treat technology and that the potential modifications/optimizations contemplated by the ROD would not be effective. The Navy continues to believe that the system as installed provides sufficient data to assess the likely effectiveness of other pump and treat configurations. As documented by the language of the third ESD, the Navy implemented all elements of the selected remedy and designed the pump and treat system with the concurrence of the regulatory agencies. Although the aquifer

No.	Comments	Responses
	implementability of P&T here, given the generally low conductivity of the shallow aquifer, but the failure of this inappropriately designed and un-optimized P&T can't be used as evidence of non-implementability. Moreover, it's difficult for EPA to consider dropping the restoration goal when elements of the remedy were never implemented, and what was installed apparently was not designed to be able to achieve the ROD goals.	restoration timeframe is likely to be much longer than anticipated by the ROD under an alternative remedy such as MNA, site conditions remain protective of human health and the environment because the plume is delimited by the monitoring well network, and ICs prevent exposures. The Navy proposes no changes to the 5-year review report based on this comment.
9.	Page 4-2, 7th bullet, line 21 – Does the 5-year timeline refer to the perched aquifer as already discussed in the 4th bullet? The shallow aquifer was expected to clean up in 10 years.	The text in the 5-year review that describes the Site A remedy components will be replaced with the exact text from the ROD, thus replacing the cited text.
10.	Page 4-4, Soil Remediation section – The construction of the infiltration barrier, including its extent, should be discussed in this section.	Additional details regarding the infiltration barrier will be added as requested.
11.	Page 4-5, line 13 – The blackberries are really more of an engineered control than an IC. Perhaps the heading should say "Institutional and Engineered Controls."	The heading will be revised as suggested.
12.	Page 4-8, lines 5 and 6 – I think it's worth noting that the plume likely already extended beyond the line of extraction wells when they were installed, given the initial concentration in EW-7 (450 µg/L).	Comment noted.
13.	Page 4-8, line 8 – Cleanup screening level (CSL) isn't a standard ROD term. This should be "cleanup level" or "ROD cleanup level."	"CSL" will be changed to "RG."
14.	Page 4-8, lines 19 and 20 – The basin liner is an integral part of the engineered remedy, **not** an IC, although there may be ICs to protect its integrity.	These lines will be rewritten as part of the clarification and assessment of the of liner's role as a remedy component.
15.	Page 4-13, line18 – It's not clear how off-site is defined here. Is it anywhere outside the Site F box shown on Figure 3-2 and the plume as currently defined (including downgradient)?	The term "off-site" will be replaced with "further downgradient."
16.	Page 4-31, line 13 – A figure showing the location of the VS wells would be helpful, perhaps as an inset on Figure 4-4.	A figuring showing the location of the VS wells will be added as requested.

No.	Comments	Responses
17.	Page 4-31, line 33 – It's not clear from Table 4-4 which 2007 sampling location wasn't sampled according to plan.	The text and table will be corrected. There were no deviations from the plans at OU 8.
18.	Page 4-32, lines 29 through 31; and Figure 6-4 – It doesn't appear to me that there are adequate wells downgradient of the base boundary to define the edge of the 5 µg/L 1,2-DCA plume, especially along the apparently higher-concentration flow path along the northeast part of the plume (between 8MW-03 and 8MW-19). This makes it hard to do a spatial assessment of MNA performance over time.	Comment noted. This consideration can be addressed as the Navy and the regulatory oversight agencies move forward with the pilot testing under Recommendation 14 of this 5-year review.
19.	Page 4-33, line 11 – A ROD amendment may not be required to do enhanced MNA, but an ESD would probably be advisable.	Comment noted.
20.	Page 4-33, lines 29 through 31 – The existing off-base monitoring wells are a long way (about 800 ft) from the base boundary. Because there are no intermediate monitoring wells to help define the current extent of the 1,2-DCE plume off-site, the plume would have to advance several hundred feet to meet this criterion. We should consider whether that much potential expansion is acceptable for an MNA remedy.	Comment noted. This consideration can be addressed as the Navy and the regulatory oversight agencies move forward with the pilot testing under Recommendation 14 of this 5-year review.
21.	Page 4-33, lines 34 through 37 – The off-base ICs should be better described here or in Section 4.7. I looked at the draft ICs Management Plan (30 June 2010) and couldn't figure out what area they covered there, although the description of what they consist of is better. A map is needed.	Additional detail regarding the ICs will be added to Section 4.7, including a map showing the off-base IC boundaries.
22.	Figure 4-1 – In the first blue line in the legend, performance is misspelled.	This typographical error will be corrected.
23.	Figure 4-2 – In the legend under Compliance wells, the designations [2b] and [2c] need to be defined (same as for the Performance wells?).	These designators will be defined.
24.	Page 6-3, lines 13 through 15 – The maximum concentration in a perched aquifer well is interesting but is an irrelevant comparison to the concentration in a shallow aquifer extraction well, and the	The text will be revised as suggested.

No.	Comments	Responses
	location relative to gradient is even less relevant. I would rewrite this sentence to say: "The highest August 2009 monitoring well RDX concentration in the perched zone was in A-MW48, located just north of the Burn Area; in the shallow aquifer it was in A-MW49, located approximately 140 feet downgradient of A-EW-7 (Figure 6-1). There are no shallow aquifer monitoring wells located within the Burn Area."	
25.	Page 6-6, lines 7 through 9 – It is unclear what is meant by "sampling methods that did not isolate the wells." Isolate from what – water from other extraction wells? This should be clarified in the text (it's not clear in the referenced report either).	This line will be revised to read, "…sampling methods that did not isolate the well being sampled from water from other extraction wells…."
26.	Page 6-7, line 8; and Table E-2 – F-MW69 is listed as having an increasing RDX trend. I don't see how this is possible when the well has never had a detection of RDX above the detection limit. I'm guessing that ND values were input at half the detection limit, so any sub-detection limit J values would be higher. It would appear to be misleading to run Mann-Kendall statistics on a data set with no detections above the detection limit.	For the purposes of the trend analysis, estimated (J qualified) RDX concentrations measured below the reporting limit have been treated as valid analytical results. The quantification of estimated RDX concentrations in samples from three of the last four monitoring events in this well, where no detectable concentrations were seen previously, seems like an important trend to note. The Navy proposes no changes to the 5-year review report based on this comment.
27.	Page 6-7, lines 18, 22, and 24 – In 3 places throughout this paragraph, reference is made to the well F-MW55**S**. However, the well that's been sampled is deep zone well F-MW55 – 55S has been a water-level only well and isn't included in Tables D-3 and E-2, while 55 is shown in Table E-2 as having an increasing trend for RDX. The S should be removed.	The "S" will be removed.
28.	Page 6-7, lines 17 and 18 – The 3 wells characterized as having increasing trends – shallow zone well F-MW35, intermediate zone well F-MW-48 and deep zone well F-MW-55 (**not** 55S) – are all "secondary" wells that have been sampled biennially over the past 10 years. Consequently, the Mann-Kendall statistic (determined over the last 10 sampling events, back to the mid-1990s), covers such an inappropriately long time frame that it may not be relevant to a 5-year review discussion focused on trends over the past 5 or	A recommendation will be added to assess the appropriateness of the statistical methods being used for trend analysis, and the associated sampling frequency. At other sites currently using the Mann-Kendall assessment, the Navy is considering other methods that might be more appropriate for the data sets now available. The Navy requests that EPA provide examples of statistical trend analysis methods that are acceptable to the agency and utilized for LTM programs of similar design.

No.	Comments	Responses
	so years. To see whether I should believe that these longer-term trends were relevant to the period in question, I charted the well data (see below). Clearly, the only well that's had an increasing trend over that period is F-MW48; the other two appear to have peaked in the early 2000s and have been gradually declining since. Not surprisingly, another well near F-MW48, F-MW44 (near F-MW48) was also listed as having a rising trend in Table E-2, and should be discussed here since it also appears to be genuinely rising over the past ~5 years (see the second chart below). The fact that the Mann-Kendall statistics for infrequently monitored wells hid the fact that 2 wells have actually been decreasing over the past several years made me wonder if there are any infrequently sampled wells with recent increasing trends hidden among the longer-term decreasing or stable trends. A cursory review of the data suggests not. However, the April 2009 value for F-MW58 was listed in Table D-1 as 61 µg/L – the rest were non-detect (ND) and this well is located outside the historic plume, so I suspect this is an error on the table. If not, it looks like a newly rising trend, and the well should be shifted to a more frequent sampling schedule. In general, I'd suggest that biennial sampling is inadequate for determining statistical trends in a non-equilibrium setting like a plume undergoing extraction. It's certainly not appropriate for the purposes of a 5YR discussion, where the period of interest is more constrained. Certainly, wells of interest – and I would hope that would include wells with increasing concentration trends – should be sampled often enough to determine if or when those trends change. It's also important to recognize quickly when wells with previously decreasing trends start increasing. If the navy wants to continue with biennial sampling for these wells, they shouldn't rely solely on the Mann-Kendall statistics, but should include	Text will be added to Section 6.4 to point out that relying solely on Mann-Kendall statistics for trend analysis can be misleading. For certain wells the Mann-Kendall analysis shows an increasing concentration trend when the actual trend is decreasing. Figures will be added to provide examples.

No.	Comments	Responses
	RDX trend charts for all wells in their annual reports as supporting information. Any well that starts rising unexpectedly should be switched to a more frequent sampling schedule.	
29.	Page 6-7, line 22 – The concentration of RDX in F-MW55 in April 2009 was 110 µg/L, not 220 (that was in F-MW54S).	The 220 µg/L value is correct in the text for F-MW55. Many of the April 2009 data values in the appendix table were shifted by one row when they were entered. The April 2009 results will be verified throughout the tables.
30.	Page 6-7, line 26 – Add “and F-MW44.”	This addition will be made.
31.	Page 6-8, line 1 – Two of these wells (F-MW35 and F-MW55) aren’t really rising anymore.	The text will be revised to state that these trends reflect the entire available data set and that recent data from F-MW35 and F-MW55 trends imply that concentrations are now declining at these wells.
32.	Page 6-8 – A section should be added after the RDX trend section to discuss TNT and DNT trends. One well, F-MW35, appears to have a rising TNT trend. In general, it appears that both contaminants are restricted to the vicinity of the source area, and that the mass in groundwater is gradually declining.	The requested additional discussion of TNT and DNT trends will be added.
33.	Page 6-8, lines 23 – Otto fuel has been detected in E-MW21U up to **1.4** µg/L (see line 26 and Table C-4), if a UJ value counts as a detection.	The qualifier “UJ” indicates a non-detected value with an estimated detection limit, and so should not be considered a detection. The Navy proposes no change to the 5-year review based on this comment.
34.	Page 6-10, line 32; and page 6-11, lines 5 and 18 – The Mountain View Road area is mentioned as being just beyond the earlier extent of the DCA plume (and apparently the nearest area where the groundwater was historically used), but Mountain View Road is not shown on any map in this report that I can find. I recommend either expanding the photo base for Figure 3-13 to show the road or adding another figure to show it.	Mountain View Road will be shown on the figure to be added showing the off-base area subject to institutional controls (see response to Comment 21).
35.	Page 6-14, lines 4 and 5 – It’s not clear from the OU 8 Site Inspection Checklist in Appendix E how the groundwater IC’s are evaluated, in particular the off-site ones.	The annual communication between the Navy and the Kitsap County Health Department will be noted on the checklist.
36.	Figure 6-2 – In the legend under Compliance wells, the designations [2b] and [2c] need to be defined (same as for the	These designators will be defined.

No.	Comments	Responses
	Performance wells?).	
37.	Page 7-1, Section 7.1.1, 2nd ¶ – EPA has contended that the reason that the P&T remedy for Site A is not functioning as intended by the ROD is because the P&T implemented was not the type the ROD intended. Instead of a plume mass removal extraction system, a downgradient plume containment line was installed (at least, containment was the intention). Because the small well capture zones can't effectively move the plume to the pumping wells very quickly, the system has pumped a lot of relatively clean water (accounting in part for the high cost per pound removed) and left most of the contaminant mass below the Burn Area relatively untouched. While it's not clear that a system designed in accordance with the ROD would have performed a lot better, the failure of **this** P&T can't be used to argue that P&T can't work here to restore the plume.	As discussed in the response to comment 7, the Navy, Ecology, and EPA agreed in 2000 that the Navy had met the ROD requirements for the selected remedy. Although the final installed extraction well configuration did not match the conceptual configuration in the ROD, the process of remedy design and implementation was transparent, overseen by the lead regulatory agency, and found to meet the ROD requirements in 1999. After initial system operation, the Navy concluded that the hydrogeology of the site was not conducive to pump and treat technology and that the potential modifications/optimizations contemplated by the ROD would not be effective. The Navy continues to believe that the system as installed provides sufficient data to assess the likely effectiveness of other pump and treat configurations. The two extraction wells currently installed beneath the former burn area also produce at a very low flow rate, indicating that additional wells in this area are unlikely to be effective at mass removal. The Navy proposes no changes to the 5-year review report based on this comment.
38.	Page 7-2, lines 25 through 28 – This strikes me as a false argument. To the extent that the cost/pound removed is increasing because the extraction wells (and presumably the plume) are getting cleaner, that's a sign of remedy success – that the P&T is cleaning up the plume! If the plume isn't getting cleaner or smaller, then there's a problem, and the fact that the extraction wells are apparently approaching asymptotes suggests that there may be a fair amount of back-diffusion or desorption going on within the aquifer that will keep concentrations above cleanup levels for a long time over much of the plume.	This paragraph is pointing out that the cost efficiency of pump and treat at this site continues to worsen, and the contaminant mass recovery is becoming more asymptotic. Although the Navy agrees that this shows successful mass removal within the area of the extraction wells, the projection that contaminant concentrations are likely to stabilize at concentrations above the RGs implies that the pump and treat system as currently configured may not be able to achieve the ultimate remediation goals. This is an important conclusion to highlight in an assessment of the functionality of the remedy. The Navy proposes no changes to the 5-year review report based on this comment.
39.	Page 7-3, Section 7.1.4 – It was appropriate to include OU 6 in this 5YR because of the perchlorate groundwater sampling, but it's not clear to me that it's necessary to include it in the future (i.e., that there are concentrations precluding unrestricted access or use). Could OU 6 be delisted, or at least dropped from future 5YRs?	The rationale for retaining OU 6 in the 5-year review process, and a path for removing it from the process, is included on page 7-12, lines 24-29. The Navy proposes no changes to the 5-year review report based on this comment.

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No.	Comments	Responses
40.	Page 7-9, 1st ¶; and Table 2 -- Regarding the issue of pthalates in groundwater, I looked back at the OU 1 ROD to see how cleanup levels were listed. I found that there isn't a clearly articulated table that says these are the compounds that are to be cleaned up to these specific levels. Instead, there's discussion in the text about ordnance compounds and a table (Table 1) that lists the chemicals of concern for each medium and associated MTCA cleanup levels. The argument in this report is that pthalates can be discounted (and left off Table 7-2) for two reasons. The first is because it's not specifically discussed in the ROD selected remedy section text. However, neither is lead, which **is** listed on Table 7-2. The second is that the RI phthalate detections were all qualified B, meaning it was also found in laboratory blanks. However, that only disqualifies a compound if the levels found in the laboratory blanks were comparable to the levels found in the environmental samples. If that's the case, it should be stated here. If not, pthalates should be brought back onto the COC list and added to the groundwater sampling for at least one round.	Phthalates were left off Table 7-2 for the data quality issues noted (which were not an issue for lead). While we agree that the ROD does not clearly articulate whether all the chemicals shown on ROD Table 1 should be addressed, the focus of the text of the ROD and subsequent groundwater monitoring for over 15 years has been on the ordnance compounds. Therefore, a rigorous review of phtahalate data collected in the late 1980's, early 1990's does not appear to be warranted. Phthalates are not a COC at OU 1. Additional information regarding phthalates will be added.
41.	Page 7-10, line 8 – The parenthetical comment should specify the 2,4- and 2,6-DNT **mixture** toxicity.	A footnote will be added after 2,4-DNT that will state the following: "The RG for 2,4-DNT is derived using a cancer slope factor based on the toxicity of 2,4-DNT and 2,6-DNT as a mixture."
42.	Page 7-10, line 26 – The second "located at the end of Section 7" is redundant.	This redundant phrase will be deleted.
43.	Page 7-11 through 7-12, Site OU 3 Soil – The discussions for Site 16/24 have always lumped them together, making it difficult to figure out which site had the incinerator(s) and which was the drum storage area. This discussion mentions a couple of inorganics exceedences (antimony and arsenic) but says they're all located near the incinerator. This suggests that the ICs boundary could be reduced to the area around the incinerator, and the other Site (24?) could be dropped from future 5YRs.	Site 16 and 24 are immediately adjacent to one another. Site 16 was the drum storage and Site 24 was the incinerator. The arsenic exceedance above 20 mg/kg was at Site 24, rather than Site 16. The geographic footprint of the combined sites is quite small, however, and the small reduction in area with a restricted land use that would result from segregating the two sites to adjust the IC boundary doesn't seem to justify the administrative expense of making the change. Figure 3-3 will be revised to more accurately reflect the proximity of these two sites to one another.

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44.	Page 7-12, line 11; Table 7-5; and Table 7-7 – The MTCA Method B level for manganese has NOT increased from 50 to 2240 µg/L. The 50 µg/L cleanup level was an inappropriately applied **secondary** MCL, which should never have been used as the basis for a CERCLA cleanup level. The MTCA B value at the time was 80 µg/L. The current MTCA B level is also inappropriately high for any prospective drinking water source and exceeds EPA's HI=1 protectiveness criterion. The RfD used in the calculation should be modified down by a factor of 3, according to IRIS and a caution on the CLARC website (https://fortress.wa.gov/ecy/clarc/CLARCCautions.aspx -- see discussion at the bottom of the web page). Applying the modifying factor brings the MTCA B level down to 746 µg/L – and a bit below EPAs HI=1 level of 880 µg/L (see EPA's risk tables at http://www.epa.gov/reg3hwmd/risk/human/index.htm).	A footnote will be added to Table 7-5 indicating the source of the manganese cleanup value is a secondary MCL. Table 7-7 lists the source of the manganese RG as "MTCA B" because that is the stated source in the ROD (see Table 21 of the OU 3 ROD); however, we agree that the value of 50 ug/L is the SMCL and the table will be edited accordingly. The current MTCA Method B value for manganese shown on Table 7-7 will be changed to reflect the lower RfD per the caution on the CLARC website, rather than the value in the CLARC database.
45.	Page 7-19, lines 1 and 2 – It seems to me it would be better (and more useful) to say how many recent detections there have been above the current risk-based level, and in how many wells.	There have been no recent detections because there have been no recent soil vapor sampling events. The Navy proposes no changes to the 5-year review report based on this comment.
46.	Page 7-19, Section 7.3 – One issue/recommendation (listed in Tables 7-13 and 8-1) concerns the unknown potential for vapor intrusion at OU 8. The recognition that there could be risk associated with a previously unrecognized and uncharacterized exposure pathway is a type of new information and should be discussed here. Also, was the OU 8 plume ever sampled for MTBE?	Vapor intrusion is already discussed starting on page 7-18, Line 31, and so there is no need to also discuss it under Section 7.3. Text will added to page 7-19 explaining that there is no current protectiveness issue based on the current use and configuration of the buildings above the plume. Groundwater samples from July 2001 were analyzed for MTBE and this compound was not detected.
47.	Table 7-5 – There are two problems with this table. To address the manganese problem discussed earlier, I would include a footnote that says that the State MCL that was the basis for the manganese cleanup level was a secondary MCL and shouldn't have been used as the basis since those standards are not	A footnote will be added clarifying the basis as a secondary MCL as noted in the response to comment #44. The appropriate current MTCA B value for manganese will be added to the table.

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	applicable (i.e., not an ARAR). The current basis would be MTCA B as adjusted by the appropriate modifying factor, and include that value (746 µg/L) under Current MTCA B. I'd remove the Current State MCL column altogether since it lists only the secondary (and not applicable) MCL. I would put a "yes" under "Change in Cleanup Level." The other problem is that the MTCA B value in CLARC for 1,3,5-TNB is in error – Ecology used the wrong number for the RfD in their calculation. The correct value is 480 µg/L (not 43,000), which is still higher than the cleanup level in the ROD. This has been confirmed by Craig McCormack – contact him at cmcc461@ecy.wa.gov with any questions. Craig has requested that CLARC be corrected. In both cases, the changes do not bring remedy protectiveness into question, so the text discussion is still fine.	Because the secondary MCL was the basis for the RG and that value has not changed we do not agree that there is a change in the cleanup level. Regardless of whether a secondary MCL would be accepted today as a cleanup level, that was the decision in the ROD. Because the secondary MCL is lower than the current MTCA B value, there is no protectiveness issue. The MTCA B value for 1,3,5-TNB will be corrected as indicated.
48.	Table 7-8 – I would put the [a] footnote designation next to the value listed for 2,4-DNT under Current MTCA Method B (i.e., 190 [a]). Otherwise, it's unclear that this number is also a Method C value.	The footnote will be placed next to the 190 value as requested.
49.	Table 7-9 – Cadmium is misspelled.	This typographical error will be corrected.
50.	Table 7-13 – a) For item 8, Ecology's soil cleanup numbers are based on a state background number, so I don't see how changes in arsenic toxicity can affect the remedy, including the area requiring ICs. Much of the Base would likely require ICs if the current toxicity number drove the soil cleanup numbers. I think this is a non-issue. b) I would consider Item 10 to be a future protectiveness issue, especially if the MNA is stalling out. c) For item 11, unless no one routinely works in the	a. If the State were to accept a value of 20 mg/kg as an applicable background value, the Navy could agree. The State's 1994 background document provides lower values for default background assumptions. In addition, the original baseline risk assessment included arsenic; therefore, arsenic's potential new slope factor is appropriately discussed in the "review of risk assessment assumptions" section. Text will be added to note that any future risk assessment would be limited by the background concentration number. b. The Navy will agree to change Issue 10 to "Yes." However, the potential future protectiveness issue is anticipated to be far in the future and well beyond the next 5-year review cycle. As indicated in the third 5-year review,

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	buildings overlying the benzene and 1,2-DCA plumes, this is a current protectiveness issue. d) I would consider the fact that ROD contingencies related to the continued levels of contamination in the perched aquifer at Site A have never been implemented to be an issue. In addition, pthalates may need to be added to the Site A analytical program. e) There may be MTBE in the groundwater at OU 8, unless there's sampling data to indicate otherwise. The footnotes regarding color need to be added to this table (same as Table 8-1).	contingent actions have been taken at OU 8 and others are being evaluated to help expedite site restoration with the effect of reducing life cycle costs. However, the Navy notes that ICs are a valid component of the remedies at NBK Bangor and other Navy facilities. For many OUs, concluding that there is a future protectiveness issue assumes that ICs will fail in the future, for which there is no evidence. c. Text will added to page 7-19 explaining that there is no current protectiveness issue based on the current use and configuration of the buildings above the plume. d. The Navy disagrees with EPA's assessment on this point, as discussed in the comment responses above. e. Groundwater analytical results from July 2001 show that MTBE was not detected in any sample. The footnotes regarding color will be added to the table.
51.	Page 8-1, lines 7-8 – If a remedial component is not effective at reducing levels of COCs, that's a future protectiveness issue at sites where groundwater restoration is a goal, even though the remedies are currently protective due to ICs, etc.	The Navy disagrees with this assertion. ICs are a valid component of the remedies. Concluding that there is a future protectiveness issue assumes that ICs will fail in the future, for which there is no evidence. For OU 8, however, the Navy will agree to change Issues 9 and 10 to "Yes" for future protectiveness, with the rationale that not implementing a contingent remedial action could plausibly result in the plume exceeding the off-base area subject to institutional controls sometime in the future.
52.	Table 8-1 – There needs to be better linkage between the issues listed on Table 7-13 and specific recommendations stemming from those issues. Also, it may be possible to drop OU 6 from future 5YRs.	Although it does not seem necessary to achieve a 1:1 correspondence between the Issues on Table 7-13 and the Recommendations on Table 8-1, the items on both tables will be rearranged and edited to achieve a closer linkage. The issue of potentially dropping OU 6 from future 5-year reviews is addressed on page 7-12. The opportunity to drop OU 6 from future 5-year reviews will be added as an issue and a recommendation.
53.	Table 8-1 – a) Items 1 and 2 – These seem pretty inadequate to address the issue which should accompany them (remedy not working as intended). Instead, the recommendation should be to consider a range of remedy optimizations,	a. The Navy believes that a broad FS-type process is not warranted at this phase of the remedial action. However, the Navy can agree to adjust the wording of the first recommendation of this 5-year review to reflect a somewhat broader focus for the assessment currently underway, "For Site A, complete the assessment of an alternative remedy to the current treatment

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	from optimizing the P&T to enhancing the apparently limited bioremediation that's occurring. Moreover, the contaminant mass balance and flux through the system needs to be assessed. If contaminants in the perched zone are still migrating to the shallow aquifer, then no action taken just in the shallow aquifer can be very successful. (It didn't clean up after 5 years, which should have triggered additional ROD action that's never been taken or even discussed to my knowledge.) Eventually, amending the ROD to a containment remedy may be justified if a truly optimized restoration remedy is ineffective. It may be appropriate to add pthalates to the analytical program. b) Item 11 – As noted above, I think this is a non-issue. c) Item 14 – It's not clear if this refers to the reappearance of LNAPL and the rising benzene levels or the 1,2-DCA plume or both. The potential presence of an MTBE plume should be assessed, if it hasn't already. Item 15 – It's not clear if this refers to both the benzene and the 1,2-DCA plumes. Depending on whether people work routinely in overlying buildings, this may be both a current and future protectiveness issue (it's properly listed as a future protectiveness issue on Table 7-13 and should be here, as well).	system, and take action based on the results of the assessment." Pthalathes have been considered as a potential COC historically, and the conclusion was to not include these compounds as COCs. b. Please see response to comment 50a. c. This recommendation specifically addresses the ROD requirement to assess contingent actions based on the slow progress towards meeting RAOs. Therefore, the recommendation is comprehensive and not specific to any COC. The potential for MTBE to be present in groundwater beneath OU 8 was assessed in 2001. Item 15 is not specific to a COC. Item 15 will be listed as a future protectiveness issue.
54.	Appendix D, Table F-1, pages F-2 through F-14 – There are problems with the subheading at the top of each page following the first one listing the well type – the "Perched Zone Monitoring Wells" subheading is at the top of every page. It needs to be corrected to monitoring or extraction wells, as appropriate.	The headings will be corrected.
55.	Appendix D, Table F-1, page F-10 – For the August 2009 RDX value in A-EW6, there's a PG qualifier. PG needs to be explained in a footnote.	The qualifier "PG" will be defined.

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56.	Appendix E, Table D-1 – The PG qualifier is associated with two August 2009 RDX values. There's also a PJ value in the July 2006 data. PG and PJ both need to be explained in a footnote (possibly for the other tables as well).	The qualifiers "PG" and "PJ" will be defined.
57.	Appendix E, Table D-1, page D-2 – The December 1998 value for F-MW64 is both anomalously high (100) and suspiciously identical to the value in the line above. Is this a typo in the table?	This is not a typo in the table. This is the value in the Navy's database.
58.	Appendix E, Table D-1, page D-3 – The April 2009 value for F-MW33 is both anomalously low and suspiciously identical to the value in the line above (0.5 U). Is this a typo in the table?	This value is a typo in the table. The value will be corrected to 160 ug/L.
59.	Appendix E, Table D-1, page D-3; and Figures 4-2 and 6-2 – There's an April 2009 value listed for F-MW36, but I don't see it on either of the Site F figures – it should be added. The high concentration suggests it's located somewhere near the source zone. It may be one of the secondary [2c] wells sampled just for the 5YR.	See response to Comment 29. The appendix table is in error. Well F-MW36 was not sampled in April 2009.
60.	Appendix E, Table D-1, page D-3 – The April 2009 value listed for F-MW55M is 0 U, which isn't possible. Is it supposed to be 0.5 U?	See response to Comment 29. The April 2009 value in the table for F-MW55M will be corrected to 110 ug/L.
61.	Appendix E, Table D-1, page D-3 – Is the 61 µg/L listed for F-MW58 for April 2009 correct?	See response to Comment 29. The April 2009 value in the table for F-MW58 will be corrected to 0.51U ug/L.

APPENDIX B

Site A Summary of Historical Groundwater Results, Mann-Kendall Statistics, and Figures

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
Perched Zone Monitoring Wells								
A-MW22	May-94	130	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	140	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	150	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	140	1.2 U	2.9 U	1.7 U	NA	NA	NA
A-MW34	Feb-95	0.36	0.050 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	0.58 U	0.65 U	1.50 U	0.86 U	NA	NA	NA
	Feb-98	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	May-98	0.94 U	0.94 U	0.94 U	0.94 U	NA	NA	NA
	Feb-99	0.92 U	0.92 U	0.92 U	0.92 U	NA	NA	NA
	Nov-09	0.26 U	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U
A-MW38	Aug-97	48	0.4 U	0.92 U	0.53 U	NA	NA	NA
A-MW47	Aug-95	160	18	0.97 J	1.2 J	NA	NA	NA
	Feb-96	120	15	1.6	1.6	NA	NA	NA
	Aug-96	74	12	2.2 U	0.6 U	NA	NA	NA
	Feb-97	100	14	2.3 U	1.3 U	NA	NA	NA
	Aug-97	34	15	0.86 J	0.5 J	NA	NA	NA
	Feb-99	37	13	1.1 U	1.1 U	NA	NA	NA
	Feb-00	22	27	0.83 U	0.83 U	NA	NA	NA
	Feb-01	8.9	10	0.51 U	0.51 U	NA	NA	NA
	May-02	32	19	1 U	1 U	NA	NA	NA
	Feb-03	22	10	0.44 U	0.44 U	NA	NA	NA
	Feb-04	58	6.9	0.88	0.49 U	NA	NA	NA
	Feb-05	9.2	6.1	0.48 U	0.48 U	NA	NA	NA
	Feb-06	36	7.3	0.6	0.49 U	NA	NA	NA
	Feb-07	74 D	5.5	1	0.17 J	NA	NA	NA
A-MW48	Feb-95	1000	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	540	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	680	0.74 U	1.7 U	0.98 U	NA	NA	NA
	Dec-97	290 J	0.94 UJ	2.2 UJ	1.2 UJ	NA	NA	NA
	Feb-99	200	0.38 U	0.38 U	0.38 U	NA	NA	NA
	Feb-00	170	0.35 U	0.35 U	0.35 U	NA	NA	NA
	Feb-04	120	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	120	0.57 U	0.57 U	0.57 U	NA	NA	NA
	Feb-06	110	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-07	120 D	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Nov-09	99 D	0.15 U	0.15 U	0.15 U	1.9 U	0.34 J	0.37 J
Shallow Aquifer Monitoring Wells								
A-MW21	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	1.2 U	1.3 U	3.1 U	1.8 U	NA	NA	NA
	Dec-97	0.62 UJ	0.7 U	1.6 U	0.9 U	NA	NA	NA
A-MW28	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	0.77 U	0.86 U	2.0 U	1.2 U	NA	NA	NA
	Dec-97	0.46 UJ	0.52 U	1.2 U	0.7 U	NA	NA	NA
	Feb-99	1.5 U	1.5 U	1.5 U	1.5 U	NA	NA	NA
	Feb-00	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Feb-01	0.46 U	0.46 U	0.46 U	0.46 U	NA	NA	NA
	May-02	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Feb-03	0.44 U	0.44 U	0.44 U	0.44 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-07	0.52 U	0.52 U	0.52 U	0.52 U	NA	NA	NA
A-MW30	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-97	0.82 U	0.92 U	2.1 U	1.2 U	NA	NA	NA
	Dec-97	0.58 UJ	0.65 U	1.5 U	0.9 U	NA	NA	NA
	Feb-99	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-00	0.99 U	0.99 U	0.99 U	0.99 U	NA	NA	NA
	Feb-01	0.46 U	0.46 U	0.46 U	0.46 U	NA	NA	NA
	May-02	0.81 U	0.81 U	0.81 U	0.81 U	NA	NA	NA
	Feb-03	1.40 U	1.40 U	1.40 U	1.40 U	NA	NA	NA
	Feb-06	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-07	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
A-MW32	May-94	0.92	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	1.1	0.65 U	0.050 U	0.050 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Nov-94	0.58	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	0.84	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	1.2	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	1	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	0.67 U	0.76 U	1.8 U	1.0 U	NA	NA	NA
	Feb-97	1.2	0.94 U	2.2 U	1.2 U	NA	NA	NA
	Aug-97	0.7	0.31 U	0.71 U	0.41 U	NA	NA	NA
	Dec-97	5.6 J	2.9 U	6.7 U	3.8 U	NA	NA	NA
	Aug-98	3.2	0.68 U	1.6 U	0.91 U	NA	NA	NA
	Feb-99	1.6	0.69 U	0.69 U	0.69 U	NA	NA	NA
	Aug-99	3.9	0.57 U	0.57 U	0.57 U	NA	NA	NA
	Feb-00	5.9	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Aug-00	3.8	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Feb-01	5.6	0.35 U	0.35 U	0.35 U	NA	NA	NA
	Jul-01	23	0.44 U	0.44 U	0.44 U	NA	NA	NA
	May-02	5.4	0.64 U	0.64 U	0.64 U	NA	NA	NA
	Aug-02	5.8	0.60 U	0.60 U	0.60 U	NA	NA	NA
	Feb-03	2.3	1.50 U	1.50 U	1.50 U	NA	NA	NA
	Sep-03	4.3	0.18 U	0.18 U	0.18 U	NA	NA	NA
	Feb-04	9.3	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	7.5	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	6.9	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-05	4.1	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-06	10	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	4.4	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	6.3	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-07	6	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	6.7	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-08	5.1	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	5.3	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW33	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.23	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.26	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	0.72 U	0.81 U	1.9 U	1.1 U	NA	NA	NA
	Feb-97	3.6	0.79 U	1.8 U	1.1 U	NA	NA	NA
	Aug-97	3.6	0.63 U	1.5 U	0.84 U	NA	NA	NA
	Dec-97	3.5 J	0.43 U	1.0 U	0.58 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Aug-98	1.6	0.45 U	1.1 U	0.60 U	NA	NA	NA
	Feb-99	0.96	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-99	1.4	0.40 U	0.40 U	0.40 U	NA	NA	NA
	Feb-00	1.5 U	1.5 U	1.5 U	1.5 U	NA	NA	NA
	Aug-00	1.3	0.61 U	0.61 U	0.61 U	NA	NA	NA
	Feb-01	1.5	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Jul-01	0.36 U	0.36 U	0.36 U	0.36 U	NA	NA	NA
	May-02	0.94 U	0.94 U	0.94 U	0.94 U	NA	NA	NA
	Aug-02	0.17 U	0.17 U	0.17 U	0.17 U	NA	NA	NA
	Feb-03	0.96 U	0.96 U	0.96 U	0.96 U	NA	NA	NA
	Sep-03	0.66 U	0.66 U	0.66 U	0.66 U	NA	NA	NA
	Feb-04	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-04	0.53 U	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Feb-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-07	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-07	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	0.25 U	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW35	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	0.74 U	0.83 U	1.9 U	1.1 U	NA	NA	NA
	Feb-97	0.85 U	0.95 U	2.2 U	1.3 U	NA	NA	NA
	Aug-97	0.62 U	0.70 U	1.6 U	0.9 U	NA	NA	NA
	Dec-97	0.35 UJ	0.40 UJ	0.9 UJ	0.5 UJ	NA	NA	NA
	Aug-98	1.0 U	1.2 U	2.7 U	1.6 U	NA	NA	NA
	Feb-99	0.91 U	0.91 U	0.91 U	0.91 U	NA	NA	NA
	Aug-99	0.92 U	0.92 U	0.92 U	0.92 U	NA	NA	NA
	Feb-00	1.4 U	1.4 U	1.4 U	1.4 U	NA	NA	NA
	Aug-00	1.5 U	1.5 U	1.5 U	1.5 U	NA	NA	NA
	Feb-01	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Jul-01	0.42 U	0.42 U	0.42 U	0.42 U	NA	NA	NA
	May-02	1.60 U	1.60 U	1.60 U	1.60 U	NA	NA	NA
	Aug-02	0.31 U	0.31 U	0.31 U	0.31 U	NA	NA	NA
	Feb-03	1.00 U	1.00 U	1.00 U	1.00 U	NA	NA	NA
	Sep-03	1.40 U	1.40 U	1.40 U	1.40 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-07	0.53 U	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Aug-07	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	0.24 U	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW44	May-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	0.19 U	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	0.27 J	0.23 UJ	0.550 UJ	0.310 UJ	NA	NA	NA
	Feb-97	0.74 U	0.83 U	1.9 U	1.1 U	NA	NA	NA
	Aug-97	0.58 U	0.65 U	1.5 U	0.86 U	NA	NA	NA
	Dec-97	0.83 UJ	0.94 U	2.2 U	1.2 U	NA	NA	NA
	Aug-98	1.1 U	1.2 U	2.9 U	1.7 U	NA	NA	NA
	Feb-99	0.81 U	0.81 U	0.81 U	0.81 U	NA	NA	NA
	Aug-99	0.57 U	0.57 U	0.57 U	0.57 U	NA	NA	NA
	Feb-00	0.29 U	0.29 U	0.29 U	0.29 U	NA	NA	NA
	Aug-00	0.79 U	0.79 U	0.79 U	0.79 U	NA	NA	NA
	Feb-01	0.66 U	0.66 U	0.66 U	0.66 U	NA	NA	NA
	Jul-01	0.30 U	0.30 U	0.30 U	0.30 U	NA	NA	NA
	Aug-02	0.34 U	0.34 U	0.34 U	0.34 U	NA	NA	NA
	Feb-03	1.00 U	1.00 U	1.00 U	1.00 U	NA	NA	NA
	Sep-03	0.53 U	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-05	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-06	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-06	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	0.52 U	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	0.25 U	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW49	May-02	380	0.7 U	0.7 U	0.7 U	NA	NA	NA
	Aug-02	550	0.4 U	0.4 U	0.4 U	NA	NA	NA
	Feb-03	300	1.0 U	1.0 U	1.0 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Sep-03	350	0.69 U	0.69 U	0.69 U	NA	NA	NA
	Feb-04	440	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	360	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	180	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-05	360	0.73	0.49 U	0.49 U	NA	NA	NA
	Feb-06	280	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	300	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Feb-07	270 D	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Aug-07	190 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	170 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	67 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	39 D	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW50	May-02	1.2 U	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Aug-02	0.62 U	0.62 U	0.62 U	0.62 U	NA	NA	NA
	Feb-03	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Sep-03	1.9 U	1.9 U	1.9 U	1.9 U	NA	NA	NA
	Feb-04	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-04	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-06	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-07	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-07	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	0.24 U	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW51	May-02	0.77 U	0.77 U	0.77 U	0.77 U	NA	NA	NA
	Aug-02	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA
	Feb-03	0.26 U	0.26 U	0.26 U	0.26 U	NA	NA	NA
	Sep-03	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	NA	NA	NA
	Aug-06	0.56 U	0.56 U	0.56 U	0.56 U	NA	NA	NA
	Feb-07	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-07	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-08	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	0.24 U	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
A-MW52	May-02	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Aug-02	0.21 U	0.21 U	0.21 U	0.21 U	NA	NA	NA
	Feb-03	0.99 U	0.99 U	0.99 U	0.99 U	NA	NA	NA
	Sep-03	1.5 U	1.4 U	1.4 U	1.4 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-06	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	0.53 U	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Aug-07	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-08	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	0.24 U	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U
A-MW53	May-02	0.87 U	0.87 U	0.87 U	0.87 U	NA	NA	NA
	Aug-02	0.27 U	0.27 U	0.27 U	0.27 U	NA	NA	NA
	Feb-03	0.71 U	0.71 U	0.71 U	0.71 U	NA	NA	NA
	Sep-03	0.83 U	0.83 U	0.83 U	0.83 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-05	0.51 U	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-06	0.54 U	0.54 U	0.54 U	0.54 U	NA	NA	NA
	Aug-06	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	0.52 U	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-08	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	0.25 U	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U
A-MW54	May-02	2.5	1.0 U	1.0 U	1.0 U	NA	NA	NA
	Aug-02	1.8	0.2 U	0.2 U	0.2 U	NA	NA	NA
	Feb-03	1.9	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Sep-03	2	1.0 U	1.0 U	1.0 U	NA	NA	NA
	Feb-04	1.7	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-04	1.5	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-05	2	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	2.3	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	2.4	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	2.3	0.49 U	0.49 U	0.49 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-07	1.7	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	1.4	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	1.1	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	1.1	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	0.65	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW55	May-02	0.88 U	0.88 U	0.88 U	0.88 U	NA	NA	NA
	Aug-02	0.3 U	0.3 U	0.3 U	0.3 U	NA	NA	NA
	Feb-03	0.88 U	0.88 U	0.88 U	0.88 U	NA	NA	NA
	Sep-03	0.95 U	0.95 U	0.95 U	0.95 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-06	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-06	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	0.52 U	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	0.50 U	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-08	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	0.24 U	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-MW56	Nov-09	0.14 J	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U
A-MW57	Nov-09	0.079 J	0.15 U	0.15 U	0.15 U	1.9 U	1.9 U	1.9 U
Extraction Wells (Shallow Aquifer)								
A-EW4	Dec-97	83 J	2.2 U	5 U	2.9 U	NA	NA	NA
	Feb-98	87 J	1.9 UJ	4.4 UJ	2.5 UJ	NA	NA	NA
	Apr-98	67 J	1.7 U	3.9 U	2.3 U	NA	NA	NA
	Aug-98	30	1.8 U	4.1 U	2.4 U	NA	NA	NA
	May-99	48	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Aug-99	79	0.78 U	0.78 U	0.78 U	NA	NA	NA
	Feb-00	75	0.91 U	0.91 U	0.91 U	NA	NA	NA
	Aug-00	71	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Feb-01	67	0.58 U	0.58 U	0.58 U	NA	NA	NA
	Aug-01	52	0.39 U	0.39 U	0.39 U	NA	NA	NA
	May-02	110	0.91 U	0.91 U	0.91 U	NA	NA	NA
	Aug-02	110	0.60 U	0.60 U	0.60 U	NA	NA	NA
	Feb-03	74	0.82 U	0.82 U	0.82 U	NA	NA	NA
	Sep-03	84	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Feb-04	64	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-04	68	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	60	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	60	0.48 U	0.48 U	0.48 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-06	100	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Aug-06	120	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Feb-07	140 D	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	110 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	97 D	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-08	89 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	94 D	0.15 U	0.15 U	0.15 U	2.1	0.16 J	0.13 J
A-EW5	Dec-97	6.1 J	0.47 U	1.1 U	0.62 U	NA	NA	NA
	Feb-98	6.2 J	1.6 UJ	3.8 UJ	2.2 UJ	NA	NA	NA
	Apr-98	5.2 J	0.56 U	1.3 U	0.74 U	NA	NA	NA
	Aug-98	23	1.1 U	2.5 U	1.4 U	NA	NA	NA
	May-99	14	0.87 U	0.87 U	0.87 U	NA	NA	NA
	Aug-99	13	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Feb-00	16	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Aug-00	17	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-01	16	0.78 U	0.78 U	0.78 U	NA	NA	NA
	Aug-01	6.5	0.49 U	0.49 U	0.49 U	NA	NA	NA
	May-02	18	0.30 U	0.30 U	0.30 U	NA	NA	NA
	Aug-02	12	0.13 U	0.13 U	0.13 U	NA	NA	NA
	Feb-03	2	0.70 U	0.70 U	0.70 U	NA	NA	NA
	Sep-03	8.6	0.42 U	0.42 U	0.42 U	NA	NA	NA
	Feb-04	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Aug-04	17	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	28	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-05	31	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-06	57	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	41	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-07	130 D	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-07	90 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	34	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-08	49 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	29 D	0.15 U	0.15 U	0.15 U	0.59 J	2.0 U	2.0 U
A-EW6	Dec-97	0.98 UJ	1.1 U	2.6 U	1.5 U	NA	NA	NA
	Feb-98	1.2 UJ	1.4 UJ	3.2 UJ	1.8 UJ	NA	NA	NA
	Apr-98	1.1 UJ	1.3 U	2.9 U	1.7 U	NA	NA	NA
	Aug-98	0.50 J	0.47 U	1.1 U	0.62 U	NA	NA	NA
	May-99	0.99 U	0.99 U	0.99 U	0.99 U	NA	NA	NA
	Aug-99	0.56 U	0.56 U	0.56 U	0.56 U	NA	NA	NA
	Feb-00	1.2 U	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Aug-00	0.99	0.46 U	0.46 U	0.46 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-01	0.53	0.44 U	0.44 U	0.44 U	NA	NA	NA
	Aug-01	0.95	0.57 U	0.57 U	0.57 U	NA	NA	NA
	May-02	0.42 U	0.42 U	0.42 U	0.42 U	NA	NA	NA
	Aug-02	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA
	Feb-03	1.3 U	1.3 U	1.3 U	1.3 U	NA	NA	NA
	Sep-03	1.1 U	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Feb-04	0.49 U	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-05	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	0.48 U	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-06	0.79	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-07	16	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	1.3	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	48	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	48 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	1.0 PG	0.15 U	0.15 U	0.15 U	2.0 U	2.0 U	2.0 U
A-EW7	Dec-97	450 J	1.5 U	3.4 U	1.9 U	NA	NA	NA
	Feb-98	470 J	1.1 UJ	2.6 UJ	1.5 UJ	NA	NA	NA
	Apr-98	660 J	1.3 U	2.9 U	1.7 U	NA	NA	NA
	Aug-98	320	0.40 U	0.92 U	0.53 U	NA	NA	NA
	May-99	500	3.3 U	3.3 U	3.3 U	NA	NA	NA
	Aug-99	380	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Feb-00	300	1.6 U	1.6 U	1.6 U	NA	NA	NA
	Aug-00	290	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Feb-01	260	0.47 U	0.47 U	0.47 U	NA	NA	NA
	Aug-01	120	0.55 U	0.55 U	0.55 U	NA	NA	NA
	May-02	710	0.92 U	0.92 U	0.92 U	NA	NA	NA
	Aug-02	630	0.47 U	0.47 U	0.47 U	NA	NA	NA
	Feb-03	310	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Sep-03	480	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-04	360	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	240	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	210	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-05	240	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	190	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	240	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-07	240 D	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-07	140 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	260 D	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-08	200 D	0.50 U	0.50 U	0.50 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Aug-09	180 D	0.15 U	0.15 U	0.15 U	3.5	0.29 J	0.21 J
A-EW8	Dec-97	110 J	0.59 U	1.4 U	0.79 U	NA	NA	NA
	Feb-98	240 J	1.6 UJ	3.8 UJ	2.2 UJ	NA	NA	NA
	Apr-98	110 J	1.2 U	2.8 U	1.6 U	NA	NA	NA
	Aug-98	270	0.86 U	2.0 U	1.2 U	NA	NA	NA
	Aug-99	160	1.7 U	1.7 U	1.7 U	NA	NA	NA
	Feb-00	120	1.1 U	1.1 U	1.1 U	NA	NA	NA
	Aug-00	160	0.73 U	0.73 U	0.73 U	NA	NA	NA
	Feb-01	68	0.34 U	0.34 U	0.34 U	NA	NA	NA
	Aug-01	110	0.53 U	0.53 U	0.53 U	NA	NA	NA
	May-02	120	1.30 U	1.30 U	1.30 U	NA	NA	NA
	Aug-02	150	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Feb-03	75	1.00 U	1.00 U	1.00 U	NA	NA	NA
	Sep-03	120	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Feb-04	320	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	170	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	110	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-05	160	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	120	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-06	250	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-07	240 D	0.52 U	0.52 U	0.52 U	NA	NA	NA
	Aug-07	140 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	240 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	230 D	0.17 J	0.49 U	0.49 U	NA	NA	NA
	Aug-09	81 D	0.15 U	0.15 U	0.15 U	1.6 J	0.12 J	0.073 J
A-MW37	Apr-94	140	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	190	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	180	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	190	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	220	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	210	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	99 J	0.34 UJ	0.80 UJ	0.46 UJ	NA	NA	NA
	Feb-97	120	1.4 U	3.3 U	1.9 U	NA	NA	NA
	Aug-97	120	1.1 U	2.6 U	1.5 U	NA	NA	NA
	Dec-97	160 J	2.2 U	5.0 U	2.9 U	NA	NA	NA
	Feb-98	130 J	1.7 UJ	3.9 UJ	2.3 UJ	NA	NA	NA
	Apr-98	220 J	0.81 U	1.9 U	1.1 U	NA	NA	NA
	Aug-98	200	1.7 U	3.9 U	2.2 U	NA	NA	NA
	May-99	130	1.4 U	1.4 U	1.4 U	NA	NA	NA
	Aug-99	180	0.64 U	0.64 U	0.64 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-00	170	1.2 U	1.2 U	1.2 U	NA	NA	NA
	Aug-00	130	0.92 U	0.92 U	0.92 U	NA	NA	NA
	Feb-01	120	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Jul-01	150	0.79 U	0.79 U	0.79 U	NA	NA	NA
	May-02	150	1.30 U	1.30 U	1.30 U	NA	NA	NA
	Aug-02	180	0.25 U	0.25 U	0.25 U	NA	NA	NA
	Feb-03	120	2.2	1.30 U	1.30 U	NA	NA	NA
	Sep-03	160	1.9 U	1.9 U	1.9 U	NA	NA	NA
	Feb-04	130	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-04	140	0.5 U	0.5 U	0.5 U	NA	NA	NA
	Feb-05	140	0.81	0.49 U	0.49 U	NA	NA	NA
	Aug-05	160	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	120	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	140	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-07	160 D	0.53 U	0.53 U	0.53 U	NA	NA	NA
	Aug-07	120 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-08	120 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Aug-08	130 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-09	130 D	0.15 U	0.15 U	0.15 U	0.17 J	0.10 J	0.094 J
A-MW46	Apr-94	120	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-94	170	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Nov-94	160	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-95	170	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-95	170	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Feb-96	200	0.65 U	0.050 U	0.050 U	NA	NA	NA
	Aug-96	180	0.56 U	1.30 U	0.74 U	NA	NA	NA
	Feb-97	180	1.3 U	3.0 U	1.7 U	NA	NA	NA
	Apr-97	190	1.3 U	3.1 U	1.8 U	NA	NA	NA
	May-97	180	1.3 U	3.1 U	1.8 U	NA	NA	NA
	May-97	140	0.74 U	1.7 U	0.98 U	NA	NA	NA
	May-97	150	0.92 U	2.1 U	1.2 U	NA	NA	NA
	Jun-97	150	1.1 U	2.6 U	1.5 U	NA	NA	NA
	Jul-97	140	0.74 U	1.7 U	0.98 U	NA	NA	NA
	Jul-97	140	0.77 U	1.8 U	1.0 U	NA	NA	NA
	Aug-97	120	0.94 U	2.2 U	1.2 U	NA	NA	NA
	Aug-97	120	0.83 U	2.1 U	1.2 U	NA	NA	NA
	Dec-97	140 J	2.5 U	5.9 U	3.4 U	NA	NA	NA
	Feb-98	120 J	1.9 UJ	4.4 UJ	2.5 UJ	NA	NA	NA
	Apr-98	200 J	1.3 U	3.1 U	1.8 U	NA	NA	NA
	Aug-98	170	0.52 U	1.2 U	0.70 U	NA	NA	NA

Table B-1. Summary of Groundwater Quality Data for Site A Through November 2009

Well No.	Sample Date	RDX (µg/L)	TNT (µg/L)	2,6-DNT (µg/L)	2,4-DNT (µg/L)	MNX (µg/L)	DNX (µg/L)	TNX (µg/L)
Groundwater Cleanup Levels		**0.8**	**2.9**	**0.13**	**0.13**	**NS**	**NS**	**NS**
	Feb-00	130	1.0 U	1.0 U	1.00 U	NA	NA	NA
	Aug-00	160	0.70 U	0.70 U	0.70 U	NA	NA	NA
	Feb-01	150	0.75 U	0.75 U	0.75 U	NA	NA	NA
	Apr-01	160	2.5 U	2.5 U	2.5 U	NA	NA	NA
	Jul-01	140	0.6 U	0.6 U	0.6 U	NA	NA	NA
	May-02	160	0.4 U	0.4 U	0.4 U	NA	NA	NA
	May-02	180	0.81 U	0.81 U	0.81 U	NA	NA	NA
	Aug-02	170	0.27 U	0.27 U	0.27 U	NA	NA	NA
	Feb-03	160	0.27 U	0.27 U	0.27 U	NA	NA	NA
	Sep-03	130	1.3 U	1.3 U	1.3 U	NA	NA	NA
	Feb-04	160	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-04	110	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Feb-05	130	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	150	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Feb-06	110	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-06	120	0.49 U	0.40 J	0.49 U	NA	NA	NA
	Feb-07	120 D	0.51 U	0.51 U	0.51 U	NA	NA	NA
	Aug-07	95 D	0.50 U	0.50 U	0.50 U	NA	NA	NA
	Feb-08	96 D	0.49 U	0.49 U	0.49 U	NA	NA	NA
	Aug-08	79 D	0.48 U	0.48 U	0.48 U	NA	NA	NA
	Aug-09	80 D	0.15 U	0.15 U	0.15 U	1.1 J	0.072 J	0.097 J

Notes:

Shallow aquifer monitoring wells A-MW37 and A-MW46 are currently used as extraction wells.

µg/L - micrograms per liter

D – Sample was diluted and reanalyzed.

DNT – dinitrotoluene

DNX - hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine

E – The reporting value is estimated because of the interference. The serial dilution was not within control limits

J – Estimated value

MNX - hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine

NA - Not Analyzed

NS - no cleanup standard available

PG - The percent difference between the original and confirmation analyses was greater than 40 percent

RDX – hexahydro-1,3,5-trinitro-1,3,5-triazine

TNT – 2,4,6-trinitrotoluene

TNX - hexahydro-1,3,5-trinitroso-1,3,5-triazine

U – Not detected at associated detection limit

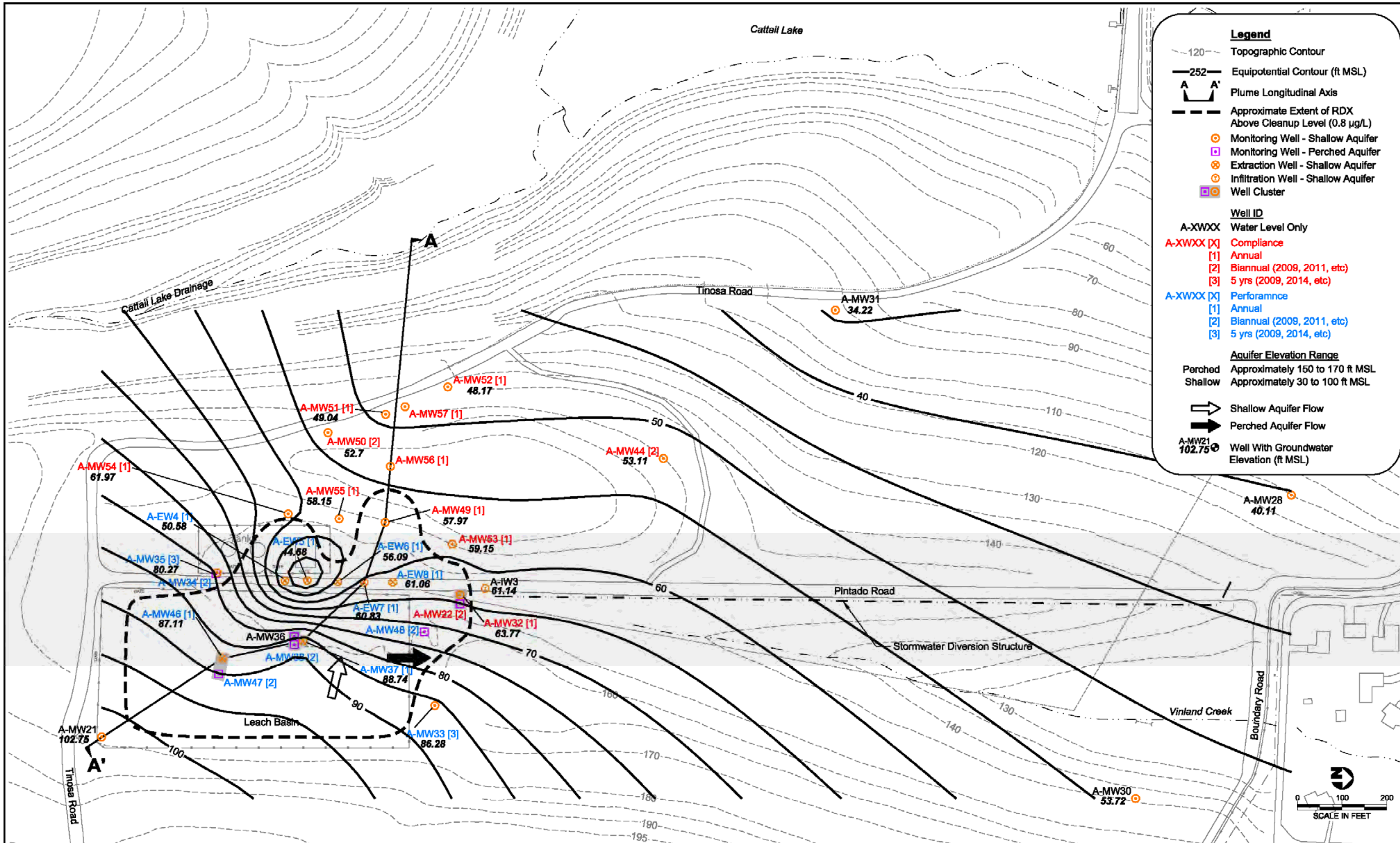
UJ - The compound was analyzed for but not detected. The sample detection limit is an estimated value.

Highlighted data are preliminary

Table B-2. Summary of Mann-Kendall Trend Analysis Results

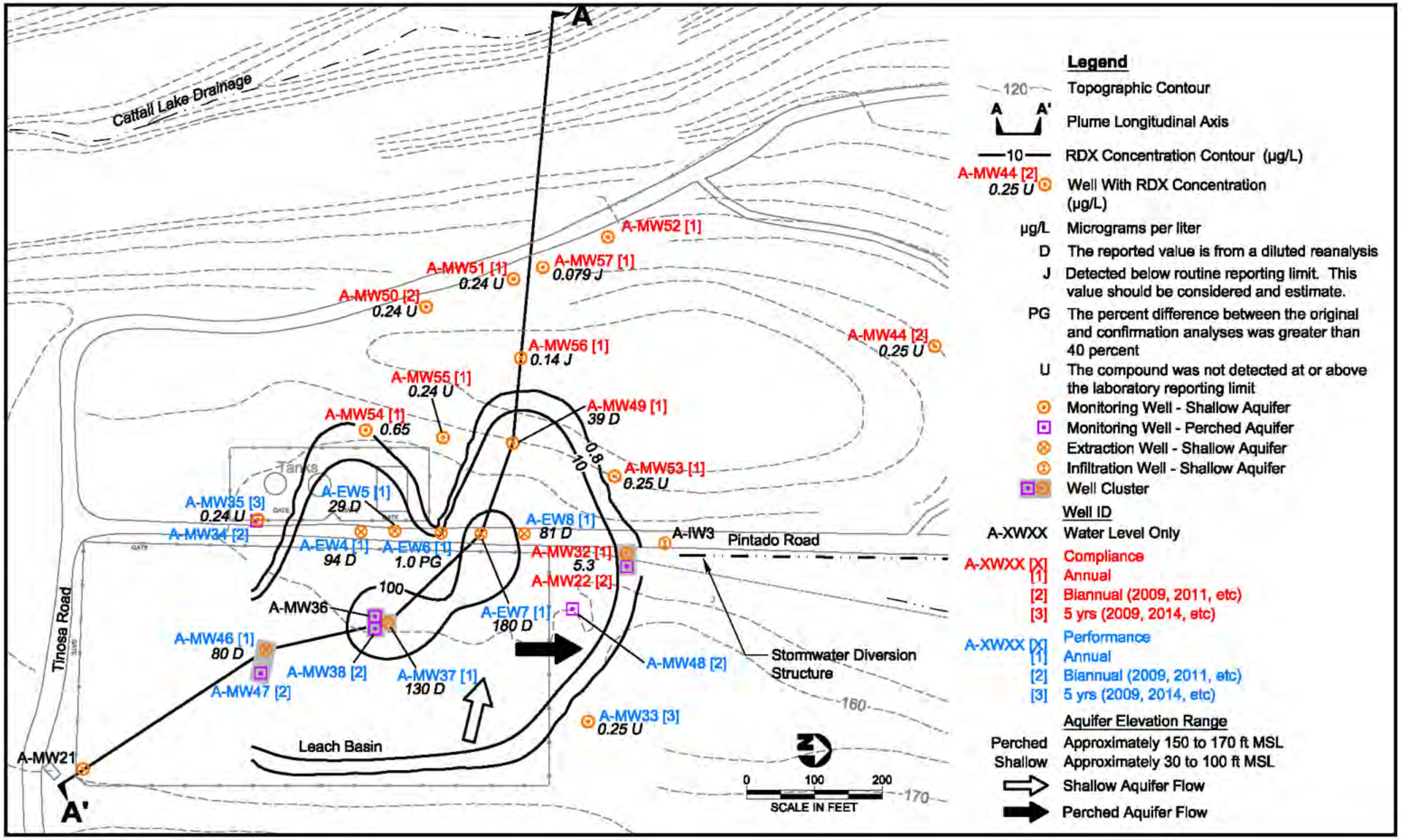
Well	RDX	TNT	2,6-DNT	2,4-DNT	Current Frequency	Period Evaluated
Perched Zone Wells:						
A-MW22	NT	ND	ND	ND	3rd Backup	5/94-2/97
A-MW34 Updated	NT	ND	ND	ND	2nd Backup	2/95 - 11/09
A-MW47	NT	D - 2	I - 1	D - 2	Biennial	8/97-2/07
A-MW48 Updated	D - 2	ND	ND	ND	Biennial	2/96 - 11/09
Shallow Aquifer Wells:						
A-MW32 Updated	D - 1	ND	ND	ND	Annual	8/04-8/09
A-MW49 Updated	D - 2	NT	ND	ND	Annual	8/04-8/09
A-MW54 Updated	D - 2	ND	ND	ND	Annual	2/04-8/09
Extraction Wells:						
A-EW4 Updated	NT	ND	ND	ND	Annual	8/04-8/09
A-EW5 Updated	I - 1	ND	ND	ND	Annual	8/04-8/09
A-EW6 Updated	I - 2	ND	ND	ND	Annual	2/04-8/09
A-EW7 Updated	NT	ND	ND	ND	Annual	8/04-8/09
A-EW8 Updated	NT	NT	ND	ND	Annual	8/04-8/09
A-MW37 Updated	D - 1	ND	ND	ND	Annual	8/04-8/09
A-MW46 Updated	D - 2	ND	NT	ND	Annual	8/04-8/09

ND = No detections
NT = No trend – Stable
NT - NS = No trend – Not Stable
D - 1 = Trend at 80% Confidence Level is Decreasing
D - 2 = Trends at 80% and 90% Confidence Levels are Decreasing
I - 1 = Trends at 80% Confidence Level is Increasing
I - 2 = Trends at 80% and 90% Confidence Levels are Increasing
DNT = dinitrotoluene
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
TNT = 2,4,6-trinitrotoluene
Updated = Mann-Kendall trend updated with data from August or November 2009



U.S. NAVY	Task Order 0007 NBK Bangor LTM	SEALASKA	Figure 3-2 Potentiometric Surface for All Wells, Site A, August 2009

T:\NAVY\Bangor\Sub-Tasks\TO 7\LTM\Site A\2009 Annual\Fig 3-2 Poten All Wells.dwg
Mod: 01/08/2010, 16:46 | Plotted: 01/11/2010, 09:08 | john_knobbs



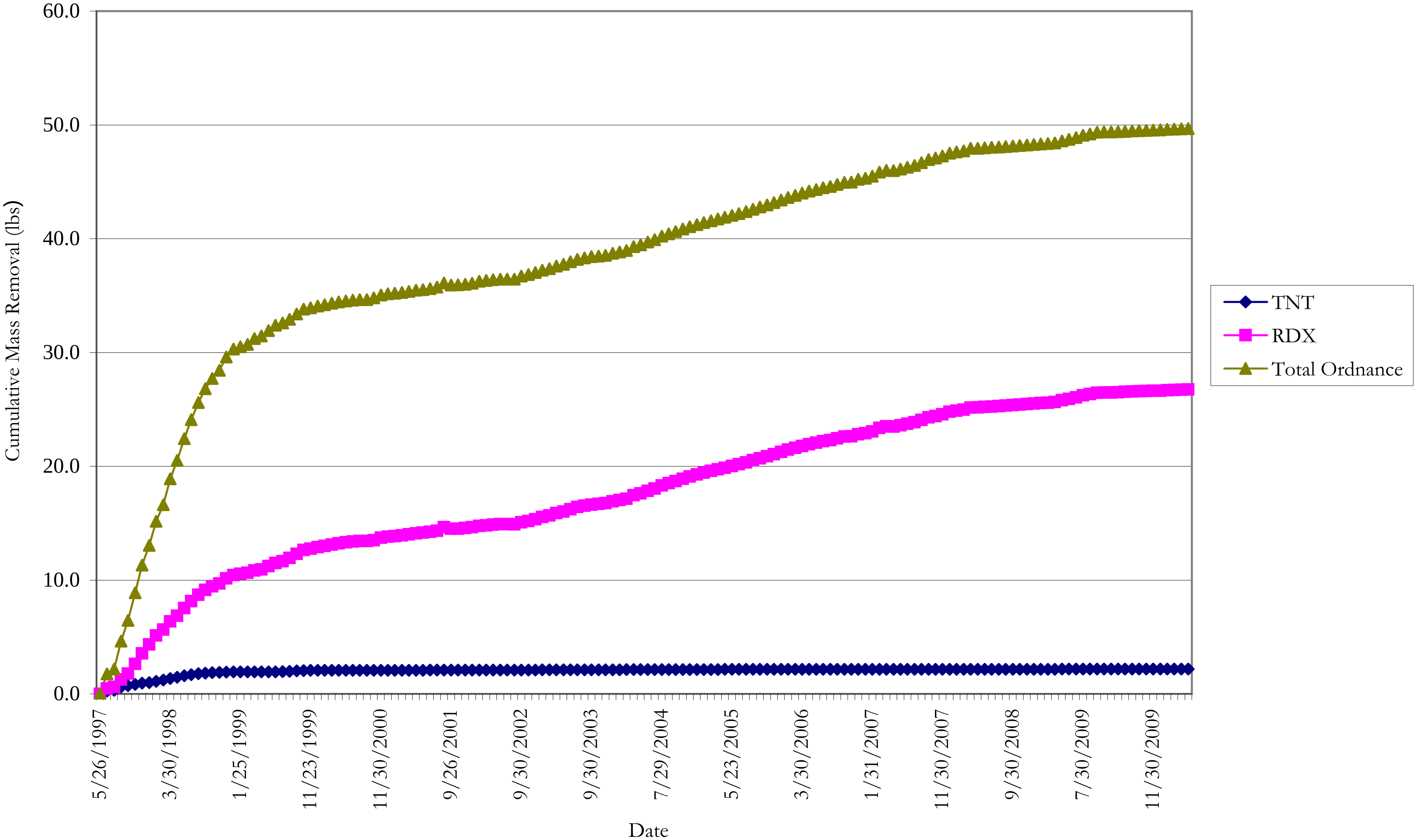
U.S. NAVY | SEALASKA

Figure 3-3.
2009 RDX Concentrations in Site A Shallow Aquifer

Task Order 0007
NBK Bangor LTM

T:\NAVY\Bangor\Sub-Tasks\TO 7\LTM\Site A\2009 Annual\Fig 3-5 Site A (August 2009 RDX).dwg
Mod: 01/11/2010, 08:39 | Plotted: 01/11/2010, 09:03 | john. knobbs

Site A P&T System Contaminant Mass Removal Since 1997



APPENDIX C

Sites F and E/11 Summary of Historical Groundwater Results, Mann-Kendall Statistics, and Figures

Table C-1 - RDX Analytical Results Compilation for the Shallow Aquifer at Site F

RDX in µg/L

Well No.	Dec-94	Feb-95	Apr-95	Jun-95	Aug-95	Oct-95	Dec-95	Feb-96	Apr-96	Jun-96	Aug-96	Oct-96	Jan-97	Apr-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Jul-98	Aug-98	Oct-98	Oct-98	Nov-98
Monitoring Wells																																
F-MW21	150						120																									
F-MW24	Dry						720																									
F-MW27	280	240	210	170	140	140	150	150	140	160	150		130									69										
F-MW31	480 J	370	230	190	230	300	350	360	210	190	250	180	380	280		160			180 J			370			320			8.4			290	
F-MW32	54						53						9.1									3.5										
F-MW33	870	820	660	620	930	1,200	1,100	1,100	770	840	1,100	880	580	420		400			420			350			320			350			310	
F-MW35	33						7.6						110									32										
F-MW36	240	240	310	350	420	390	340	350	520	620	600	610		550		430			380													
F-MW37	3.0						2.4						3.0									2.4										
F-MW38	880	1,800	1,100	1,100	1,100	1,200	1,000	1,100	3,100	1,100	1,200	1,200	1,200	1,100		1,300			1,100			1,000			710			620			89	
F-MW39	860	910	1,100	1,200	1,200	1,300	940	1,100	2,700	1,100	1,200	1,300	1,200	1,000		1,400			1,100			1,700			1,200			1,000			1,000	
F-MW40	0.95 U			0.95 U			0.95 U			0.95 U			0.95 U									0.27 J										
F-MW41	0.95 U	2.0	2.9	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	1.3 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.2 J			0.35 J			0.95 U			130	
F-MW42	1.6	6.9	22	50	68	100	110	150	90	120	97	90	60	32		25			13			6.2			3.6			2.7			2.4	
F-MW43	0.95 U			2.4 U			0.95 U			0.95 U			0.95 U									0.22 J										
F-MW44	1.0 J	0.95 U	0.95 U	2.4 U	1.0	0.95 U	0.95 U	0.95 U	0.93 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.95 U			0.95 U			0.95 U			0.95 U	
F-MW45	1.6						1.8			1.9			1.4									0.66 J										
F-MW46	0.95 U			0.95 U			0.95 U			0.95 U			0.95 U									0.95 U										
F-MW48	22						29						300									280										
F-MW51	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	2.9 U	0.95 U	0.95 U		250									0.28 J										
F-MW52	72	0.95 U	0.95 U	0.95 U	0.21 J	0.95 U	0.95 U	0.95 U	1.3 U	0.95 U	47		670									5.4										
F-MW53	990	1,100	700	430	420	370	300	290	160	250	210		1,000									320										
F-MW54	0.95 U						0.95 U																									
F-MW54S	1,100	1,100	780	820	790	780	590	290	98	100	120	270	200	95		600			630			120			69			160			140	
F-MW55	7.8	4.1	5.5	4.5	3.6	6.1	7.4	3.1	5.8	5.5	5.7		7.7									180			910							
F-MW55M												1,000	760	460		1,100			1,000			1,300						1,100			1,400	
F-MW56	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	2.3 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.95 U			0.95 U			0.95 U			0.95 U	
F-MW57	0.95 U	0.95 U	0.95 U	0.95 U	0.31 J	0.95 U	0.95 U	0.95 U	1.3 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.95 U			0.95 U			0.95 U			0.95 U	
F-MW58	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	1.1 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.95 U			0.95 U			0.95 U			0.95 U	
F-MW59												660	230	520		770			850			700			590			500			380	
F-MW60												0.95 U	0.95 U	0.95 U		0.95 U			0.95 U			0.95 U			0.95 U			0.95 U			0.95 U	
F-MW61												0.95 U	0.95 U	11	23	75	130		70	64	52	45	44	36	30	25	21	19	17		14	13
F-MW62												520	540	280		170	70		100	71	74	57	54	31	35	32	27	26	26		22	22
F-MW63															0.95 U			0.95 U	0.95 U	0.22 J	1.8	1.3	11	14	15	31	34	54	63	0.95 U	350	100
F-MW64																		6.5	8.8	8.4	7.6	7.3	7.9	7.9	4.7	4.2	3.8	3.0	3.7	0.95 U	2.5	100
F-MW65																										0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U
F-MW66																																
F-MW67																																
F-MW68																																
F-MW69																																
Extraction Wells																																
F-EW1	1,300	670	470	450	410	350	360	330	240	270	250	250	240	200					390			200			160			150			110	
F-EW2	540	800	580	590	510	420	510	480	450	430	350	460	330	360		80			43			280			250			210			170	
F-EW3	1,100	450	370	390	330	290	300	280	310	260	190	240	220	210		220			170			200			160			160			130	
F-EW4	9.5	8.8	15	22	38	81	110	110	160	180	220		300	290		280			260			250			250			240			210	
F-EW5	320	64	60	65	77	72	82	91	98	110	120		400	190		160			140			140			120			170			130	
F-EW6	1,100	850	620	680	660	590	570	640	520	530	450		1,100	480		400			310			270			200			140				
F-EW7												170	76	87		82			92			60			62			50			47	
F-EW8												660	590	540		470			450			370			320			320			230	
F-EW9													1,100			630			590			520			450			460			340	
F-EW10													1,200	970		670			730			580			620			600			510	

Notes:

RDX groundwater cleanup level is 0.8 ug/L.

Blank spaces indicate sample not collected on that date.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

PG - The % difference between the original and confirmation analyses is greater than 40%

Table C-1 - RDX Analytical Results Compilation for the Shallow Aquifer at Site F

RDX in µg/L

Well No.	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99	Aug-99	Oct-99	Jan-00	Apr-00	Jul-00	Oct-00	Jan-01	Apr-01	Jul-01	Oct-01	Jan-02	Apr-02	Jul-02	Oct-02	Jan-03	Apr-03	Jul-03	Oct-03	Jan-04	Feb-04	Apr-04	Jul-04	Oct-04
Monitoring Wells																															
F-MW21																															
F-MW24																															
F-MW27		54													35								26 J								
F-MW31		270			330			260			260		290		51		60 J		56		170		68 R		120 UJ					130.0	
F-MW32		3.8													8.6								7.6 UJ								
F-MW33		550			200			290			230		170		210		220		250		170		290 J		180					200.0	
F-MW35		690													790								420								
F-MW36																															
F-MW37		2.6													4.5								4.9								
F-MW38		280			280			280			200		120		120		28		86		57		59 J		46					46.0	
F-MW39		1,300			1,400			2,700			1,900		980		1,500		2200		3800		1200		2600		2000					820.0	
F-MW40		0.95 U													0.35 U								0.81 U								
F-MW41		1.1			12			1.9 U			10		9.2		8.3		6.7		6.8		3.9		6.0 J		3.8					3.9	
F-MW42		2.5			2.2			2.3			2.0		1.6		1.3		0.97		0.81		1.0		1.2 UJ		0.65 J					0.9	
F-MW43		0.95 U													0.82 U								0.87 UJ								
F-MW44		0.95 U			0.95 U			0.84 U			1.0 U		1.6 U		0.47 U		1 U		0.55 U		0.56 U		4.4 J		6.9					28.0	
F-MW45		0.61 J													0.83 U								0.61 U								
F-MW46		0.95 U													0.60 U								0.52 UJ								
F-MW48		280													200								410								
F-MW51		0.95 U													0.55 U								1.1 UJ								
F-MW52		8.4													1.9								1.0 UJ								
F-MW53		100													23								11 J								
F-MW54																															
F-MW54S		60			25			66			31		21		37		35		28		21		18 J		6.4					12.0	
F-MW55		42													240								730 J								
F-MW55M		1,100			1,100			1,300			1,300		210		880		820				950		320		240					150.0	
F-MW56		0.95 U			0.95 U			1.1 U			1.6 U		0.79 U		0.99 U		0.46 U		0.95 U		0.87 U		1.2 UJ		1.4 UJ					0.5 U	
F-MW57		0.95 U			0.95 U			0.84 U			0.86 U		0.64 U		0.77 U		0.47 U		0.99 U		0.52 U		0.65 UJ		0.57 UJ					0.6 U	
F-MW58		0.95 U			0.95 U			0.62 U			1.2 U		0.77 U		0.49 U		0.53 U		0.74 U		0.68 U		0.78 UJ		0.79 UJ					0.53 U	
F-MW59		400			360			340			220		180		130		100		120		130		100		99					110	
F-MW60		0.95 U			0.95 U			1.1 U			1.2 U		0.29 U		0.34 U		0.49 U		0.52 U		0.83 U		1.2 UJ		1.3 UJ					0.5 U	
F-MW61	11	11	10	0.95 U	7.6	6.4	5.7	5.6	4.9	4.1	3.4	4.4	2.5	3.1	2.3	2.8	1.8	2.1	4.1	4.6	2.8	3.0	2.7 J	1.8	1.7 J	1.5			0.49 U	0.5 U	0.49 U
F-MW62	20	18	15	16	13	13	12	12	14	12	11	9.3	7.3	8.1	6.9	6.9	5.4	6.2	5.6	5.9	4.2	6.5	6.2	4.9	4.0	3.6			0.66	0.6	0.52 U
F-MW63	110	120	110	150	100	95	93	96	110	98	91	77	60	41	51	47	43	41	32	35	23	32	28 J	21	18	15			19	17	16
F-MW64	2.6	2.5	2.3	2.7	2.5	2.4	1.6	1.7	1.2	0.93	1.2 U	0.57 U	1.3 U	0.84 U	0.94 U	1.0 U	0.53 U	0.58 U	1.1 U	0.94 U	0.83 U	0.59 U	0.98 J	0.95	0.98	0.63			1.0	1.40	0.9
F-MW65	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	1.4 U	0.42 U	0.61 U	1.3 U	0.65 U	0.52 U	0.75 U	0.61 U	0.82 U	0.58 U	0.4 U	0.7 U	0.97 U	0.83 U	0.43 U	0.12 U	0.96 UJ	0.53U	0.92 UJ	0.62 U			0.49 U	0.49 U	0.49 U
F-MW66																												0.49 U			
F-MW67																												3.9			
F-MW68																												3.9			
F-MW69																												0.49 U			
Extraction Wells																															
F-EW1		120			91			93			87		70		58		56		66		47		56		38					50	
F-EW2		190			160			180			150		120		100		100		110		77		81		55					70	
F-EW3		160			130			97			110 J		83		81		79		87		71		73		57					49	
F-EW4		140			260			250			250		190		220		150		170		160		150		130					140	
F-EW5		110			140			110			120		87		84		86		77		62		65		56					61	
F-EW6		110			91			84			60		56		43		36		33		22		23		19					18	
F-EW7		44 J			56			54			40		26		23		19		20		16		15 J		15					15	
F-EW8		270			190			240			170		140		130		110		120		76		100		80					96	
F-EW9					340			320			230		200		180		150		180		140		140		130					80	
F-EW10		530			520			510			420		350		360		310		320		360		220		180					190	

Notes:

RDX groundwater cleanup level is 0.8 ug/L.

Blank spaces indicate sample not collected on that date.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

PG - The % difference between the original and confirmation analyses is greater than 40%

Table C-1 - RDX Analytical Results Compilation for the Shallow Aquifer at Site F

RDX in µg/L																			
Well No.	Jan-05	Apr-05	Aug-05	Oct-05	Jan-06	Apr-06	Jul-06	Oct-06	Jan-07	Apr-07	Jun-07	Oct-07	Jan-08	Apr-08	Jul-08	Oct-08	Jan-09	Apr-09	Aug-09
Monitoring Wells																			
F-MW21																			
F-MW24																			
F-MW27	20								19									11	
F-MW31	140 J		140 J		84 J		90 J		67 D				120	37				57 DP	
F-MW32	1.5								0.51 U									0.5 U	
F-MW33	170		200		180 J		140 J		220 D				130	74				160 D	
F-MW35	140								220 D									590 D	
F-MW36																			
F-MW37	4.9								0.52 U									3.7	
F-MW38	36		36		32		38		23				16	20				18	
F-MW39	1800		2500		1000 J		1300 J		570 D				630	740 D				1400 D	
F-MW40	0.5 U								0.50 U									0.49 U	
F-MW41	3.6		2.9		2.6		1.7 J		2.1		1.0		1.5	1.7		1.2		0.93	
F-MW42	1.1		0.97		1.0		1.2		1.1		0.91		0.86	0.63		0.69		0.75	
F-MW43	0.48 U								0.52 U									0.49 U	
F-MW44	50		52		49		42		63 D				96	160 D				240 D	
F-MW45	0.51 U								0.53 U									0.49 U	
F-MW46	0.49 U								0.53 U									0.49 U	
F-MW48	830								990 D									2,900 D	
F-MW51	0.54 U								0.51 U									0.49 U	
F-MW52	0.49 U								0.53 U									0.49 U	
F-MW53	4.7								4.9									3.1	
F-MW54																			
F-MW54S	9.9		9.4		9.2		6.1		7.7				5.7	11				9.7	
F-MW55	470								400 D									220 D	
F-MW55M	110		96		150 J		25 J		120 D				70	60 D				110 D	
F-MW56	0.49 U		0.48 U		0.53 U		0.49 U		0.54 U									0.49 U	
F-MW57	0.48 U		0.49 U		0.50 U		0.48 U		0.53 U									0.48 U	
F-MW58	0.49 U		0.48 U		0.49 U		0.49 U		0.54 U									0.51 U	
F-MW59	95		90		89 J		89 J		85 D									61	
F-MW60	0.49 U		0.49 U		0.49 U		0.48 U		0.52 U									0.49 U	
F-MW61	0.48 U	0.5 U	0.50 U	0.49 U	0.52 U	0.49 U	0.48 UJ	0.48 U	0.52 U				0.49 U	0.53 U				0.48 U	
F-MW62	0.48 U	0.5 U	0.52 U	0.48 U	0.51 U	0.51 U	0.48 U	0.49 U	0.53 U				0.51 U	0.53 U				0.49 U	
F-MW63	16	13	15	15	13	12	9.9	8.7	8.8	7.1	5.7	6.5	5.6	5.2	5.0	5	4.3	4.9	4.6 PG
F-MW64	0.89	0.93	1.8	1.5	0.93	1.1	0.93	0.93	1.0	1.2	1.0	1.0	0.98	0.61	0.59	0.56	0.66	0.72	0.76
F-MW65	0.49 U	0.49 U	0.48 U	0.48 U	0.48 U	0.5 U	0.48 UJ	0.50 U	0.50 U				0.49 U	0.54 U	0.50 U			0.48 U	
F-MW66			0.49 U	0.50 U	0.48 U	0.5 U	0.49 U	0.50 U	0.50 U	0.50 U	0.50 U	0.48 U	0.49 U	0.53 U	0.50 U	0.5 U	0.49 U	0.48 U	0.25 U
F-MW67	3.5	2.6	3.1	3.1	3.6	2.4	3.1	3.7	4.0	2.8	2.4	3.5	3.8	2.9	3.3	4.8	4.5	4.6	4.7
F-MW68	4.5	4.3	5.6	5.1	5.4	5	7.3 PJ	4.9	6.0	5.8	4.7	4.5	3.8	2.9	3.4	3.6	3.5	3.5	3.5 PG
F-MW69			0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.51 U	0.50 U	0.49 U	0.49 U	0.48 U	0.53 U	0.19 U	0.26 J	0.34 J	0.49 U	0.23 J
Extraction Wells																			
F-EW1	49		45		46		220 ENJ		48				35	29				31	
F-EW2	58		57		65 J		62 EJ		60 D				47	43				40	
F-EW3	50		48		47		47		49				43	32				31	
F-EW4	140		120		120 J		130 EJ		120 D				91	91 D				86 D	
F-EW5	56		53		55		74 EJ		58 D				45	46				43	
F-EW6	20		18		15		12		12				9.5	9.3				8.4	
F-EW7	12		14		11		11		13				9.9	10				10	
F-EW8	84		68		78 J		75 EJ		76 D				67	60 D				58 D	
F-EW9	88		76		73 J		76 EJ		72 D				53	65 D				54 D	
F-EW10	160		150		150 J		120 EJ		120 D				75	87 D				77 D	

Notes:

RDX groundwater cleanup level is 0.8 ug/L.

Blank spaces indicate sample not collected on that date.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

PG - The % difference between the original and confirmation analyses is greater than 40%

Table C-2 - TNT Analytical Results Compilation for the Shallow Aquifer at Site F

TNT in µg/L

Well No.	Dec-94	Feb-95	Apr-95	Jun-95	Aug-95	Oct-95	Dec-95	Feb-96	Apr-96	Jun-96	Aug-96	Oct-96	Jan-97	Apr-97	Jul-97	Oct-97	Jan-98	Apr-98	Jul-98	Oct-98	Jan-99	Apr-99	Jul-99	Jan-00	Jul-00	Jan-01	Apr-01	Jul-01	Jan-02	Apr-02	Jul-02	Oct-02	Jan-03
Monitoring Wells																																	
F-MW21	2,200						2,100																										
F-MW24	Dry						540																										
F-MW27	700	0.65 U	0.65 U	0.65 U	0.33 J	0.65 U	0.65 U	0.65 U	2.6 U	0.65 U	0.65 U		0.65 U				0.65 U				0.65 U					0.88 U							1.6 UJ
F-MW31	8,900	4,700	3,800	3,900	3,700	5,400	7,000	8,600	4,000	3,800	5,600	4,300	5,300	4,800	3,800	3,600	4,000	4,100	64	4,600	5,800	4,500	5,100	5,800	5,400	2,800		2900	2500		3,300		1,900 J
F-MW32	51						100						32				10				7.6					78							110
F-MW33	2,200 J	2,000	2,400	2,000	1,800	1,600	1,300	890	1,400	1,500	1,200	1,800	1,200	2,400	2,000	2,400 J	1,700	2,000	1,700	1,300	1,200	1,400	1,700	1,200	900	610		650	660		960		500 J
F-MW35	6.5 U						0.17 J						0.65 U				0.65 U				0.13 J					0.55 U							10
F-MW36	32 U	0.38 J	0.42 J	0.65 U	0.86	0.65 U	0.65 U	0.65 U	3.5 U	0.65 U	0.65 U	0.65 U		0.65 U	0.65 U	0.65 U																	
F-MW37	0.65 U						0.65 U						0.65 U				0.65 U				0.65 U					0.66 U							0.46 U
F-MW38	0.65 U	0.65 U	0.16 J	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	2.30 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.2 U	1.1 U	0.34 U	0.68 U		0.18 UJ	0.56 U		0.61 U		0.77 U
F-MW39	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.80 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.73 U	1.1 U	0.34 U	0.47 U		0.94 UJ	0.7 U		0.52 U		0.90 UJ
F-MW40	0.65 U			0.19 J			0.65 U			0.65 U			0.65 U				0.65 U				0.65 U					0.35 U							0.81 UJ
F-MW41	0.65 U	0.7 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.4 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.9 U	1.1 U	1.0 U	0.48 U		1 UJ	1.4 U		0.26 U		1.4 UJ
F-MW42	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.3 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.44 U	0.52 U	1.4 U	0.84 U		0.57 UJ	0.47 U		0.51 U		1.2 UJ
F-MW43	0.65 U			1.6 U			0.65 U			0.65 U			0.65 U				0.65 U				0.65 U					0.82 U							0.87 UJ
F-MW44	0.65 U	0.65 U	0.65 U	1.6 U	0.58 J	0.65 U	0.65 U	0.65 U	1 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.84 U	1.0 U	1.6 U	0.47 U		1 UJ	0.55 U		0.56 U		1.3 UJ
F-MW45	0.65 U						0.65 U			0.65 U			0.65 U				0.65 U				0.65 U					0.83 U							0.61 U
F-MW46	0.65 U			0.65 U			0.65 U			0.65 U			0.65 U				0.49 J				0.65 U					0.60 U							0.52 U
F-MW48	0.65 U						0.65 U						0.65 U				0.65 U				0.65 U					0.20 U							1.0 UJ
F-MW51	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.95 U	3.2 U	0.65 U	0.65 U		0.65 U				0.65 U				0.65 U					0.55 U							1.1 UJ
F-MW52	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.95 U	2.3 U	0.65 U	0.65 U		0.65 U				0.65 U				0.38 J					0.23 U							1.0 UJ
F-MW53	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.95 U	1.4 U	0.65 U	0.65 U		0.65 U				0.65 U				0.65 U					0.60 U							1.2 UJ
F-MW54	0.41 J						0.65 U																										
F-MW54S	250	120 J	110	140	140	160	93	60 J	22	18	7.2	17	24 J	4.9	42	51	12	6.9	19 J	19	10	4.4	10	4.6	3.3	3.6		2.6	1.4 U		2.4		1.8 J
F-MW55	0.65 U	0.65 U	3.2 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.3 U	0.65 U	0.65 U	0.65 U	0.65 U				0.65 U	0.65 U			0.65 U					0.40 U							0.73 U
F-MW55M													0.65 U	0.65 U	0.65 U	0.65 U	0.65 U		0.65 U	0.65 U	0.65 U	0.65 U	0.36 U	0.70 U	0.68 U	0.88 U		0.86 U			0.86 U		1.3 UJ
F-MW56	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	2.6 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.1 U	1.6 U	0.79 U	0.99 U		0.46 UJ	0.95 U		0.87 U		1.2 UJ
F-MW57	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.4 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.84 U	0.86 U	0.64 U	0.77 U		0.47 UJ	0.99 U		0.52 U		0.65 UJ
F-MW58	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.3 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.62 U	1.2 U	0.77 U	0.49 U		0.53 U	0.74 U		0.68 U		0.78 UJ
F-MW59												0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.2 U	0.47 U	0.74 U	0.74 U		0.77 U	0.51 U		1.0 U		0.30 U
F-MW60												0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.1 U	1.2 U	0.29 U	0.34 U		0.49 UJ	0.52 U		0.83 U		1.2 UJ
F-MW61												0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.47 U	1.2 U	0.60 U	0.35 U	1.4 U	0.56 U	1.1 U	0.96 U	0.53 U	0.6 U	0.94 UJ
F-MW62												0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.96 U	0.94 U	1.1 U	0.44 U	0.77 U	0.39 U	0.82 U	0.62 U	0.7 U	0.61 U	1.2 UJ
F-MW63																0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.42 U	1.6 U	0.90 U	1.30 U	0.70 U	0.62 U	0.48 U	1.1 U	0.53 U	0.49 U	0.81 UJ
F-MW64																0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.52 U	1.2 U	1.3 U	0.94 U	1.0 U	0.53 U	1.1 U	0.94 U	0.83 U	0.59 U	0.79 UJ
F-MW65																			0.65 U	0.65 U	0.65 U	0.65 U	0.42 U	0.65 U	0.75 U	0.82 U	0.58 U	0.4 U	0.97 U	0.83 U	0.43 U	0.12 U	0.96 UJ
F-MW66																																	
F-MW67																																	
F-MW68																																	
F-MW69																																	
Extraction Wells																																	
F-EW1	460	330	260	270	240	210	200	190	180	170	160	170	160	150		260	150	130	110	86	94	64	72	67	61	35		37	43		43		38
F-EW2	57 J	51 J	40	29	27	21 J	24 J	22 J	22	20	18	22 J	16	20	45	25	28 J	22	16	13	14	12	15	11	8.1	5.2		6.1	7.1		6.2		4.8
F-EW3	95	87	80	110	90	91	97	87	110	100	0.65 U	84	89	92	92	82	120	95	95	79	95	84	77	87	78	52		57	68		74		61
F-EW4	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1.2	0.65 U	2.7 U	0.65 U	87		0.65 U	0.65 U	0.23 J	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.20 U	0.75 U	0.52 U	0.91 U		0.46 U	0.42 U		0.33 U		0.40 U
F-EW5	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	8	0.65 U	2.2 U	0.65 U	0.65 U		0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.21 U	0.64 U	0.52 U	0.38 U		1.6 U	1.2 U		0.79 U		0.90 UJ
F-EW6	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.39 J	0.65 U	1.4 U	0.65 U	0.65 U		0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U		0.65 U	0.65 U	0.75 U	0.82 U	0.81 U	0.3 U		0.33 U	0.49 U		0.74 U		0.56 U
F-EW7												440	370	350	300	480	240	260	200	200	270	290	280	210	170	130		110	150		140		110 J
F-EW8												0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.42 J	0.65 U	0.75 U	0.65 U	0.88 U	1.1 U		0.66 U	0.84 U		0.79 U		1.1 UJ
F-EW9													0.65 U		0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U		0.65 U	0.43 U	0.31 U	0.96 U	0.55 U		0.38 U	0.84 U		0.77 U		1.2 UJ
F-EW10													0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.49 U	0.56 U	0.44 U	0.82 U		0.51 U	0.75 U		0.65 U		0.40 U

Notes:

TNT groundwater cleanup level is 2.9 ug/L.

TNT remains non-detect in all samples from wells F-MW61 through F-MW65. TNT results from more frequent monitoring of these 5 wells since June 1997 (monthly, and then quarterly) are not presented here.

Blank spaces indicate sample not collected on that date.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

Table C-2 - TNT Analytical Results Compilation for the Shallow Aquifer at Site F

TNT in µg/L																										
Well No.	Apr-03	Jul-03	Oct-03	Jan-04	Apr-04	Jul-04	Oct-04	Jan-05	Apr-05	Aug-05	Oct-05	Jan-06	Apr-06	Jul-06	Oct-06	Jan-07	Apr-07	Jun-07	Oct-07	Jan-08	Apr-08	Jul-08	Oct-08	Jan-09	Apr-09	Aug-09
Monitoring W																										
F-MW21																										
F-MW24																										
F-MW27								0.48 U								0.53 U									0.5 U	
F-MW31		2,000 J				2,200		2,200		3,200		1800 J		2500 J		2600 D				1,900	2,200 D				1,900 D	
F-MW32								0.49 U								0.51 U									0.5 U	
F-MW33		490				490		430		540		450 J		390 J		440 D				380	250 D				370 D	
F-MW35								42								36									57 D	
F-MW36																										
F-MW37								0.49 U								0.52 U									0.49 U	
F-MW38		0.56 U				0.49 U		0.48 U		0.48 U		0.50 U		0.49 U		0.56 U				0.52 U	0.54 U				0.49 U	
F-MW39		1.1 U				0.49 U		0.5 U		0.49 U		0.49 U		0.5 U		0.53 U				0.49 U	0.54 U				0.50 U	
F-MW40								0.5 U								0.50 U				0.5 U	0.54 U				0.49 U	
F-MW41		0.57 U				0.54 U		0.5 U		0.49 U		0.48 U		0.49 UJ		0.52 U		0.50 U					0.25 J		0.49 U	
F-MW42		0.38 UJ				0.52 U		0.51 U		0.48 U		0.48 U		0.49 U		0.52 U		0.49 U		0.5 U	0.54 U		0.49 U		0.51 U	
F-MW43								0.48 U								0.52 U									0.49 U	
F-MW44		0.88 U				0.49 U		0.48 U		0.49 U		0.51 U		0.49 U		0.51 U				0.5 U	0.54 U				0.49 U	
F-MW45								0.51 U								0.53 U									0.49 U	
F-MW46								0.49 U								0.53 U									0.49 U	
F-MW48								0.5 U								0.52 U									0.49 U	
F-MW51								0.54 U								0.51 U									0.49 U	
F-MW52								0.49 U								0.53 U									0.49 U	
F-MW53								0.53 U								0.52 U									0.49 U	
F-MW54																										
F-MW54S		0.68				0.48 U		0.5		0.49 U		0.58		0.49 U		0.53 U				0.49 U	0.8				0.62	
F-MW55								0.48 U								0.52 U				0.5 U	0.53 U				0.48 U	
F-MW55M		0.96 UJ				0.49 U		0.48 U		0.48 U		0.52 U		0.49 U		0.53 U									0.49 U	
F-MW56		1.4 UJ				0.5 U		0.49 U		0.48 U		0.53 U		0.49 U		0.54 U									0.49 U	
F-MW57		0.57 U				0.61 U		0.48 U		0.49 U		0.50 U		0.48 U		0.53 U									0.48 U	
F-MW58		0.79 U				0.53 U		0.49 U		0.48 U		0.49 U		0.49 U		0.54 U									0.51 U	
F-MW59		0.73 U				0.49 U		0.48 U		0.48 U		0.48 U		0.48 U		0.54 U									0.5 U	
F-MW60		1.3 UJ				0.49 U		0.49 U		0.49 U		0.49 U		0.48 U		0.52 U									0.49 U	
F-MW61	0.56 UJ	0.38 UJ	0.42 U		0.49 U	0.49 U	0.49 U	0.48 U	0.5 U	0.50 U	0.49 U	0.52 U	0.49 U	0.48 U	0.48 U	0.52 U				0.49 U	0.53 U				0.48 U	
F-MW62	0.83 UJ	0.43 U	0.74 U		0.48 U	0.52 U	0.52 U	0.48 U	0.5 U	0.52 U	0.48 U	0.51 U	0.51 U	0.48 U	0.49 U	0.53 U				0.51 U	0.53 U				0.49 U	
F-MW63	0.64 UJ	0.30 U	0.21 U		0.49 U	0.49 U	0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.49 U	2.6	0.49 U	0.49 U	0.50 U	0.50 U	0.49 U	0.48 U	0.48 U	0.54 U	0.49 U	0.49 U	0.49 U	0.48 U	0.15 U
F-MW64	0.64 UJ	0.64 U	0.21 U		0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.48 U	0.48 U	0.49 U	0.51 U	0.48 U	0.50 U	0.49 U	0.49 U	0.49 U	0.48 U	0.49 U	0.53 U	0.50 U	0.50 U	0.50 U	0.49 U	0.15 U
F-MW65	0.53 UJ	0.92 U	0.62 U		0.49 U	0.49 U	0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.48 U	0.5 U	0.48 UJ	0.50 U	0.50 U				0.49 U	0.54 U	0.50 U			0.48 U	
F-MW66			0.49 U							0.49 U	0.50 U	0.48 U	0.5 U	0.49 U	0.50 U	0.50 U	0.50 U	0.50 U	U	0.49 U	0.53 U	0.50 U	0.50 U	0.49 U	0.48 U	0.15 U
F-MW67			0.49 U					0.48 U	0.51 U	0.48 U	0.49 U	0.50 U	0.5 U	0.50 U	0.48 U	0.53 U	0.50 U	0.49 U	0.49 U	0.49 U	0.54 U	0.48 U	0.49 U	0.49 U	0.50 U	0.15 U
F-MW68			0.49 U					0.5 U	0.5 U	0.48 U	0.50 U	0.49 U	0.5 U	0.48 UJ	0.48 U	0.51 U	0.50 U	0.49 U	0.48 U	0.49 U	0.53 U	0.48 U	0.50 U	0.49 U	0.50 U	0.15 U
F-MW69			0.49 U							0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.51 U	0.50 U	0.49 U	0.49 U	0.48 U	0.53 U	0.49 U	0.49 U	0.50 U	0.49 U	0.15 U
Extraction We																										
F-EW1		29				32		40		34		30		35		32				27	21				28	
F-EW2		4.3				3.5		3.3		4.0		3.4		3.0		2.6				1.8	1.9				1.30	
F-EW3		61				58		58		68		59 J		54 EJ		62 D				51	45				44	
F-EW4		0.7 U				0.49 U		0.49 U		0.48 U		0.48 U		0.48 U		0.51 U				0.49 U	0.54 U				0.49 U	
F-EW5		0.96 U				0.49 U		0.49 U		0.48 U		0.51 U		0.48 U		0.51 U				0.49 U	0.53 U				0.49 U	
F-EW6		1.2 U				0.49 U		0.49 U		0.49 U		0.49 U		0.48 U		0.45 U				0.49 U	0.53 U				0.49 U	
F-EW7		150				94		74		78		62 J		69 EJ		72 D				46	52				62 D	
F-EW8		0.68 U				0.5 U		0.49 U		0.48 U		0.48 U		0.48 U		0.50 U				0.5 U	0.53 U				0.49 U	
F-EW9		1.7 U				0.49 U		0.48 U		0.50 U		0.48 U		0.48 U		0.51 U				0.49 U	0.54 U				0.48 U	
F-EW10		0.43 U				0.49 U		0.49 U		0.48 U		0.48 U		0.48 U		0.50 U				0.49 U	0.53 U				0.49 U	

Notes:

TNT groundwater cleanup level is 2.9 ug/L.

TNT remains non-detect in all samples from wells F-MW61 through F-MW65. TNT results from more frequent monitoring of these 5 wells since June 1997 (monthly, and then quarterly) are not presented here.

Blank spaces indicate sample not collected on that date.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

Table C-3 - DNT Analytical Results Compilation for the Shallow Aquifer at Site F

Total DNT in µg/L																																		
Well No.	Dec-94	Feb-95	Apr-95	Jun-95	Aug-95	Oct-95	Dec-95	Feb-96	Apr-96	Jun-96	Aug-96	Oct-96	Jan-97	Apr-97	Jul-97	Oct-97	Jan-98	Apr-98	Jul-98	Oct-98	Jan-99	Apr-99	Jul-99	Jan-00	Jul-00	Jan-01	Jul-01	Jan-02	Apr-02	Jul-02	Oct-02	Jan-03	Apr-03	Jul-03
Monitoring Wells																																		
F-MW21	166 J						189																											
F-MW24	Dry						5.2																											
F-MW27	85 J	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	4.8 U	0.25 U	0.25 U		0.25 U				0.25 U				0.25 U					0.88 U						1.6 UJ		
F-MW31	450 J	300	240	230	270	320	354	380	274	240	310	250	410	290	194	240 J	264	230	2.4 J	290	358	236	278	366	296	222	207	150		190		120 J		120 UJ
F-MW32	2.19 J						4.6						0.43				0.25 J				0.24 J					6.4						2.3 R		
F-MW33	240 J	180	180	150	140	110	97	59	103	100	64	140	74	190	183	196 J	138	150	140	105	94	121	157	119	67.9	61	12 U	44		67		36 J		38
F-MW35	2.5 U						0.25 U						0.25 U				0.25 U				0.25 U					0.55 U						0.79 UJ		
F-MW36	12 U	0.25 U	0.25 U	0.1 U	0.14 J	0.25 U	0.25 U	0.25 U	6.5 U	0.25 U	0.25 U	1.07		0.25 U	0.25 U	0.25 U																		
F-MW37	0.3 U						0.25 U						0.25 U				0.25 U				0.25 U					0.66 U						0.46 U		
F-MW38	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	4.3 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.2 U	1.1 U	0.34 U	0.68 U	0.18 UJ	0.56 U		0.61 U		0.77 UJ		0.6 UJ
F-MW39	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	3.3 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.73 U	1.1 U	0.34 U	0.47 U	0.94 U	0.7 U		0.94 U		0.90 UJ		1.1 UJ
F-MW40	1.1 U			0.25 U			0.25 U			0.25 U			0.25 U				0.25 U				0.25 U					0.35 U						0.81 UJ		
F-MW41	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.6 U	0.25 U	0.25 U		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.9 U	1.1 U	1.0 U	0.48 U	1 UJ	1.4 U		0.26 U		1.4 UJ		0.6 UJ
F-MW42	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.4 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.44 U	0.5 U	1.4 U	0.84 U	0.57 U	0.47 U		0.51 U		1.2 UJ		0.4 UJ
F-MW43	0.25 U			0.25 U			0.25 U			0.25 U			0.25 U				0.25 U				0.25 U					0.82 U						0.87 UJ		
F-MW44	0.3 U	0.25 U	0.25 U	0.25 U	0.11 J	0.25 U	0.25 U	0.25 U	1.9 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.84 U	1.0 U	1.6 U	0.47 U	1 UJ	0.55 U		0.56 U		1.3 UJ		0.9 UJ
F-MW45	0.25 U						0.25 U			0.25 U			0.25 U				0.25 U				0.25 U					0.83 U						0.61 U		
F-MW46	0.25 U			0.25 U			0.25 U			0.25 U			0.25 U				0.25 U				0.25 U					0.60 U						0.52 UJ		
F-MW48	0.19 J						0.25 U						0.25 U				0.25 U				0.25 U					0.20 U						1.0 UJ		
F-MW51	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	6 U	0.25 U	0.25 U		0.25 U				0.25 U				0.25 U					0.55 U						1.1 UJ		
F-MW52	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	4.3 U	0.25 U	0.25 U		0.25 U				0.25 U				0.25 U					0.23 U						1.0 UJ		
F-MW53	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.7 U	0.25 U	0.25 U		0.25 U				0.25 U				0.25 U					0.60 U						1.2 UJ		
F-MW54	0.25 U						0.25 U			0.25 U																								
F-MW54S	9 JP	0.88	0.28	0.65	0.78	0.8	0.44	0.42 J	3.7 U	0.28 J	0.25 U	0.25 U	0.49	0.25 U	1.05 J	1.3 J	0.3 J	0.2 J	0.30 J	0.26 J	0.28 J	0.25 U	0.56 U	0.52 U	0.92 U	0.47 U	0.39 U	1.4 U		0.38 U		0.38 UJ		0.16 UJ
F-MW55	0.25 U	0.25 U	0.5 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.5 U	0.25 U	0.25 U		0.25 U				0.25 U	0.25 U			0.25 U					0.40 U						0.73 UJ		
F-MW55M												0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U		0.25 U	0.26	0.25 U	0.25 U	0.36 U	0.70 U	0.68 U	0.88 U	0.86 U			0.86 U		1.3 UJ		0.96 UJ
F-MW56	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	4.7 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.1 U	1.6 U	0.79 U	0.99 U	0.46 UJ	0.95 U		0.87 U		1.2 UJ		1.4 UJ
F-MW57	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.7 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.84 U	0.86 U	0.64 U	0.77 U	0.47 UJ	0.99 U		0.52 U		0.65 UJ		0.57 UJ
F-MW58	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.3 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.62 U	1.2 U	0.77 U	0.49 U	0.53 U	0.74 U		0.68 U		0.78 UJ		0.49 UJ
F-MW59												0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.2 U	0.47 U	0.74 U	0.74 U	0.77 U	0.51 U		1 U		0.30 U		0.73 UJ
F-MW60												0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1.1 U	1.2 U	0.29 U	0.34 U	0.49 UJ	0.52 U		0.83 U		1.2 UJ		1.3 UJ
F-MW61												0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.47 U	1.2 U	0.60 U	0.35 U	0.56 U	1.1 U	0.96 U	0.53 U	0.6 U	0.94 UJ	0.56 UJ	0.38 UJ
F-MW62												0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.96 U	0.94 U	1.1 U	0.44 U	0.39 U	0.82 U	0.62 U	0.7 U	0.61 U	1.2 UJ	0.83 UJ	0.43 UJ
F-MW63																0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.42 U	1.6 U	0.90 U	1.30 U	0.62 UJ	0.48 U	1.1 U	0.53 U	0.49 U	0.81 UJ	0.64 UJ	0.30 UJ
F-MW64																0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U	1.2 U	1.3 U	0.94 U	0.53 UJ	1.1 U	0.94 U	0.83 U	0.59 U	0.79 U	0.64 UJ	0.64 UJ
F-MW65																			0.25 U	0.25 U	0.25 U	0.25 U	0.42 U	0.65 U	0.75 U	0.82 U	0.4 UJ	0.97 U	0.83 U	0.43 U	0.12 U	0.96 UJ	0.53 UJ	0.92 UJ
F-MW66																																		
F-MW67																																		
F-MW68																																		
F-MW69																																		
Extraction Wells																																		
F-EW1	5.2	3.4	2.3	2.2	2.1	2.0	1.6	3.0	3.2 U	2.3	2.2	1.9	1.4	2.2		3.8	2.0	1.7	2.0	0.87	0.92	1.1	1.3	1.5	1.0	0.79	0.69	0.74 U		0.23 U		0.99 UJ		0.2 UJ
F-EW2	25 U	0.64	0.64	0.39	0.33	0.34	0.30	0.39	4.3 U	0.38	0.34	0.53 U	0.25	0.55	0.74	0.8 J	0.4	0.4 J	0.2 J	0.12 J	0.37 J	0.24	0.83 U	1.1 U	0.87 U	1.3 U	1.3 U	0.66 U		0.58 U		0.43 U		0.27 UJ
F-EW3	12 U	3.3	3.4	4.2	3.8	4.6	4.3	3.8	7.5 J	4.7	0.5 U	3.4	4.4	4.7	4.9	4.3 J	6.3	4.1	4.4	2.4	3.0	3.0	1.5	4.5	2.9	2.85	2.2	2.3		2.4		2.1 J		2.2
F-EW4	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.14 J	0.25 U	5.0 U	0.25 U	3.7		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.20 U	0.75 U	0.52 U	0.91 U	0.46 U	0.42 U		0.33 U		0.4 U		0.7 UJ
F-EW5	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.59	0.25 U	4.0 U	0.25 U	0.5 U		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.21 U	0.64 U	0.52 U	0.38 U	1.6 U	1.2 U		0.79 U		0.9 UJ		0.96 UJ
F-EW6	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2.7 U	0.25 U	0.5 U		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U		0.25 U	0.25 U	0.75 U	0.82 U	0.81 U	0.3 U	0.33 U	0.49 U		0.74 U		0.56 U		1.2 UJ
F-EW7												21.2	17.1	16.1	13.8	22.8	12.1	11.1	9.7	11.2	14.6	18 J	14	9.7	6.6	6.78	5.2	4.8		4.3		3.8 R		4.2
F-EW8												0.5 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.75 U	0.65 U	0.88 U	1.1 U	0.66 U	0.84 U		0.79 U		1.1 UJ		0.68 UJ
F-EW9													0.25 U		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U		0.25 U	0.43 U	0.31 U	0.96 U	0.55 U	0.38 U	0.84 U		0.77 U		1.2 UJ		1.7 UJ
F-EW10													0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.49 U	0.56 U	0.44 U	0.82 U	0.51 U	0.75 U		0.65 U		0.4 U		0.43 UJ

Notes:

DNT groundwater cleanup level is 0.13 ug/L.

Blank spaces indicate sample not collected on that date.

DNT remains non-detect in all samples from wells F-MW61 through F-MW65. DNT results from more frequent monitoring of these 5 wells since June 1997 (monthly, and then quarterly) are not presented here.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

J – Detected below routine reporting limit. This value should be considered an estimate.

Table C-3 - DNT Analytical Results Compilation for the Shallow Aquifer at Site F

Total DNT in µg																								
Well No.	Oct-03	Jan-04	Apr-04	Jul-04	Oct-04	Jan-05	Apr-05	Aug-05	Oct-05	Jan-06	Apr-06	Jul-06	Oct-06	Jan-07	Apr-07	Jun-07	Oct-07	Jan-08	Apr-08	Jul-08	Oct-08	Jan-09	Apr-09	Aug-09
Monitoring Wells																								
F-MW21																								
F-MW24																								
F-MW27						0.48 U								0.53 U									0.5 U	
F-MW31				123.8 J		130		185		58 J		110 J		110 D				96	91				97 D	
F-MW32						0.49 U								0.51 U									0.5 U	
F-MW33				41.5 J		37		40		36		28		30				34.8	23				30.6 P	
F-MW35						0.49 U								0.51 U									0.5 PU	
F-MW36																								
F-MW37						0.49 U								0.52 U									0.49 U	
F-MW38				0.49 U		0.48 U		0.48 U		0.50 U		0.49 U		0.56 U				0.52 U	0.54 U				0.49 U	
F-MW39				0.49 U		0.49 U		0.49 U		0.49 U		0.5 U		0.53 U				0.49 U	0.54 U				0.5 U	
F-MW40						0.5 U								0.5 U									0.49 U	
F-MW41				0.54 U		0.5 U		0.49 U		0.48 U		0.49 UJ		0.52 U		0.5 U		0.5 U	0.54 U		0.49 U		0.49 U	
F-MW42				0.52 U		0.51 U		0.48 U		0.48 U		0.49 U		0.52 U		0.49 U		0.5 U	0.54 U		0.49 U		0.51 U	
F-MW43						0.48 U								0.52 U									0.49 U	
F-MW44				0.49 U		0.48 U		0.49 U		0.51 U		0.49 U		0.51 U				0.5 U	0.54 U				0.49 U	
F-MW45						0.51 U								0.53 U									0.49 U	
F-MW46						0.49 U								0.53 U									0.49 U	
F-MW48						0.5 U								0.52 U									0.49 U	
F-MW51						0.54 U								0.51 U									0.49 U	
F-MW52						0.49 U								0.53 U									0.49 U	
F-MW53						0.53 U								0.52 U									0.49 U	
F-MW54																								
F-MW54S				0.48 U		0.48 U		0.49 U		0.49 U		0.49 U		0.53 U				0.49 U	0.53 U				0.49 U	
F-MW55						0.48 U								0.52 U									0.48 U	
F-MW55M				0.49 U		0.48 U		0.48 U		0.52 U		0.49 U		0.53 U				0.5 U	0.53 U				0.49 U	
F-MW56				0.5 U		0.49 U		0.48 U		0.53 U		0.49 U		0.54 U									0.49 U	
F-MW57				0.61 U		0.48 U		0.49 U		0.50 U		0.48 U		0.53 U									0.48 U	
F-MW58				0.53 U		0.49 U		0.48 U		0.49 U		0.49 U		0.54 U									0.51 U	
F-MW59				0.49 U		0.48 U		0.48 U		0.48 U		0.48 U		0.54 U									0.5 U	
F-MW60				0.49 U		0.49 U		0.49 U		0.49 U		0.48 U		0.52 U									0.49 U	
F-MW61	0.42 UJ		0.49 U	0.49 U	0.49 U	0.48 U	0.5 U	0.50 U	0.49 U	0.52 U	0.49 U	0.48 U	0.48 U	0.52 U				0.49 U	0.53 U				0.48 U	
F-MW62	0.35 UJ		0.48 U	0.52 U	0.52 U	0.48 U	0.5 U	0.52 U	0.48 U	0.51 U	0.51 U	0.48 U	0.49 U	0.53 U				0.51 U	0.53 U				0.49 U	
F-MW63	0.21 UJ		0.49 U	0.49 U	0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.49 U	1.5	0.49 UJ	0.49 U	0.5 U	0.5 U	0.49 U	0.48 U	0.48 U	0.54 U	0.49 U	0.49 U	0.49 U	0.48 U	0.15 U
F-MW64	0.21 UJ		0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.48 U	0.48 U	0.49 U	0.51 U	0.48 U	0.5 U	0.49 U	0.49 U	0.49 U	0.48 U	0.49 U	0.53 U	0.5 U	0.5 U	0.5 U	0.49 U	0.15 U
F-MW65	0.62 UJ		0.49 U	0.49 U	0.49 U	0.49 U	0.49 U	0.48 U	0.48 U	0.48 U	0.5 U	0.48 UJ	0.5 U	0.5 U				0.49 U	0.54 U	0.5 U			0.48 U	
F-MW66	0.49 U							0.49 U	0.50 U	0.48 U	0.5 U	0.49 UJ	0.5 U	0.5 U	0.5 U	0.5 U	U	0.49 U	0.53 U	0.5 U	0.5 U	0.49 U	0.48 U	0.15 U
F-MW67	0.49 U					0.48 U	0.51 U	0.48 U	0.49 U	0.50 U	0.5 U	0.5 U	0.48 U	0.53 U	0.5 U	0.49 U	0.49 U	0.49 U	0.54 U	0.48 U	0.49 U	0.49 U	0.5 U	0.15 U
F-MW68	0.49 U					0.5 U	0.5 U	0.48 U	0.50 U	0.49 U	0.5 U	0.48 UJ	0.48 U	0.51 U	0.5 U	0.49 U	0.48 U	0.49 U	0.53 U	0.48 U	0.5 U	0.49 U	0.5 U	0.15 U
F-MW69	0.49 U							0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.51 U	0.5 U	0.49 U	0.49 U	0.48 U	0.53 U	0.49 U	0.49 U	0.5 U	0.49 U	0.15 U
Extraction Wells																								
F-EW1				0.7		0.68		0.64	0.58	0.58		36 PJ		0.4 J				0.56	0.4 J				0.59	
F-EW2				0.49 U		0.49 U		0.48 U	0.50 U	0.50 U		0.48 U		0.51 U				0.49 U	0.54 U				0.5 U	
F-EW3				2.97		2.4		2.7	2.6 U	2.6		2.2		2.7				2.8	2				2.2 PJ	
F-EW4				0.49 U		0.49 U		0.48 U	0.48 U	0.48 U		0.48 U		0.51 U				0.49 U	0.54 U				0.49 U	
F-EW5				0.49 U		0.49 U		0.48 U	0.51 U	0.51 U		0.48 U		0.51 U				0.49 U	0.53 U				0.49 U	
F-EW6				0.49 U		0.49 U		0.49 U	0.49 U	0.49 U		0.48 U		0.45 U				0.49 U	0.54 U				0.49 U	
F-EW7				3.5		2.9		2.8	2.6 U	2.6		3.5		2.8				2.1	2.2				3.1 PJ	
F-EW8				0.5 U		0.49 U		0.48 U	0.48 U	0.48 U		0.48 U		0.5 U				0.5 U	0.53 U				0.49 U	
F-EW9				0.49 U		0.48 U		0.50 U	0.48 U	0.48 U		0.48 U		0.51 U				0.49 U	0.54 U				0.48 U	
F-EW10				0.5 U		0.48 U		0.48 U	0.48 U	0.48 U		0.48 U		0.5 U				0.49 U	0.53 U				0.49 U	

Notes:

DNT groundwater cleanup level is 0.13 ug/L.

Blank spaces indicate sample not collected on that date.

DNT remains non-detect in all samples from wells F-MW61 through F-MW65. DNT results from more frequent monitoring of these 5 wells since June 1997 (monthly, and then quarterly) are not presented here.

U – Not detected at associated detection limit.

D – The reported value is from a diluted reanalysis.

P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported

Table C-4 - Otto Fuel Analytical Results Compilation for the Shallow Aquifer at Site F

	Otto Fuel Concentration in µg/L																
Well ID	Aug-96	Jan-97	Oct-97	Jan-98	Apr-98	Jul-98	Oct-98	Apr-99	Jan-00	Jan-01	Jan-02	Jan-03	Jan-05	Jan-06	Jan-07	Jan-08	Apr-08
Site F Wells																	
F-EW4		0.10 U	0.10	0.12	0.10 U	0.10 U	0.10 U	0.10 U									
Site E/11 Wells																	
E-MW21L	0.25 U	0.10 U															
E-MW21U	0.36	0.47	0.57	0.69	0.51	0.63	0.65	1.0	0.10 U	0.77	0.87	0.67	1.4 UJ	0.10 U	0.42 U	0.89	0.32
E-MW22L	0.25 U	0.10 U															
E-MW22U	0.25 U	0.10 U															
E-MW23L	0.25 U	0.10 U															
E-MW23U	0.25 U	0.21		0.34	0.25	0.33	0.62	0.57	0.10 U	0.50	0.51	0.4	1.1 UJ	0.10 U	0.49 U	0.74	0.31

Notes:
The Otto Fuel groundwater cleanup level is 0.2 ug/L.
The "L" and "U" designations associated with well ID refer to lower (deeper) and upper (shallower) wells, respectively, within a well cluster.
Blank spaces indicate sample not collected on that date.
U – Not detected at associated detection limit.
D – The reported value is from a diluted reanalysis.
P – When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported
J – Detected below routine reporting limit. This value should be considered an estimate.

Table C-5. Summary of Mann-Kendall Trend Analyses					
Last ten sampling events					
Well	RDX	TNT	DNT	Current Sampling Frequency	Period Evaluated
Northern Plume Edge Wells:					
F-MW61	ND	ND	ND	Annual	8/05-4/09
F-MW62	ND	ND	ND	Annual	8/05-4/09
F-MW63	D- 2	ND	ND	Quarterly	1/07-4/09
F-MW64	NT – S	ND	ND	Quarterly	4/04-4/09
F-MW65	ND	ND	ND	Annual	10/05-4/09
F-MW66	ND	ND	ND	Quarterly	1/07-4/09
F-MW67	I - 2	ND	ND	Quarterly	1/07-4/09
F-MW68	D- 2	ND	ND	Quarterly	1/07-4/09
F-MW69	I - 1	ND	ND	Quarterly	1/07-4/09
Extraction Wells:					
F- EW1	D- 2	D- 2	D- 2	Annual	1/00-4/09
F- EW2	D- 2	D- 2	ND	Annual	1/00-4/09
F- EW3	D- 2	D- 2	D- 1	Annual	7/03-4-09
F- EW4	D- 2	ND	ND	Annual	7/03-4-09
F- EW5	D- 2	ND	ND	Annual	1/00-4/09
F- EW6	D- 2	ND	ND	Annual	7/03-4-09
F- EW7	D- 2	D- 2	D- 2	Annual	1/00-4/09
F- EW8	D- 2	ND	ND	Annual	1/00-4/09
F- EW9	D- 2	ND	ND	Annual	7/03-4-09
F- EW10	D- 2	ND	ND	Annual	7/03-4-09
Primary Wells:					
F-MW31	D- 2	D- 2	ND	Annual	7/03-4/09
F-MW33	D- 2	D- 2	D- 2	Annual	1/00-4/09
F-MW38	D- 2	ND	ND	Annual	7/03-4/09
F-MW39	D- 1	ND	ND	Annual	7/03-4/09
F-MW40	D- 2	ND	ND	5 Year	12/95-4/09
F-MW41	D- 2	ND	ND	Semiannual	1/05-4/09
F-MW42	D- 2	ND	ND	Semiannual	1/05-4/09
F-MW43	D- 2	ND	ND	5 Year	12/95-4/09
F-MW44	I - 2	ND	ND	Annual	7/03-4/09
F-MW46	D- 2	NT - S	ND	5 Year	12/95-4/09
F-MW54S	NT - S	D- 1	ND	Annual	7/03-4/09
F-MW55M	D- 2	ND	ND	Annual	7/03-4/09
F-MW56	D- 2	ND	ND	Biennial	7/02-4/09
F-MW57	D- 2	ND	ND	Biennial	7/02-4/09
F-MW58	D- 2	ND	ND	Biennial	7/02-4/09
F-MW59	D- 2	ND	ND	Biennial	7/02-4/09
F-MW60	ND	ND	ND	Biennial	1/99-4/09

Table C-5. Summary of Mann-Kendall Trend Analyses (continued)					
Last ten sampling events					
Well	**RDX**	**TNT**	**DNT**	**Current Sampling Frequency**	**Period Evaluated**
Secondary Wells:					
F-MW27	**D -2**	**ND**	**ND**	Biennial	4/96-1/07
F-MW32	**D -2**	**D -2**	**D-1**	Biennial	12/95-4/09
F-MW35	**I -2**	**I -2**	**ND**	Biennial	12/94-4/09
F-MW37	**NT-S**	**ND**	**ND**	Biennial	12/94-4/09
F-MW45	**D -2**	**ND**	**ND**	5 Year	12/95-4/09
F-MW48	**I-2**	**ND**	**ND**	Biennial	12/94-4/09
F-MW51	**NT - NS**	**ND**	**ND**	5 Year	4/96-4-1/07
F-MW52	**D -2**	**NT-S**	**ND**	5 Year	6/96-4/09
F-MW53	**D -2**	**ND**	**ND**	Biennial	6/96-4/09
F-MW55	**I-2**	**ND**	**ND**	Biennial	8/96-4/09

Notes:

ND	= No detections in the last ten sampling events
NT-S	= No trend – Stable
NT - NS	= No trend – Not Stable
D - 1	= Trend at 80% Confidence Level is Decreasing
D - 2	= Trend at 80% and 90% Confidence Levels are Decreasing
I - 1	= Trend at 80% Confidence Level is Increasing
I - 2	= Trend at 80% and 90% Confidence Levels are Increasing

Table C-6. Site F ordnance removed by extraction wells.

	April 2008 Through March 2009							Total Since August 1996			
		Concentration			Mass Removed				Mass Removed		
Well	Volume Removed (Gallons)	RDX (µg/L)	TNT (µg/L)	DNT (µg/L)	RDX (lbs)	TNT (lbs)	DNT (lbs)	Volume Removed (Gallons)	RDX (lbs)	TNT (lbs)	DNT (lbs)
Lower Well Field											
F-EW1	24,558,900	31	28	0.59 U	6.34	5.73	0.12	223,645,350	140.52	94.25	4.12
F-EW2	16,567,400	40	1.3 U	0.5 U	5.52	0.18	0.07	142,333,010	139.85	8.28	0.66
F-EW3	15,846,400	31	44	2	4.09	5.81	0.26	197,013,990	135.24	104.00	4.62
F-EW7	8,912,300	10	62 D	2.7	0.74	4.60	0.20	120,869,050	24.51	137.11	6.29
F-EW8	8,762,600	58	0.49 U	0.49 U	4.24	0.04	0.04	197,195,462	255.95	0.96	0.81
Lower Well Field											
F-EW4	22,468,600	86 D	0.49 U	0.49 U	16.10	0.09	0.09	263,383,320	346.32	1.17	1.00
F-EW5	81,568,203	43	0.49 U	0.49 U	29.23	0.33	0.33	968,893,958	584.75	4.64	4.28
F-EW6	28,658,500	8.4	0.49 U	0.49 U	2.01	0.12	0.12	316,853,220	143.72	1.35	1.21
F-EW9	13,559,600	54	0.48 U	0.48 U	6.10	0.05	0.05	240,469,398	346.42	1.09	0.96
F-EW10	29,705,400	77	0.49 U	0.49 U	19.06	0.12	0.12	264,097,827	521.87	1.13	0.97

Notes:

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

TNT = Trinitrotoluene

DNT = Dinitrotoluene

µg/L – microgram per liter

U – Analyte not detected at specified reporting limit.

D = The reported value is from a diluted reanalysis

P = When a dual column GC technique is employed, this flag indicates that test results from the two columns differ by more than 25%. Generally, the higher value is reported.

RDX Concentration in Selected Wells, Site F, OU 2

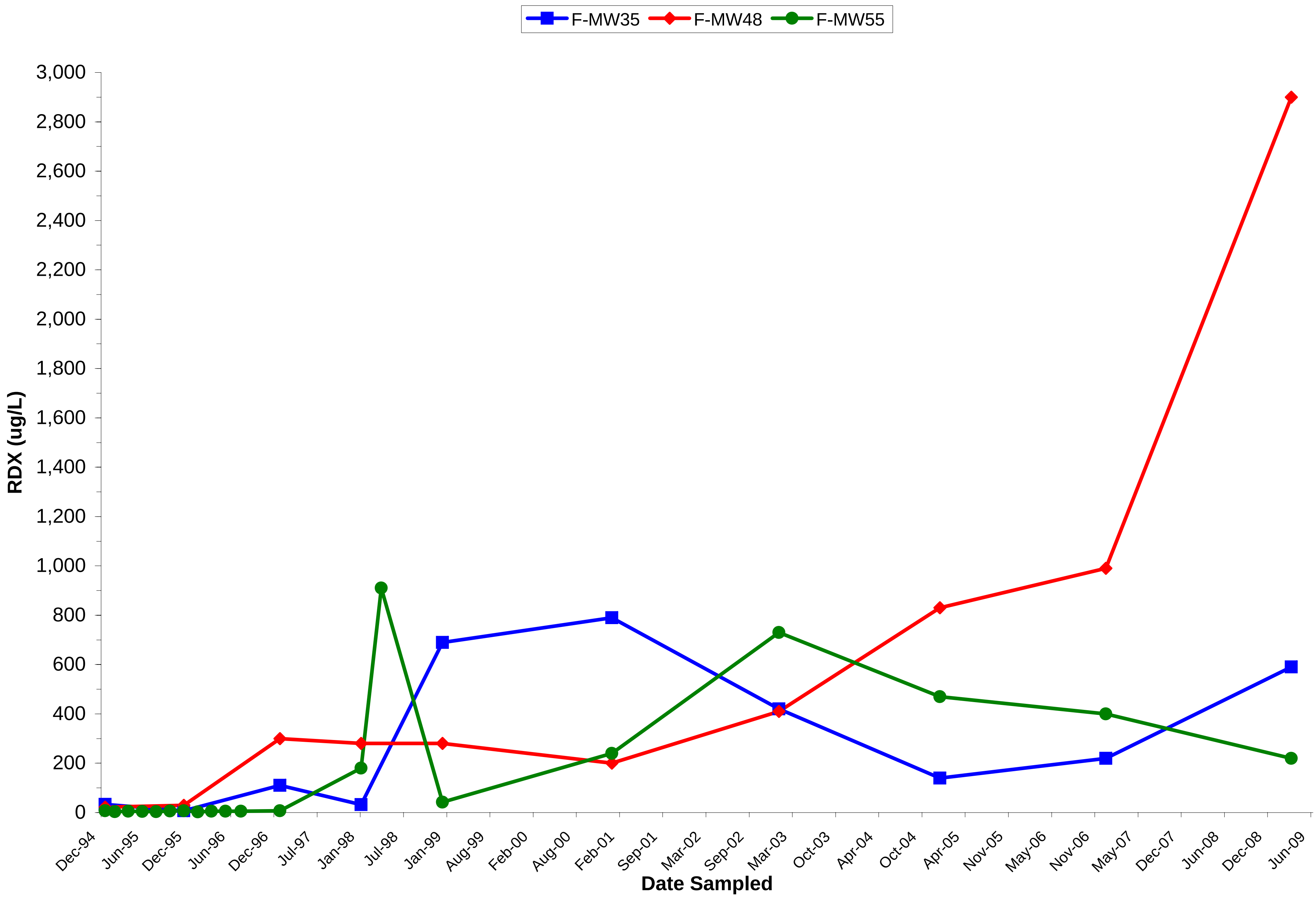


Figure C-1

APPENDIX D

OU 8 Historical Groundwater Results

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor

Monitoring Location	Date Sampled	Analyte (Cleanup Level)											
		1,1,2-Trichloroethane (TCA) (5.0 µg/L)		1,1-Dichloroethene (DCE) (0.5 µg/L)		1,2-Dibromoethane (EDB) (0.8 µg/L)		1,2-Dichloroethane (DCA) (5.0 µg/L)		Benzene (5.0 µg/L)		Toluene (1,000 µg/L)	
8MW47	3/16/1998	50	U	50	U	16	J	700	J	7800		7800	J
	6/23/1998	50	U	50	U	13	J	140		2900	J	16000	J
	9/28/1998	100	U	100	U	100	U	250		5900		11000	
	3/30/1999	50	U	50	U	50	U	640	U	11000	J	2500	J
	9/27/1999	50	U	50	U	50	U	50	U	3800	J	12000	J
	3/27/2000	100	U	100	U	100	U	100	U	2000		5600	J
	6/22/2000	100	U	100	U	100	U	100	U	2600	J	14000	J
	11/1/2000	100	U	100	U	400	U	100	U	3200		22000	
	1/17/2001	50	U	50	U	20	J	50	U	3800		20000	
	4/17/2001	20	U	30	U	20	U	30	U	4400	D	19000	D
	7/18/2001	20	U	24	U	15	U	23	U	4600	D	20000	D
	10/24/2001	10	UD	12	UD	37	JD	290	D	7500	D	21000	D
	5/30/2002	10	U	12	U	10	J	12	U	3600		18000	
	10/30/2002	10	U	12	U	24	J	12	U	7800		18000	
	4/9/2003	5	U	6	U	9.5	J	5.7	U	7300		12000	J
	10/9/2003	2.5	U	3	U	33		160		8900		11000	
	4/15/2004	10	U	12	U	7.3	U	25	JD	4000	D	19000	D
	10/12/2004	1.7	J	0.6	U	21		140		11000		11000	
	4/7/2005	0.69	U	0.61	U	19		120	U	6900		15000	
	10/11/05	18		0.5	U	19		190	J	12000		12000	
	05/01/06	110		0.5	U	25		4		3700	D	11000	D
	10/01/06	170	J	1	U	10	J	200	J	12000	D	8100	D
	04/01/07	0.5	U	0.5	U	0.5	U	0.5	U	2100		11000	
	10/01/07	NS		NS		NS		NS		NS		NS	
	04/01/08	NS		NS		NS		NS		NS		NS	
	10/08/08	NS		NS		NS		NS		NS		NS	
	4/08/09	NS		NS		NS		NS		NS		NS	
	10/08/09	25	U	25	U	13	JD	61	D	12,000	D	6,700	D

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor (continued)

Monitoring Location	Date Sampled	Analyte (Cleanup Level) 1,1,2-Trichloroethane (TCA) (5.0 µg/L)		1,1-Dichloroethene (DCE) (0.5 µg/L)		1,2-Dibromoethane (EDB) (0.8 µg/L)		1,2-Dichloroethane (DCA) (5.0 µg/L)		Benzene (5.0 µg/L)		Toluene (1,000 µg/L)	
8MW06	3/13/1998	20	U	20	U	20	U	1100	J	73		4.4	J
	6/19/1998	50	U	50	U	50	U	1500	J	250		18	J
	9/28/1998	50	U	50	U	50	U	1200		110		6.5	J
	3/29/1999	20	U	20	U	20	U	1000	J	53		3	J
	9/27/1999	50	U	50	U	50	U	1100		130		20	J
	3/24/2000	50	U	50	U	50	U	1600	J	170		11	J
	6/21/2000	1	U	1	U	1	U	1200	D	470	J	82	D
	10/31/2000	0.5	U	0.5	U	0.4	J	1200		370		61	
	1/18/2001	1	U	1	U	3	J	1200		950		340	
	4/17/2001	2	U	3	U	2	U	1200	D	860	D	200	D
	7/18/2001	2.5	U	3	U	1.9	U	1200	D	850	D	91	D
	10/23/2001	0.5	U	0.6	U	1.8	JD	1400	D	830	D	180	D
	5/30/2002	1	U	1.2	U	1.6	J	1700		1100		140	
	10/30/2002	1	U	1.2	U	2.5	J	1500		1400		180	J
	4/9/2003	0.5	U	0.6	U	0.37	U	1100		910		27	
	10/7/2003	0.5	U	0.6	U	0.37	U	940		580		57	
	4/14/2004	0.5	U	0.6	U	1.6	JD	1100	D	1900	D	69	D
	10/8/2004	0.5	U	0.6	U	1.5	J	1300	J	1700		110	
	4/7/2005	0.69	U	0.61	U	1.4	J	980		3000		57	
	10/11/05	0.5	U	0.5	U	1.2		2400		6300		76	J
	04/26/06	0.5	U	0.5	U	1.1		820	D	3600	D	110	
	10/01/06	1	U	1	U	1	U	660	D	1300	D	23	J
	04/01/07	0.5	U	0.5	U	0.5	U	740		4800		100	
	10/01/07	0.5	U	0.5	U	1.3		690	D	4700	D	170	D
	04/01/08	0.5	U	0.5	U	0.5	U	800		7200		160	
	10/09/08	0.5	U	0.5	U	0.5	U	640	D	4400	D	200	D
	4/08/09	0.5	U	0.5	U	0.5	U	940	D	11000	D	300	D
	10/06/09	25	U	25	U	25	U	810	D	13,000	J	590	D

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor (continued)

Monitoring Location	Date Sampled	Analyte (Cleanup Level) 1,1,2-Trichloroethane (TCA) (5.0 µg/L)		1,1-Dichloroethene (DCE) (0.5 µg/L)		1,2-Dibromoethane (EDB) (0.8 µg/L)		1,2-Dichloroethane (DCA) (5.0 µg/L)		Benzene (5.0 µg/L)		Toluene (1,000 µg/L)	
8MW33	3/13/1998	20		9.2		1	U	270		0.73	J	1	U
	8/5/1998	31		16		1	U	51		0.4	J	0.12	J
	9/25/1998	34	J	15		1	U	35		0.44	J	1	U
	3/24/1999	1	U	1	U	1	U	1	U	1	U	1	U
	6/24/1999	37	J	18	J	1	U	26	J	0.32	J	1	U
	9/22/1999	28	J	18		1	U	18	J	0.3	J	1	U
	12/15/1999	31	J	17		2	U	26	J	0.24	J	2	U
	3/23/2000	27	J	18		1	U	20	J	0.23	J	1	U
	6/20/2000	31	J	21		1	U	16		0.26	J	1	U
	10/31/2000	31		20		2	U	15		0.2	J	0.1	J
	1/18/2001	25		14		2	U	14		0.3	J	0.5	U
	4/17/2001	25		14		0.08	U	16		0.2	J	0.4	J
	7/20/2001	24		13		0.073	U	14		0.5	U	0.5	U
	10/24/2001	24		15		0.073	U	14		0.18	J	0.26	U
	5/30/2002	23		17		0.073	U	17		0.28	J	0.098	U
	10/30/2002	25		16		0.073	U	13		0.11	U	0.098	U
	4/10/2003	19		15		0.073	U	16		0.25	J	0.098	U
	10/8/2003	19		18		0.073	U	12		0.14	J	0.098	U
	4/14/2004	18		14		0.073	U	35		0.18	J	0.098	U
	10/8/2004	19		16		0.073	U	27	J	0.13	J	0.098	U
	4/5/2005	14		10		0.099	U	38		0.15	J	0.5	U
	10/10/05	13		10		0.5	U	30		0.5	U	0.5	U
	04/22/06	12		9.9		0.5	U	58		0.5	U	0.5	U
	10/01/06	12		10		1	U	54		1	U	1	U
	04/01/07	9.9		5.3		0.5	U	49		0.5	U	0.5	U
	10/01/07	9.4		6.4		0.5	U	72		0.5	U	0.5	U
	04/01/08	6.8		5.1		0.5	U	57		0.5	U	0.5	U
	10/07/08	7.8		6.3		0.5	U	64		0.5	U	0.5	U

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor (continued)

Monitoring Location	Date Sampled	Analyte (Cleanup Level)											
		1,1,2-Trichloroethane (TCA) (5.0 µg/L)		1,1-Dichloroethene (DCE) (0.5 µg/L)		1,2-Dibromoethane (EDB) (0.8 µg/L)		1,2-Dichloroethane (DCA) (5.0 µg/L)		Benzene (5.0 µg/L)		Toluene (1,000 µg/L)	
	4/06/09	5.4		3.5		0.5	U	51		0.5	U	0.5	U
	10/05/09	7.7		4.5		0.5	U	67		0.5	U	0.06	J
8MW03	3/9/1998	5.4	J	2.1	J	1	U	150		29		1	U
	9/24/1998	5		2		1	U	110		6.6		1	U
	3/24/1999	1	U	1	U	1	U	1	U	1	U	1	U
	6/23/1999	6	J	2.7	J	1	U	90	J	4.8		1	U
	9/21/1999	4.7		2.4		1	U	70	J	1.5		1	U
	3/21/2000	4.2		2.4		1	U	69	J	0.83	J	1	U
	10/30/2000	5.5		3.4		2	U	80		0.54		0.3	J
	1/16/2001	4.9		3		0.8	U	61		0.53		0.5	U
	4/16/2001	4.5		2.7		0.08	U	56		0.99		0.2	J
	7/18/2001	3.6		2.9		0.073	U	49		0.11	U	0.5	U
	10/22/2001	3.4		2.7		0.073	U	46		1.2		0.13	U
	5/30/2002	3.7		2.7		0.073	U	47		2.3		0.16	J
	10/29/2002	3		1.8		0.073	U	28		1.3		0.098	U
	4/7/2003	1.7		1.6		0.073	U	18		0.28	J	0.098	U
	10/6/2003	1.9		2		0.073	U	20		0.37	J	0.098	U
	4/12/2004	0.87		0.68		0.073	U	11		0.11	U	0.15	J
	10/6/2004	1.3		1.4		0.073	U	19		0.2	J	0.098	U
	4/6/2005	1		0.93		0.099	U	12		0.14	U	0.34	J
	10/13/05	1		1.1		0.5	U	14		0.5	U	0.5	U
	04/27/06	0.8		0.9		0.5	U	14		0.5	U	0.5	U
	10/01/06	0.72	J	0.98	J	1	U	16		1	U	1	U
	04/01/07	0.5	U	0.47	J	0.5	U	11		0.5	U	0.5	U
	10/01/07	0.63		0.83		0.5	U	16		0.22	J	0.5	U
	04/01/08	0.52		0.76		0.5	U	11		0.23	J	0.5	U
	10/06/08	0.61		0.84		0.5	U	13		0.23	J	0.5	U
	4/06/09	0.68		0.82		0.5	U	10		0.28	J	0.5	U

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor (continued)

Monitoring Location	Date Sampled	Analyte (Cleanup Level)											
		1,1,2-Trichloroethane (TCA) (5.0 µg/L)		1,1-Dichloroethene (DCE) (0.5 µg/L)		1,2-Dibromoethane (EDB) (0.8 µg/L)		1,2-Dichloroethane (DCA) (5.0 µg/L)		Benzene (5.0 µg/L)		Toluene (1,000 µg/L)	
	10/05/09	0.6		0.77		0.5	U	11		0.24 J		0.5	U
8MW13	3/11/1998	3.3		1.1		1	U	70		2.6		1	U
	6/17/1998	2.1		0.55	J	1	U	37		2.3		0.38	J
	6/17/1998	2.1						32	J	2.3			
	9/23/1998	1.5		0.45	J	1	U	24		2.4		1	U
	12/14/1998	1.5		0.39	J	1	U	21		2.4		1	U
	3/25/1999	0.95	J	1	U	1	U	7.3		0.3	J	1	U
	6/24/1999	0.73	J	1	U	1	U	4.3		1	U	1	U
	9/20/1999	0.86	J	1	U	1	U	3.4		0.29	J	1	U
	12/13/1999	0.72	J	1	U	1	U	3.5		0.43	J	1	U
	3/23/2000	0.59	J	1	U	1	U	2.7		0.3	J	1	U
	6/19/2000	0.53	J	1	U	1	U	2.2		0.13	J	1	U
	11/2/2000	0.52		0.5	U	2	U	2.9		0.5	U	0.5	U
	1/15/2001	0.53		0.5	U	0.8	U	3.2		0.5	U	0.5	U
	4/19/2001	0.1	U	0.2	U	0.08	U	2.9		0.2	U	0.1	U
	7/19/2001	0.44	J	0.12	U	0.073	U	2.9		0.11	U	0.5	U
	10/25/2001	0.41	J	0.12	U	0.073	U	2		0.11	U	0.18	U
	5/30/2002	0.28	J	0.12	U	0.073	U	1.4		0.11	U	0.098	U
	10/29/2002	0.04	J	0.12	U	0.073	U	1.6		0.11	U	0.098	U
	4/8/2003	0.25	J	0.12	U	0.073	U	0.85		0.11	U	0.098	U
	10/6/2003	0.23	J	0.12	U	0.073	U	0.76		0.11	U	0.098	U
	4/13/2004	0.21	J	0.12	U	0.073	U	0.7		0.11	U	0.098	U
	10/7/2004	0.23	J	0.12	U	0.073	U	0.82	J	0.11	U	0.098	U
	4/4/2005	0.18	J	0.13	U	0.099	U	0.84		0.14	U	0.5	U
	10/06/05	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
	5/2/2006	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
	10/1/06	1	U	1	U	1	U	1	U	1	U	1	U
	4/1/07	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
	10/1/2007	0.5	U	0.5	U	0.5	U	0.38	J	0.5	U	0.5	U

Table D-1. Historical Sample Results, OU 8 MNA, Naval Base Kitsap Bangor (continued)

Monitoring Location	Date Sampled	Analyte (Cleanup Level)					
		1,1,2-Trichloroethane (TCA) (5.0 µg/L)	1,1-Dichloroethene (DCE) (0.5 µg/L)	1,2-Dibromoethane (EDB) (0.8 µg/L)	1,2-Dichloroethane (DCA) (5.0 µg/L)	Benzene (5.0 µg/L)	Toluene (1,000 µg/L)
Monitoring Location	Date Sampled	Analyte (Cleanup Level)					
		1,1,2-Trichloroethane (TCA) (5.0 µg/L)	1,1-Dichloroethene (DCE) (0.5 µg/L)	1,2-Dibromoethane (EDB) (0.8 µg/L)	1,2-Dichloroethane (DCA) (5.0 µg/L)	Benzene (5.0 µg/L)	Toluene (1,000 µg/L)
	4/1/2008	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/3/2008	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	4/09/09	0.5 U	0.5 U	0.5 U	1.7	0.5 U	0.5 U
	10/13/09	0.5 U	0.5 U	0.5 U	2.1	0.5 U	0.14 J

Notes:

D = The result is reported from a diluted analysis.

DCA = 1,2-dichloroethane

DCE = 1,1-dichloroethene

EDB = 1,2-dibromoethane

J = The result is an estimated concentration that is less than the reporting limit but greater than or equal to the method detection limit (MDL).

µg/L = micrograms per liter

TCA = 1,1,2-Trichloroethane

U = The compound was analyzed for but was not detected (non-detect) at or above the MRL/MDL.

APPENDIX E

Site Inspection Checklists and Operation and Maintenance Cost by Site

Site Inspection Checklists

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *NBK Bangor, OU 1 (Site A)*	**Date of inspection:** 9/9/09
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:** Overcast

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☒ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other *Soil excavation and on-site treatment; leach basin closure; well abandonment*
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact Ray Kobeski / NAVFAC NW RPM / 9/8/10 / (360) 396-0597
Name / Title / Date / Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name / Title / Date / Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name / Title / Date / Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name / Title / Date / Phone no.
Problems; suggestions; ☐ Report attached ______

1. **O&M Contractor** Ty Snyder ______ ______
Name / Title / Date
Interviewed ☒ at site ☐ at office ☐ by phone Phone no. ______
Problems, suggestions; ☐ Report attached *System labeling is outdated in some places and caused some issues when O&M responsibilities transferred between contractors. This could cause further issues with maintenance personnel changes. It is recommended that all labeling be reviewed and updated as appropriate.*

3. **LTM Contractor** _*Ty Snyder - Sealaska*_________ __*O&M Technician*___ ___*9/9 09*_____
Name Title Date
Interviewed ☒ at site ☐ at office ☐ by phone Phone no. ______________
Problems, suggestions; ☐ Report attached __*Identified labeling issue*________________________________
____

4. **Regulatory authorities and response agencies** **See Section 6 of third 5-year review**

Agency ____________________________
Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ____________________________
Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ____________________________
Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ____________________________
Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

5. **Members of the public** **See Section 6 of third 5-year review**

Contact ____________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ____________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ____________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ____________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

III. DOCUMENTS & RECORDS	
1.	**O&M Records** ☒ O&M manual ☒ Readily available ☒ Up to date ☐ N/A ☐ As-built drawings ☐ Readily available ☐ Up to date ☐ N/A ☒ Maintenance logs ☒ Readily available ☒ Up to date ☐ N/A Remarks____
2.	**Leach basin closure records** ☒ Readily available ☒Up to date Remarks *Documented in first five-year review, with citations to record documents.*
3.	**Soil excavation and treatment records** ☒ Readily available ☒ Up to date Remarks *Documented in first five-year review, with citations to record documents.*
4.	**Well Abandonment Records** ☒ Readily available ☐ Up to date Remarks *On-going Navy policy to abandon unused wells. Wells abandoned with regulatory concurrence.*
5.	**Groundwater Monitoring Records** ☒ Readily available ☒ Up to date Remarks *See text of 5-year review report.*
6.	**Institutional Controls Inspection Records** ☒ Readily available ☒ Up to date Remarks *See text of 5-year review report. 2005 inspection records missing, other years available.*

IV. O&M COSTS	
1.	**O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ☐ Contractor for PRP ☐ Federal Facility in-house ☒ Contractor for Federal Facility ☐ Other____
2.	**O&M Cost Records** **See breakdown at end of this appendix** ☒ Readily available ☒ Up to date ☒ Funding mechanism/agreement in place Original O&M cost estimate____________ ☐ Breakdown attached Total annual cost by year for review period if available From________ To________ ____________ ☐ Breakdown attached Date Date Total cost From________ To________ ____________ ☐ Breakdown attached Date Date Total cost From________ To________ ____________ ☐ Breakdown attached Date Date Total cost From________ To________ ____________ ☐ Breakdown attached Date Date Total cost From________ To________ ____________ ☐ Breakdown attached Date Date Total cost

3.	**Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: *Low groundwater recovery rates result in elevated cost per pound of ordnance constituents removal.*
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Site A Burn Area	
1.	**Treatment system secure?** ☒ Yes ☐ No Remarks
2.	**Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No Remarks
3.	**Any wells installed except for environmental cleanup?** ☐ Yes ☒ No Remarks
4.	**Any indication of damage to leach basin liner?** ☐ Yes ☒ No Remarks
5.	**Any evidence of excavation?** ☒ Yes ☐ No Remarks Repair done to cover exposed liner in May 2008 two pits-4' deep, 8x10
B. Site A Debris Area 2	
1.	**Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No Remarks
2.	**Are signs and posts present, in good condition, and legible?** ☒ Yes ☐ No Remarks
3.	**Is deterrent vegetation intact with no penetrating trails?** ☒ Yes ☐ No Remarks Blackberries removed because invasive species
4.	**Any evidence of excavation?** ☐ Yes ☒ No Remarks
C. Overall Institutional Controls Evaluation	

1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by) *Site visit* Frequency *Annual* Responsible party *Sealaska under contract to NAVFAC NW* Contact ______*RayKobeski* *NAVFAC NW RPM*____ _________ *(360) 396-0597*_____ Name Title Date Phone no. Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☐ Yes ☐ No ☒ None Other problems or suggestions: ☐ Report attached *None*____
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks____
	VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A
	A. Groundwater treatment system components
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☒ Carbon adsorbers ☒ Filters___________Bay Filters___________________ ☐ Additive (*e.g.*, chelation agent, flocculent)___________________ ☐ Others____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☒ Quantity of groundwater treated annually_______5 gpm _____________ ☐ Quantity of surface water treated annually________________________ Remarks_Update labels on equipment and sampling ports. O&M plan in plant_
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance Remarks_____________Oversize carbon vessels_____________________
4.	**Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____

5. **Treatment Building(s)**
☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks Clean the gutters

6. **Monitoring Wells** (pump and treatment remedy)
☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☒ Needs Maintenance ☐ N/A
Remarks Lids off some extraction wells not locked. Wells located per recent monitoring reports. Debris and drum at MW-49

B. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

C. Other Remedy Components

1. Soil excavation ☒ Completed ☐ Not Completed
2. Leach basin closure ☒ Completed ☐ Not Completed
3. Well abandonment ☒ Completed ☐ Not Completed

VII. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

See sections 4, 5, and 6 of third 5-year review

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

See section 4, 6, and 7 of third 5-year review

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

The 2009 annual report concluded that the extraction system cannot accomplish sufficient drawdown in the low-permeability aquifer to achieve containment. The Navy is currently assessing the potential for MNA at the site. If MNA is not appropriate at the site, this condition could effect future protectiveness at the site.

D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. ____ ____________*Navy is continuously evaluating optimization opportunities.*

OU 1 (Site A) Inspection Photographs

OU 1 (Site A) Treatment System Building

OU 1 (Site A) Treatment System Compressor

OU 1 (Site A) Extraction Well Vaults

OU 1 (Site A) Extraction Well Vault Close Up

OU 1 (Site A) Leach Basin Photo 1

OU 1 (Site A) Leach Basin Photo 2

OU 1 (Site A) Inspection Photographs (continued)

OU 1 (Site A) Carbon Vessels

OU 1 (Site A) Treatment Building Interior

OU1 (Site A) Debris Area Sign

OU 1 (Site A) Deterrent Vegetation

Site Inspection Checklist

I. SITE INFORMATION

Site name: *NBK Bangor, OU 2 (Site F)*	**Date of inspection:** 9/9/2009
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other *Soil excavation and on-base treatment; infiltration barrier*
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact Ray Kobeski | NAVFAC NW RPM | 9/8/10 | (360) 396-0597
Name | Title | Date | Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

1. **O&M Contractor** Ty Snyder Sealaska | Technician | 9/9 2009
Name | Title | Date
Interviewed ☒ at site ☐ at office ☐ by phone Phone no. ______
Problems, suggestions; ☐ Report attached ______

3. **LTM Contractor** ______ ______ ______
Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ______
Problems, suggestions; ☐ Report attached ______

4. **Regulatory authorities and response agencies** **See Section 6 of third 5-year review**

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

5. **Members of the public** **See Section 6 of third 5-year review**

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

III. DOCUMENTS & RECORDS
1. **O&M Records** ☒ O&M manual ☒ Readily available ☐ Up to date ☐ N/A ☐ As-built drawings ☐ Readily available ☐ Up to date ☐ N/A ☒ Maintenance logs ☒ Readily available ☐ Up to date ☐ N/A ☐ Health and Safety Plan ☐ Readily available ☐ Up to date ☐ N/A ☐ Access logs ☐ Readily available ☐ Up to date ☐ N/A Remarks________________________________
2. **Soil excavation and treatment records** ☒ Readily available ☒ Up to date Remarks *Documented in first five-year review, with citations to record documents.*
3. **Infiltration barrier as-built records** ☒ Readily available ☒ Up to date Remarks *Documented in first five-year review, with citations to record documents.*
4. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date Remarks *See text of 5-year review report.*
5. **Institutional Controls Inspection Records** ☒ Readily available ☒ Up to date Remarks *See text of 5-year review report. 2005 inspection records not available, other years available.*
IV. O&M COSTS
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ☐ Contractor for PRP ☐ Federal Facility in-house ☒ Contractor for Federal Facility ☐ Other________________________________
2. **O&M Cost Records** **See breakdown at end of this appendix** ☐ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place Original O&M cost estimate____________ ☐ Breakdown attached Total annual cost by year for review period if available From__________ To__________ ______________ ☐ Breakdown attached Date Date Total cost From__________ To__________ ______________ ☐ Breakdown attached Date Date Total cost From__________ To__________ ______________ ☐ Breakdown attached Date Date Total cost From__________ To__________ ______________ ☐ Breakdown attached Date Date Total cost From__________ To__________ ______________ ☐ Breakdown attached Date Date Total cost
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: The cost per pound of contaminant mass removed increased from approximately $1,250 per pound in 2004 (U.S. Navy 2004e) to an average of approximately $6,000 per pound during this review period, which is a 480 percent increase. This I likely due to decreasing influent concentrations.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Site F	
1.	**Treatment system secure?** ☒ Yes ☐ No Remarks_______________
2.	**Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No Remarks_______________
3.	**Any wells installed except for environmental cleanup?** ☐ Yes ☒ No Remarks_______________
4.	**Any indication of damage to infiltration barrier or cracked asphalt?** ☐ Yes ☒ No Remarks_______________
5.	**Any evidence of excavation?** ☐ Yes ☒ No Remarks_______________
B. Overall Institutional Controls Evaluation	
1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by) _______________ Frequency _______________ Responsible party _______________ Contact _______________ _______________ _______________ _______________ Name Title Date Phone no. Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☐ Yes ☐ No ☒ None Other problems or suggestions: ☐ Report attached _______________
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks_______________

VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A	
A. Groundwater treatment system components	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☒ Carbon adsorbers ☒ Filters___________Bay Filters___________ ☐ Additive (*e.g.*, chelation agent, flocculent)___________ ☐ Others___________ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date ☒ Equipment properly identified ☐ Quantity of groundwater treated annually_________23 to 25 million gals/month___ ☐ Quantity of surface water treated annually___________ Remarks___________
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks___________
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance Remarks___________
4.	**Discharge Structure and Appurtenances** ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks____________Injection Wells___________
5.	**Treatment Building(s)** ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☒ Chemicals and equipment properly stored Remarks___________
6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks______Per on going monitoring___________
B. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

C. Other Remedy Components		
1. **Soil excavation**	☒ Completed	☐ Not Completed
2. **Infiltration barrier**	☒ Completed	☐ Not Completed

VII. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

See section 4 of third 5-year review.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

See section 4 and 7 of third 5-year review.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

None.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Navy is continuously evaluating optimization opportunities.

OU 2 (Site F) Inspection Photographs

OU 2 (Site F) Treatment Building

OU 2 (Site F) Treatment Building Interior

OU 2 (Site F) Treatment Building Interior

OU 2 (Site F) Treatment System Control Panel

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *NBK Bangor, OU 3 (Sites 16/24 and 25)*	**Date of inspection:**
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other__*Verification monitoring of groundwater*
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. *No OU-specific interviews were conducted, as all actions at OU 3 are complete except annual IC inspections. Interviews for other OUs included general site-wide questions that pertain to this OU.*

III. DOCUMENTS & RECORDS

1. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date
Remarks *Documented in first five-year review, with citations to record documents.*

2. **Institutional Controls Inspection Records** ☒ Readily available ☒ Up to date
Remarks *See text of 5-year review report. 2005 inspection records not available, other years available.*

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☒ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other____
____

2. **O&M Cost Records –** *NA – only IC inspections by Navy required*
☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____________________ ☐ Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
From__________	To__________	__________________	☐ Breakdown attached
From__________	To__________	__________________	☐ Breakdown attached
From__________	To__________	__________________	☐ Breakdown attached
From__________	To__________	__________________	☐ Breakdown attached
From__________	To__________	__________________	☐ Breakdown attached

3.	**Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: ________________________________
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Site 16/24	
1.	**Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No Remarks: ________________________________.
2.	**Any evidence of excavation?** ☐ Yes ☒ No Remarks________________________________
B. Site 25	
1.	No ICs Required or Established
C. Overall Institutional Controls Evaluation	
1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by) *Self reporting* Frequency *Annual* Responsible party *NAVFAC NW* Contact Ray Kobeski Name Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☐ Yes ☐ No ☒ None Other problems or suggestions: ☐ Report attached ________________________________
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks________________________________
VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A	
A. Groundwater Monitoring	
2.	**Verification Monitoring Completed?** ☒ Yes ☐ No Remarks *Navy and regulatory agencies have concluded that monitoring is no longer required. Metals concentratrations in groundwater do not exceed background.*
VII. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). *See text of 5-year review report.*

B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See text of 5-year review report.*
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *See text of 5-year review report.*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *See text of 5-year review report.*

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *NBK Bangor, OU 6 (Site D)*	**Date of inspection:** 9/9/2009
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☐ Access controls
☐ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls
☒ Other__*Soil excavation and on-base treatment; short-term groundwater monitoring; surface water confirmation monitoring*

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact ______Ray Kobeski __________ __NAVFAC NW RPM 9/8/10 _(360) 396-0597_
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____

____

Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____

____

Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____

____

Contact ____________________________ __________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____

1. **O&M Contractor** ____*Ty Snyder - Sealaska*_______ __*Technician*____________ __*9/9/2009*__
Name Title Date
Interviewed ☒ at site ☐ at office ☐ by phone Phone no. ______________
Problems, suggestions; ☐ Report attached ____

____

3. **LTM Contractor**_______*Same*_____________ ________________________ _____________
Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _______________
Problems, suggestions; ☐ Report attached ____
____

4. **Regulatory authorities and response agencies** **See Section 6 of third 5-year review**

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

5. **Members of the public** **See Section 6 of third 5-year review**

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

III. DOCUMENTS & RECORDS
1. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date Remarks *Documented in first five-year review, with citations to record documents.*
2. **Soil Treatment Records** ☒ Readily available ☒ Up to date Remarks *Documented in first five-year review, with citations to record documents.*
IV. REMEDY COSTS
1. **Implementing Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ☐ Contractor for PRP ☐ Federal Facility in-house ☒ Contractor for Federal Facility ☐ Other______________________________
2. **Remedy Cost Records** **See breakdown at end of this appendix** ☐ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place Original O&M cost estimate____________________ ☐ Breakdown attached Total annual cost by year for review period if available From__________ To__________ __________________ ☐ Breakdown attached Date Date Total cost From__________ To__________ __________________ ☐ Breakdown attached Date Date Total cost From__________ To__________ __________________ ☐ Breakdown attached Date Date Total cost From__________ To__________ __________________ ☐ Breakdown attached Date Date Total cost From__________ To__________ __________________ ☐ Breakdown attached Date Date Total cost
3. **Unanticipated or Unusually High Costs During Review Period** Describe costs and reasons: __None______________________________
VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A
A. Surface Water and Groundwater Monitoring
1. Verification Monitoring Completed? ☐ Yes ☒ No Remarks____.
B. Other Remedy Components
1. Soil excavation and treatment ☒ Completed ☐ Not Completed

VII. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). *See section 4 of third 5-year review.*
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See section 4 and 7 of third 5-year review.*
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *None.*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *Navy is continuously evaluating optimization opportunities.*

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *NBK Bangor, OU 7 (Sites B, E/11, 2, 10, and 26)*	**Date of inspection:**
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

☒ Landfill cover/containment ☐ Monitored natural attenuation
☒ Access controls ☐ Groundwater containment
☒ Institutional controls ☐ Vertical barrier walls
☒ Groundwater pump and treatment (as part of Site F system)
☐ Surface water collection and treatment
☒ Other *Surface water control; off-site soil and debris disposal; verification monitoring of groundwater, sediment, and clam tissue*

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact Ray Kobeski — NAVFAC NW RPM — 9/8/10 — (360) 396-0597
Name — Title — Date — Phone no.
Problems; suggestions; ☐ Report attached ____________________

Contact ____________________ ____________ ______ ________
Name — Title — Date — Phone no.
Problems; suggestions; ☐ Report attached ____________________

Contact ____________________ ____________ ______ ________
Name — Title — Date — Phone no.
Problems; suggestions; ☐ Report attached ____________________

Contact ____________________ ____________ ______ ________
Name — Title — Date — Phone no.
Problems; suggestions; ☐ Report attached ____________________

1. **O&M Contractor** N/A ____________ ________
Name — Title — Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ________
Problems, suggestions; ☐ Report attached ____________________

3. **LTM Contractor**______________________________ ________________________ _____________
Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _______________
Problems, suggestions; ☐ Report attached ____
____

4. **Regulatory authorities and response agencies** **See Section 6 of third 5-year review**

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

5. **Members of the public** **See Section 6 of third 5-year review**

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ ____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

III. DOCUMENTS & RECORDS

1. **Otto fuel monitoring of Site F system for Site E/11** ☒ Readily available ☐ Up to date
Remarks____
____

2. **Soil and debris disposal records (Sites 2, B, and E/11)** ☒ Readily available ☒ Up to date
Remarks *Documented in first five-year review, with citations to record documents.*

3. **Soil cover and storm water control as-built records (Site B)** ☒ Readily available ☒Up to date
Remarks *Documented in first five-year review, with citations to record documents.*

4. **Soil cover inspection and maintenance records (Site B)** ☒ Readily available ☒ Up to date
Remarks____
____

5. **Sediment and clam tissue monitoring records (Site 26)** ☒ Readily available ☒ Up to date
Remarks *Final sediment and clam tissue monitoring round completed during second 5-year review. With concurrence of regulatory agency, no further monitoring of these media at this site are required.*

5. **Groundwater monitoring records (Site 10)** ☒ Readily available ☐ Up to date
Remarks____
____

6. **Institutional controls inspection records (Sites B, E/11, 10)** ☒ Readily available ☒ Up to date
Remarks *See text of 5-year review report. 2005 inspection records missing, other years available.*

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other____
____

2. **O&M Cost Records** **See breakdown at end of this appendix**
☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____________________ ☐ Breakdown attached

Total annual cost by year for review period if available

From__________ To__________ ___________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ ___________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ ___________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ ___________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ ___________________ ☐ Breakdown attached
Date Date Total cost

3.	**Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: ____________	
	V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Site B – Floral Point (checklist items from ICMP)		
1.	**Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No Remarks____________	
2.	**Any erosion along shoreline or on the vegetated cover?** ☒ Yes ☐ No Remarks *Some minor scarping was observed on the southern side in beach mix. Otherwise, the 2006 repair appears to be in good condition.*	
3.	**Appropriate vegetation on cover?** ☒ Yes ☐ No Remarks____________	
4.	**Sufficient remaining gravel thickness on cap?** ☒ Yes ☐ No Remarks____________	
B. Sites E/11 and 10 covered by ICs at Sites F and OU 8, respectively.		
C. Overall Institutional Controls Evaluation		
1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by) ____________ Frequency ____________ Responsible party ____________ Contact ____________ Name ____________ Title ______ Date ______ Phone no. Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☒ Yes ☐ No Other problems or suggestions: ☐ Report attached ____________	
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks: *With the exception of Site 10, ICs appear to be adequate. The area covered by ICs at Site 10 needs to be expanded due to conditions noted during construction completed within this 5-year review period. This issue is being addressed by preparation of a revised ICMP scheduled to be completed in 2010.*	

VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A

A. Groundwater treatment system components – USING SITE F SYSTEM.

B. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☐ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining
☐ Sediments and clams are not being affected by COCs at Floral Point
Remarks_*Assessment of Otto fuel groundwater plume containment needs to be included in Site F annual evaluation.*

C. Floral Point Cover

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent______________ Depth____________
Remarks____*None.*

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths____________ Widths___________ Depths__________
Remarks____*None.*

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______________ Depth____________
Remarks____*None.*

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Areal extent______________ Depth____________
Remarks____*None.*

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☒ No signs of stress
☒ Trees/Shrubs (indicate size and locations on a diagram)
Remarks____*See aerial.*

6. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
Areal extent______________ Height____________
Remarks____

7. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks____

8. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent______________
Remarks_*Minor scarping identified at Site F. Annual inspections will monitor this. NAVFAC NW has demonstrated good response to inspection identified deficiencies.*

D. Surface water control swales	
1.	**Erosion** ☐ Location shown on site map ☒ No evidence of erosion Areal extent______________ Depth____________ Remarks____
2.	**Obstructions** Type_____________________ ☒ No obstructions ☐ Location shown on site map Areal extent______________ Size____________ Remarks____
3.	**Excessive Vegetative Growth** Type____________________ ☒ No evidence of excessive growth ☐ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent______________ Remarks____
E. Cover Penetrations ☐ Applicable ☐ N/A	
1.	**Monitoring Wells** (within surface area of landfill) ☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
2.	**Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A Remarks_____*None*
F. Other Remedy Components	
1. Soil and debris disposal ☒ Completed ☐ Not Completed	

VII. OVERALL OBSERVATIONS

A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). *See section 4 of third 5-year review.*
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See section 4 and 7 of third 5-year review.*

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *None.*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *Navy is continuously evaluating optimization opportunities.*

OU 7 (Sites B, Floral Point) Inspection Photographs

OU 7 (Site B) Shoreline

OU 7 (Site B) Shoreline

OU 7 (Site B) Shoreline

OU 7 (Site B) Shoreline Showing Minor Scarping

OU 7 (Site B) Vegetative Cover

OU 7 (Site B) Shoreline Boat Launch Access Road

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *NBK Bangor, OU 8 (Sites 27, 28, 29 and offsite plume)*	**Date of inspection:**
Location: *Kitsap, WA*	**EPA ID:** *110000771219*
Agency, office, or company leading the five-year review: *US NAVY, NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other *LNAPL removal*
- ☒ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact	Name	Title	Date	Phone no.
Contact	Ray Kobeski	NAVFAC NW RPM	9/9/2009	(360) 396-0597

Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

Contact ______ ______ ______ ______
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______

1. **O&M Contractor** SeaAlaska ______ ______
Name Title Date

Interviewed ☐ at site ☐ at office ☒ by phone Phone no. ______

Problems, suggestions; ☐ Report attached ______

3. **LTM Contractor**______________________________ ________________________ _____________
Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _______________
Problems, suggestions; ☐ Report attached ____
____

4. **Regulatory authorities and response agencies** **See Section 6 of third 5-year review**

Agency ______________________________
Contact ______________________________ ___________________ ________ _____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ _____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ _____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Agency ______________________________
Contact ______________________________ ___________________ ________ _____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

5. **Members of the public** **See section 6 of third 5-year review**

Contact ______________________________ ________ _____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ _____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ _____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

Contact ______________________________ ________ _____________
Name Date Phone no.
Problems; suggestions; ☐ Report attached ____
____

III. DOCUMENTS & RECORDS

1. **LNAPL recovery system installation records** ☒ Readily available ☒ Up to date
Remarks____

____

2. **Groundwater monitoring records** ☒ Readily available ☒ Up to date
Remarks____

____

6. **Institutional controls inspection records** ☒ Readily available ☒ Up to date
Remarks *See text of 5-year review report. 2005 inspection records missing, other years available.*

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other____

____

2. **O&M Cost Records** **See breakdown at end of this appendix**
☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate____________________ ☐ Breakdown attached

Total annual cost by year for review period if available

From__________ To__________ __________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ __________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ __________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ __________________ ☐ Breakdown attached
Date Date Total cost
From__________ To__________ __________________ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: ____

____

____

____

____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. OU 8 (all sites

1. **Current land use consistent with ROD and ICMP?** ☒ Yes ☐ No
Remarks____

____

2.	**Have any wells been installed except for environmental cleanup?** ☐ Yes ☒ No Remarks
3.	**Monitoring reports supplied to Health Department?** ☒ Yes ☐ No Remarks
4.	**Any wells allowed by Health Department in restricted area?** ☐ Yes ☒ No Remarks
B. Overall Institutional Controls Evaluation	
1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by) Visual and annual communication with Kitsap County Health Department Frequency Annual Responsible party NAVFAC NW Contact Name Title Date Phone no. Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☐ Yes ☐ No Other problems or suggestions: ☐ Report attached No Violations
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks
VI. TREATMENT COMPONENTS ☒ Applicable ☐ N/A	
A. LNAPL and MNA Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ LNAPL is being removed ☐ Contaminant concentrations are declining ☒ MNA is effective Remarks

B. Monitored Natural Attenuation Infrastructure	
1.	**Monitoring Wells** (natural attenuation portion of remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
VII. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). *See section 4 of third 5-year review.*
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See section 4 and 7 of third 5-year review.*
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *None.*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *Navy is continuously evaluating optimization opportunities.*

Operation and Maintenance Cost by Site

NBK BANGOR ER PROGRAM OPERATION AND MAINTENANCE COST BY SITE

OU 8

Awd Fy	Site Name	Actn Title	Award Amt		
2005	SITE 00027	05 Facilities Support	$4,928		
2005	SITE 00028	05 Facilities Support	$4,928		
2005	SITE 00029	05 Facilities Support	$4,928	$14,784 FY 05	
2010	SITE 00028	10 NBK Bangor HW Paperwork Processing	$3,000		
2010	SITE 00028	10 NBK Bangor Site A & F Operations and Maintenance	$28,500	$31,500 FY 10	ESTIMATE
		Total	$46,284		

SITE A

Awd Fy	Site Name	Actn Title	Award Amt		
2005	SITE 00200	05 Facilities Support	$5,280		
2005	SITE 00200	05 NSB Bangor Mowing Site 200	$16,335		
2005	SITE 00200	05 Site A and F RAO / Routine Maintenance	$187,243	$208,858 FY 05	
2006	SITE 00200	06 Bangor Grounds Maintenance	$2,244		
2006	SITE 00200	06 NBK Road Repairs & Routine Maintenance, Site A, F and Floral Point.	$13,381		
2006	SITE 00200	06 Operations and Maintenance (Bangor)	$334,770	$350,395 FY 06	
2007	SITE 00200	07 Bangor Waste Disposal	$347		
2007	SITE 00200	07 Operation and Maintenance (Bangor)	$209,868		
2007	SITE 00200	07 Road Repair NBK and JPC	$71,277	$281,492 FY 07	
2008	SITE 00200	08 Bangor Brush Removal Sites A, F, Floral Point (CMNST)	$2,415		
2008	SITE 00200	08 Operation and Maintenance NBK at Bangor	$199,315	$201,730 FY 08	
2009	SITE 00200	(Work Order CZJVB) 09 RNISH Brush Removal at Bangor Site A, F and Floral Point Maximo Parent Work Order CY9HW ELIN	$195		
2009	SITE 00200	09 NBK Bangor Hazardous Waste Paperwork Processing	$3,000		
2009	SITE 00200	09 NBK Bangor Site A & F Operations and Maintenance	$180,600	$183,795 FY 09	
2010	SITE 00200	10 NBK Bangor (Work Order) RNISH Brush Removal at Bangor Site A, F and Floral Point	$3,300		
2010	SITE 00200	10 NBK Bangor HW Paperwork Processing	$3,500		
2010	SITE 00200	10 NBK Bangor Site A & F Operations and Maintenance	$104,500	$111,300 FY 10	ESTIMATE
		Total	1,337,570		

SITE B FLORAL POINT

Awd Fy	Site Name	Actn Title	Award Amt		
2005	SITE 00201	05 Facilities Support	$8,096	$8,096 FY 05	
2006	SITE 00201	06 NBK Road Repairs & Routine Maintenance, Site A, F and Floral Point.	$297		
2006	SITE 00201	06 Operations and Maintenance (Bangor)	$14,555	$14,853 FY 06	
2007	SITE 00201	07 Operation and Maintenance (Bangor)	$11,992		
2007	SITE 00201	07 Road Repair NBK and JPC	$13,707	$25,700 FY 07	
2008	SITE 00201	08 Bangor Brush Removal Sites A, F, Floral Point (CMNST)	$1,509		
2008	SITE 00201	08 Operation and Maintenance NBK at Bangor	$17,587	$19,096 FY 08	
2009	SITE 00201	(Work Order CZJVB) 09 RNISH Brush Removal at Bangor Site A, F and Floral Point Maximo Parent Work Order CY9HW ELIN	$195	$195 FY 09	
2010	SITE 00201	10 NBK Bangor (Work Order) RNISH Brush Removal at Bangor Site A, F and Floral Point	$3,400	$3,400 FY 10	ESTIMATE
		Total	$71,339		

SITE F

Awd Fy	Site Name	Actn Title	Award Amt		
2005	SITE 00204	05 Site A and F RAO / Routine Maintenance	$187,243		
2005	SITE 00204	05 Site A and F RAO / Routine Maintenance	$228,853	$416,096 FY 05	
2006	SITE 00204	06 NBK Road Repairs & Routine Maintenance, Site A, F and Floral Point.	$13,381		
2006	SITE 00204	06 Operation and Maintenance (Mod 1), install Motor Controllers	$14,166		
2006	SITE 00204	06 Operations and Maintenance (Bangor)	$371,158	$398,704 FY 06	
2007	SITE 00204	07 Bangor Mow Site F Treatment Plan	$1,341		
2007	SITE 00204	07 Bangor Warning Sign Site A	$1,281		
2007	SITE 00204	07 Bangor Waste Disposal	$347		
2007	SITE 00204	07 Mow Site A & Floral Point, Bangor	$3,224		
2007	SITE 00204	07 Operation and Maintenance (Bangor)	$377,763		
2007	SITE 00204	07 Road Repair NBK and JPC	$12,336	$396,292 FY 07	
2008	SITE 00204	08 Bangor Brush Removal Sites A, F, Floral Point (CMNST)	$2,113		
2008	SITE 00204	08 Operation and Maintenance NBK at Bangor	$369,319	$371,431 FY 08	
2009	SITE 00204	09 NBK Bangor Site A & F Operations and Maintenance	$270,900	$270,900 FY 09	
2010	SITE 00204	10 NBK Bangor (Work Order) RNISH Brush Removal at Bangor Site A, F and Floral Point	$3,300		
2010	SITE 00204	10 NBK Bangor HW Paperwork Processing	$3,500		
2010	SITE 00204	10 NBK Bangor Site A & F Operations and Maintenance	$342,000	$348,800 FY 10	ESTIMATE
		Total	$2,202,224		

NBK BANGOR ER PROGRAM LTM COST BY SITE

OU 8

Awd Fy	Site Name	Actn Title	Award Amt $		
2005	SITE 00027	05 OU 8 MNA/LTM Mod 2	$17,782		
2005	SITE 00028	05 OU 8 MNA/LTM Mod 2	$17,782		
2005	SITE 00029	05 OU 8 MNA/LTM Mod 2	$18,321		
2005	SITE 00027	05 Site 201, A and F LTM	$29,320		
2005	SITE 00028	05 Site 201, A and F LTM	$26,062		
2005	SITE 00029	05 Site 201, A and F LTM	$29,320	**$138,586 FY 05**	
2006	SITE 00027	06 Compliance Monitoring (Bangor)	$42,591		
2006	SITE 00028	06 Compliance Monitoring (Bangor)	$42,591		
2006	SITE 00029	06 Compliance Monitoring (Bangor)	$42,591	**$127,772 FY 06**	
2007	SITE 00027	07 Compliance Monitoring (Bangor)	$37,551		
2007	SITE 00028	07 Compliance Monitoring (Bangor)	$37,551		
2007	SITE 00029	07 Compliance Monitoring (Bangor)	$42,244	**$117,346 FY 07**	
2008	SITE 00027	08 Compliance Monitoring NBK at Bangor	$20,765		
2008	SITE 00028	08 Compliance Monitoring NBK at Bangor	$20,765		
2008	SITE 00029	08 Compliance Monitoring NBK at Bangor	$20,765	**$62,294 FY08**	
2009	SITE 00027	09 MOd 1 to 08 Compliance Monitoring NBK Bangor	$11,582		
2009	SITE 00028	09 MOd 1 to 08 Compliance Monitoring NBK Bangor	$11,582		
2009	SITE 00029	09 MOd 1 to 08 Compliance Monitoring NBK Bangor	$11,582		
2009	SITE 00029	09 MOD 1 to NBK Compliance LTM OU8 Site A & F	$22,808		
2009	SITE 00029	09 NBK Bangor Compliance LTM OU8 Site A& F	$44,203	**$101,757 FY 09**	
2010	SITE 00027	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	$34,260		
2010	SITE 00028	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	$34,260		
2010	SITE 00029	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	$39,970	**$108,490 FY 10**	ESTIMATE
		Total	**$656,244**		

SITE A

Awd Fy	Site Name	Actn Title	Award Amt $		
2005	SITE 00200	05 Site 201, A and F LTM	97,733	**97,733 FY 05**	
2006	SITE 00200	06 Compliance Monitoring (Bangor)	$143,744	**$143,744 FY 06**	
2007	SITE 00200	07 Compliance Monitoring (Bangor)	$126,733		
2007	SITE 00200	07 LTM Bangor Mod 1	7,074	**$133,807 FY 07**	
2008	SITE 00200	08 Compliance Monitoring NBK at Bangor	$55,372	**$55,372 FY 08**	
2009	SITE 00200	09 MOD 1 to NBK Compliance LTM OU8 Site A & F	$75,267		
2009	SITE 00200	09 NBK Bangor Compliance LTM OU8 Site A& F	145,868	**$221,136 FY 09**	
2010	SITE 00200	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	$137,040	**$137,040 FY 10**	ESTIMATE
		Total	**788,832**		

SITE B FLORAL POINT

Awd Fy	Site Name	Actn Title	Award Amt $		
2005	SITE 00201	05 Site 201, A and F LTM	133,568	**133,568 FY 05**	
2010	SITE 00201	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	11,420	**11,420 FY 10**	ESTIMATE
		Total	**144,988**		

SITE F

Awd Fy	Site Name	Actn Title	Award Amt $		
2005	SITE 00204	05 Site 201, A and F LTM	9,773		
2005	SITE 00204	05 Site F Compliance and Performance Monitoring Mod 2	20,661	**30,434 FY 05**	
2006	SITE 00204	06 Compliance Monitoring (Bangor)	$260,869	**$260,869 FY 06**	
2007	SITE 00204	07 Compliance Monitoring (Bangor)	$229,998	**$229,998 FY 07**	
2008	SITE 00204	08 Compliance Monitoring NBK at Bangor	$110,744	**$110,744 FY 08**	
2009	SITE 00204	09 MOd 1 to 08 Compliance Monitoring NBK Bangor	$42,467		
2009	SITE 00204	09 MOD 1 to NBK Compliance LTM OU8 Site A & F	130,007		
2009	SITE 00204	09 NBK Bangor Compliance LTM OU8 Site A& F	251,954	**$424,429 FY 09**	
2010	SITE 00204	10 NBK Bangor Compliance IC Inspections (LUC) and LTM OU8, Site A & F	$314,050	**$314,050 FY 10**	ESTIMATE
		Total	**1,370,523**		

NBK BANGOR ER PROGRAM UTILITIES BY SITE

Awd Fy	Site Name	Actn Title	Award Amt $		
		SITE A			
2005	SITE 00200	05 Site A & F Utilities - Increase Funds	$825		
2005	SITE 00200	05 Utilities Bills Sites A, F and OU 8	$27,864	**$28,689 FY 05**	
2006	SITE 00200	06 Utilities	$1,704		
2006	SITE 00200	06 Utilities	$1,594		
2006	SITE 00200	06 Utilities Bill (Bangor)	$9,681		
2006	SITE 00200	06 Utilities Bill (BANGOR) (Feb-June)	$9,320	**$22,299 FY 06**	
2008	SITE 00200	08 Utility Bills at Bangor	$5,649		
2008	SITE 00200	08 Utility Bills at Bangor (Amd 01)	$5,578		
2008	SITE 00200	08 Utility Bills at Bangor (Amd 02)	$5,477		
2008	SITE 00200	08 Utility Bills at Bangor Estimate (Amd 03)	$5,662	**$22,366 FY 08**	
2009	SITE 00200	09 NBK Bangor Utlility Bill	$32,327	**$32,327 FY 09**	
2010	SITE 00200	10 Utility Bills at Bangor for FY10	$35,000	**$35,000 FY 10**	ESTIMATE
		Total	**$140,681**		
		SITE F			
2005	SITE 00204	05 Site A & F Utilities - Increase Funds	2,475		
2005	SITE 00204	05 Utilities Bills Sites A, F and OU 8	36,936	**$39,411 FY 05**	
2006	SITE 00204	06 Utilities	$2,083		
2006	SITE 00204	06 Utilities	1,948		
2006	SITE 00204	06 Utilities Bill (Bangor)	11,832		
2006	SITE 00204	06 Utilities Bill (BANGOR) (Feb-June)	11,392	**$27,255 FY 06**	
2007	SITE 00204	07 Utility Bills (Bangor)	$9,618		
2007	SITE 00204	07 Utility Bills (Bangor) Amendment 02	27,154		
2007	SITE 00204	07 Utility Bills (Bangor) Amendment 1	16,070	**$52,842 FY 07**	
2008	SITE 00204	08 Utility Bills at Bangor	$16,947		
2008	SITE 00204	08 Utility Bills at Bangor (Amd 01)	16,733		
2008	SITE 00204	08 Utility Bills at Bangor (Amd 02)	16,430		
2008	SITE 00204	08 Utility Bills at Bangor Estimate (Amd 03)	16,987	**$67,097 FY 08**	
2009	SITE 00204	09 NBK Bangor Utlility Bill	$35,021	**$35,021 FY 09**	
2010	SITE 00204	10 Utility Bills at Bangor for FY10	$35,000	**$35,000 FY 10**	ESTIMATE
		Total	**256,625**		