



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION I

5 Post Office Square, Suite 100  
Boston, MA 02109-3912

Superfund Records Center  
SITE: NEW LONDON SUB BASE  
BREAK: 8.3  
OTHER: 594062

December 14, 2016

Mr. Brian Murray  
Remedial Project Manager  
Environmental Restoration  
NAVFAC MIDLANT OPNEEV  
Bldg. Z-144  
9742 Maryland Avenue  
Norfolk, VA 23511-3095

Re: Fourth Five-Year Review for the Naval Submarine Base New London Superfund Site

Dear Mr. Murray:

Thank you for the opportunity to review the *Fourth Five-Year Review for CERCLA Sites at Naval Submarine Base New London, Groton, CT*, dated December 2016. EPA has determined that this statutory review is consistent with the *Comprehensive Five-Year Review Guidance* (OSWER No. 9355.7-03B-P dated June 2001). EPA concurs with the findings that the remedies that have been implemented at the Area A Landfill, the Goss Cove Landfill, the Defense Reutilization and Marketing Office, the Area A Downstream/Over Bank Disposal Area, the Area A Weapons Center, the Torpedo Shops, the Area A Wetland, and Basewide Groundwater, are protective of human health and the environment.

For those operable units that are still under investigation or construction, EPA is pleased to see the Navy's continued commitment to following the CERCLA process in accordance with the Federal Facilities Agreement. Access is restricted at most of the sites that have not yet been remediated to minimize potential threats to human health. EPA agrees that the protectiveness of the selected remedies for the sites currently under investigation or construction will be evaluated in subsequent Five-Year Reviews.

During EPA's site walkover on October 14, 2015, numerous issues were identified with respect to the on-going maintenance of several remedies currently in place. These issues are summarized appropriately on page xxiii, Table 6-6, and Table 12-5 of the *Fourth Five-Year Review* report along with corresponding recommendations to address them. EPA is pleased that the Navy has already put in place plans to correct these deficiencies and looks forward to working with you to address them.

This fourth Five-Year Review requirement was established by the first Five-Year Review (completed on December 7, 2001) that was prompted by the remedial action start for the Area A

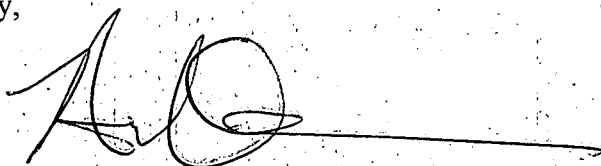


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Landfill. Consistent with Section 121(c) of the CERCLA, the next Five-Year Review must be finalized on or before December 14, 2021.

Sincerely,



Bryan Olson, Director  
Office of Site Remediation and Restoration

cc: Kenneth Feathers, CTDEEP, Hartford, CT  
Tracey McKenzie, USN, Groton, CT  
Kymberlee Keckler, EPA, Boston, MA

29 November 2016

Ms. Tracey McKenzie  
Environmental Restoration Project Manager  
Naval Submarine Base New London  
Public Works Environmental Division  
Box 400  
439 Tautog Avenue, Room 104  
Groton, Connecticut 06349


**Subject: Final Fourth Five-Year Review  
Naval Submarine Base New London, Groton, Connecticut  
Contract No. N62470-11-8013, CTO WE61**

Dear Ms. McKenzie:

On behalf of the United States Navy, Resolution Consultants has prepared the attached Final Fourth Five-Year Review, for the Naval Submarine Base New London, Groton, Connecticut (NSB NLON). Also attached is the signature page, to be signed by the NSB NLON Commander.

Any questions regarding this correspondence should be directed to Mr. Robert McCarthy, Task Order Manager, at 860-665-1140 or Ms. Nicole Cowand, U.S. Navy Remedial Project Manager at 757-341-2009.

Sincerely,



By: Robert McCarthy, PE, LEP  
CTO Project Manager, NSB NLON



**RESOLUTION  
CONSULTANTS**

**FINAL FOURTH FIVE-YEAR REVIEW  
OPERABLE UNITS 1, 2, 3, 4, 5, 9, AND 12**

**NAVAL SUBMARINE BASE NEW LONDON  
GROTON, CONNECTICUT**

**Revision: 0**

**Prepared for:**



**Department of the Navy  
Naval Facilities Engineering Command Mid-Atlantic  
9742 Maryland Avenue  
Norfolk, Virginia 23511-3095**

**December 2016**



**FINAL FOURTH FIVE-YEAR REVIEW  
OPERABLE UNITS 1, 2, 3, 4, 5, 9, AND 12**

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**Revision: 0**

**Prepared for:**



**Department of the Navy  
Naval Facilities Engineering Command Mid-Atlantic  
9742 Maryland Avenue  
Norfolk, Virginia 23511-3095**

**Prepared by:**



**Resolution Consultants**  
*A Joint Venture of AECOM & EnSafe*  
**1500 Wells Fargo Building  
440 Monticello Avenue  
Norfolk, Virginia 23510**

**Contract Number N62470-11-D-8013  
CTO WE61**

**December 2016**

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**Robert McCarthy  
Contract Task Order Manager**

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## List of Acronyms

µg/DL	microgram(s) per decileter
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
AFFF	Aqueous Film-Forming Foam
AGVIQ	AGVIQ-CH2M HILL Constructors, Inc. Joint Venture III
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
Atlantic	Atlantic Environmental Services
B&RE	Brown and Root Environmental
BaPEQ	Benzo(a)pyrene Equivalent
BEHP	Bis-(2-ethylhexyl)phthalate
BGOURI	Basewide Groundwater Operable Unit Remedial Investigation
bgs	below ground surface
BRA	Baseline Risk Assessment
bss	below sediment surface
CB&I	CB&I Federal Services, LLC
CCR	Construction Completion Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMAA	Command Master-At-Arms
COC	contaminant of concern
COPC	contaminant of potential concern
CPAH	carcinogenic polynuclear aromatic hydrocarbons
CSM	Conceptual Site Model
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTE	Central Tendency Exposure
DCA	Dichloroethane
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethene
DDT	Dichlorodiphenyltrichloroethane
DDTR	Dichlorodiphenyltrichloroethane residual
DEC	Direct Exposure Criteria
DGI	Data-Gap Investigation
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office

### List of Acronyms (continued)

ERA	Ecological Risk Assessment
ER-M	Effects Range — Medium
ERM-Q	Effects Median Range — Quotient
ERP	Environmental Restoration Program
ESD	Explanation of Significant Difference
ESQD	Explosives Safety Quantity Distance
°F	degrees Fahrenheit
FFA	Federal Facility Agreement
FS	Feasibility Study
FWEC	Foster Wheeler Environmental Corporation
GCL	Geosynthetic Clay Liner
GMP	Groundwater Monitoring Plan
H&S	H&S Environmental
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
I/C	Industrial/Commercial
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental Lifetime Cancer Risk
IROD	Interim Record of Decision
IR	Installation Restoration
J&E	Johnson & Ettinger
LDPE	Low-Density Polyethylene
LTM	Long-Term Monitoring
LUC	Land Use Control
LUC RD	Land Use Control Remedial Design
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
mg/L	milligram(s) per liter
mph	mile(s) per hour
msl	mean sea level

## **List of Acronyms (continued)**

NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NFA	No Further Action
NIRIS	Naval Installation Restoration Information Solution
NLONINST	New London Instruction
NSB NLON	Naval Submarine Base New London
NTCRA	Non-Time Critical Removal Action
O&M	Operations and Maintenance
OBDA	Overbank Disposal Area
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
OT	Oily Tank
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PDI	Pre-Design Investigation
PFC	Perfluorinated Compound
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PMC	Pollutant Mobility Criteria
RACR	Remedial Action Completion Report
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RG	Remedial Goal
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
RSR	Remediation Standard Regulations

### **List of Acronyms (continued)**

SASE	Site Assessment Screening Evaluation
SOPA	Standard Operating Procedure — Administrative
SPLP	Synthetic Precipitate Leachate Procedure
SUBASENLONINST	Subase New London Instruction
SVOC	Semivolatile Organic Compound
SWPC	Surface Water Protection Criteria
TBC	To Be Considered
TCA	Trichloroethane
TCDD	Tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TEF	Toxic Equivalency Factors
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
UU/UE	Unlimited Use and Unrestricted Exposure
VI	Vapor Intrusion
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
WQS	Water Quality Standard(s)
WWTP	Wastewater Treatment Plant

## **EXECUTIVE SUMMARY**

### **Five-Year Review Summary Form**

This five-year review has been prepared by the Naval Facilities Engineering Command Mid-Atlantic for seven Operable Units (OUs) at Naval Submarine Base New London (NSB NLON) in Groton, Connecticut. The purpose of the five-year review is to evaluate implementation and performance of remedies to determine if they are protective of human health and the environment. The United States Department of the Navy (Navy) is the lead agency responsible for this five-year review at NSB NLON, working with the United States Environmental Protection Agency (U.S. EPA) and the Connecticut Department of Energy and Environmental Protection (CTDEEP) under a Federal Facility Agreement signed by all parties in 1994. This five-year review was conducted because hazardous substances, pollutants, and contaminants from past storage, handling, and disposal practices remain at each OU above levels that allow for unlimited use and unrestricted exposure. The next five-year review, which will be conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and pertinent U.S. EPA and Navy five-year review guidance, is scheduled to be completed in December 2021.

NSB NLON is a 687-acre facility in southeastern Connecticut in the Towns of Ledyard and Groton, New London County. The facility is situated on the eastern bank of the Thames River, approximately 6 miles north of Long Island Sound. NSB NLON has been an active Navy facility since 1867, with submarine base operations since 1916. Today, NSB NLON provides base operations support for Navy submarine forces and other naval organizations and tenants. NSB NLON accommodates submarine training facilities, military offices, medical facilities, and facilities for submarine maintenance, repair, and overhaul. The base also provides housing and support services for Navy personnel.

The Navy initiated environmental investigation of NSB NLON in 1979 and the site was placed on the National Priorities List in August 1990. The cleanup program has identified numerous sites within 12 OUs for which Records of Decision (RODs) have been signed; five OUs have required No Further Action (NFA) under CERCLA. This is the fourth five-year review for NSB NLON. The following summarizes the sites and corresponding OUs included in this five-year review. Issues and recommendations for sites with long-term protectiveness concerns and protectiveness statements are in the following five-year review summary forms.

#### **Site 2A (Area A Landfill) — Operable Units 1 and 9**

Site 2A was used as a landfill and received NSB NLON wastes including residues from the former base incinerator, refuse, and debris from 1957 to 1973. The components of the selected remedy for the Area A Landfill (OU 1) were source control (capping), institutional controls, surface controls to minimize erosion and manage runoff, and post-closure groundwater and

surface water monitoring to evaluate the effectiveness of the cap and ensure that contaminants do not migrate to groundwater. The OU 1 ROD deferred management and migration of contaminants in groundwater to OU 9 (Basewide Groundwater). The OU 9 ROD identified no unacceptable risks for groundwater at Sites 2A and 2B and recommended continuing groundwater compliance monitoring and institutional controls implemented as part of the OU 1 landfill source control remedy.<sup>1</sup> Annual groundwater monitoring data continue to indicate there is no concern for contaminant migration from Site 2A soil to groundwater.

Remedial actions implemented at Site 2A are protective of human health and the environment. Source control actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration and prevent direct contact with soil. An Operations and Maintenance (O&M) program has been implemented and results verify that the cap is performing as designed. Implementation of Subbase New London Instruction (SUBASENLONINST) 5090.25 provides institutional controls until the Land Use Control Remedial Design (LUC RD) is finalized.

The OU 9 LUC RD provides institutional controls for groundwater at Sites 2A and 2B and SUBASENLONINST 5090.25 directs base personnel to the OU 9 LUC RD. The groundwater remedy (groundwater and surface water monitoring and land use controls [LUCs]) remains protective at Sites 2A and 2B.

### **Site 2B (Area A Wetland) — Operable Units 9 and 12**

Site 2B was undeveloped, wooded land, until the late 1950s when dredge spoils from the Thames River were pumped and contained within an earthen dike to form the present-day Area A Wetland. Contamination at Site 2B is from surface releases such as pre-cap runoff from the Area A Landfill (Site 2A), runoff from the Area A Weapons Center (Site 20), and placement of pesticide bricks within the wetland. The selected remedy — sediment excavation, wetland restoration and monitoring, and LUCs — was implemented during this five-year review period. Groundwater monitoring was not a required component of the selected remedy for Site 2B; monitoring wells and surface water sampling locations within the physical boundaries of Site 2B support the groundwater and surface water monitoring program for Site 2A.<sup>1</sup>

Remedial actions implemented at Site 2B are protective of human health and the environment. The sediment removal action (excavation, disposal, and wetland restoration) addressed ecological exposures. An O&M program has been implemented and results verify that the restoration is performing as designed. The Site 2B LUC RD provides institutional controls for sediment and SUBASENLONINST 5090.25 directs base personnel to the Site 2B LUC RD.

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<sup>1</sup> Due to the proximity of Site 2A and Site 2B, groundwater at both sites are collectively referred to as Site 2.



The OU 9 LUC RD provides institutional controls for groundwater at Sites 2A and 2B and SUBASENLONINST 5090.25 directs base personnel to the OU 9 LUC RD. The groundwater remedy (groundwater and surface water monitoring and LUCs) remains protective at Sites 2A and 2B.

### **Site 3 (Area A Downstream Water Courses/Overbank Disposal Area) — Operable Units 3 and 9**

Site 3 drains the Area A Landfill and Area A Wetland through water bodies and streams that ultimately flow into the Thames River. Suspected sources of contamination are historical application of pesticides to surface water bodies and the golf course, contaminant migration via storm water runoff from placing Thames River dredge spoils at upland sites, historical use of the Overbank Disposal Area for disposal, and abandoned septic system leach fields at the Torpedo Shops (Site 7). The selected remedy for soil and sediment (OU 3) included excavation and dredging, onsite dewatering, and offsite disposal of soil and sediment; restoration of wetlands and waterways; and monitoring. The selected remedy was intended to eliminate human health and ecological risks associated with soil and sediment; however, an area that could not be excavated due to concerns regarding the structural integrity of the Area A Dike was subsequently encapsulated, as documented in an Explanation of Significant Difference. Institutional controls (including inspections) were also required for the concrete encapsulated soil. The selected remedy for groundwater (OU 9) included institutional controls and monitoring. Annual groundwater monitoring conducted during this five-year review period did not detect groundwater contaminants of concern (COCs) above remedial goals.

Remedial actions implemented at Site 3 are protective of human health and the environment. Soil and sediment actions (excavation and subsequent encapsulation of residual contamination) addressed human health and ecological exposures. An O&M program has been implemented and results verify that the soil and sediment remedy is performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

The OU 9 LUC RD provides institutional controls for groundwater at Site 3 and SUBASENLONINST 5090.25 directs base personnel to the OU 9 LUC RD. The groundwater remedy (groundwater monitoring and LUCs) remains protective at Site 3.

### **Site 6 (Former Defense Reutilization and Marketing Office) — Operable Unit 2**

Site 6 was used as a landfill and waste-burning area from 1950 to 1969, during which time waste was partially covered eventually creating developable land. Most of the source was removed during a time-critical removal action and the remaining materials contained by a cap system. The selected remedy included institutional controls, LUCs, and post-closure groundwater monitoring to evaluate the effectiveness of the cap and ensure that contaminants do not migrate to the Thames River.

Annual groundwater monitoring data continue to indicate there is no concern for contaminant migration from Site 6 soil to groundwater (and ultimately to the Thames River). During this five-year review period, installation of a construction trailer resulted rebar cap penetrations in at least two locations; there is no indication of contaminant release due to the penetrations due to minimal void space between the rebar and asphalt (i.e., minimal opportunity for water to penetrate the cap) but sealing may be necessary. Additional engineering review will be required to evaluate long-term protectiveness of the cap and permanent repairs to the cap, if necessary, will be made once the trailer is removed from the site.

Remedial actions implemented at Site 6 are currently protective of human health and the environment in the short term. Most of the source was removed and the remaining material was contained by a cap system during a time-critical removal action; the cap system minimizes infiltration and subsequent contaminant migration and prevents direct contact with soil. An O&M program has been implemented and results verify that the remedy and cap are performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized. However, to provide long-term protectiveness, it is necessary to ensure proper enforcement SUBASENLONINST 5090.25 by implementation of a storage permit in the LUC RD, improved onsite signage and markings (i.e., painting a line along the cap boundary), and to assess whether cap penetrations will affect cap integrity.

#### **Site 8 (Goss Cove Landfill) — Operable Unit 5**

Site 8 was used as a landfill and received incinerator ash and inert rubble from 1946 to 1957. The Navy-operated Nautilus Museum and a paved parking lot were constructed over the former landfill; the remainder of the site is used for equipment storage. The selected presumptive remedy for the soil and waste/fill material was containment (capping), institutional controls, and long-term groundwater monitoring to evaluate the effectiveness of the cap and ensure that contaminants do not migrate to Goss Cove or the Thames River. Annual groundwater monitoring data continue to indicate there is no concern for contaminant migration from Site 8 soil to groundwater or to Goss Cove and the Thames River. This site has also been impacted by tetrachloroethene-contaminated groundwater which has migrated from a former off-base dry cleaning operation (Former Fusconi's Cleaners). Tetrachloroethene concentrations have decreased over this five-year review period, most significantly during 2014 and 2015 sampling events, likely resulting from removal actions at the former dry cleaners in 2014 conducted by CTDEEP under State cleanup authority.

Remedial actions implemented at Site 8 are protective of human health and the environment. Remedial actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration, and prevent direct contact with soil. An O&M program has been implemented

and results verify that the cap is performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

#### **Site 9 (Former Wastewater Oily Tank 5) and Site 23 (Former Fuel Farm) — Operable Unit 9**

Site 9 (Former Oily Tank [OT]-5) was a 750,000-gallon concrete underground storage tank (UST) initially used to store No. 6 fuel oil then, in the late 1970s, converted to store bilge water and other waste solutions. Site 9 is located within the physical boundaries of Site 23, which included No. 6 fuel oil and diesel fuel USTs OT-1 through OT-9 and the OT-10 complex; those tanks were closed in place under CTDEEP's Underground Storage Tank Program. Groundwater at these sites is managed under OU9 (Basewide Groundwater). Due to the physical location of Site 9 (within Site 23), groundwater is collectively referred to as Sites 9 and 23. The selected remedy was institutional controls, including restricting extraction and use of the groundwater until contaminant concentrations are shown to be protective of human health and the environment.

The Navy conducted Site Assessment Screening Evaluations for soil at Site 9 and Site 23 (particularly in the vicinity of OT-4 and OT-10) and determined there are no remaining CERCLA issues. Closure for soil at Site 9 and Site 23 under CERCLA will require additional steps including the preparation of a NFA ROD under CERCLA for soil; the Navy is preparing a technical memorandum which will detail these steps.

The OU 9 LUC RD provides institutional controls for Sites 9 and 23, SUBASENLONINST 5090.25 directs base personnel to the OU 9 LUC RD.

The groundwater remedy for Sites 9 and 23 is protective of human health and the environment; LUCs minimize exposure to groundwater at Sites 9 and 23.

#### **Lower Subase — Operable Unit 4**

Within NSB NLON, the Lower Subase consists of approximately 33 acres on the eastern bank of the Thames River with 15 piers and berths for submarine docking, and facilities for submarine maintenance, repair, and overhaul. The Lower Subase ROD, signed since the last five-year review, included Zones 1 through 7 and recommended NFA for Zones 2, 5, and 6.

Sources of soil COCs throughout Lower Subase include USTs, former fuel distribution lines, and submarine maintenance activities, with utility lines acting as secondary conduits for transport. Existing development (i.e., buildings, foundations, and pavement) prevent, limit, or minimize human and ecological exposures. Sources of sediment COCs in OU 4 include releases from Zone 4 and Lower Subase and Former Pier 1 marine railway activities (sandblasting, paint scraping, and

ship maintenance). No groundwater COCs were identified for any Lower Subbase zones. Remedial actions at OU 4 are in progress. Some components of the remedial action (soil LUCs, long-term groundwater monitoring [to confirm contaminants in soil are not migrating to groundwater], and regular inspections) are being managed comprehensively and will be implemented at each zone upon completion of remedial action at Zone 4.

Zone-specific remedy components are discussed below.

### ***Zone 1 (Sites 10 and 11)***

Remedial actions at OU 4 Zone 1 are still ongoing. Zone 1 includes Site 10 (Fuel Storage Tanks and Tank 54-H) and Site 11 (Building 29 Power Plant Oil Tanks). Zone 1 soil poses potentially unacceptable risk to residential receptors. The selected remedy included institutional controls (including CERCLA risk-based engineering controls).

Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at OU 4 Zone 1 (Sites 10 and 11) will be protective of human health and the environment upon completion. CERCLA risk-based engineering controls (existing building foundations and pavement) are in place, and LUCs and long-term monitoring will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

### ***Zone 3 (Site 17)***

Remedial actions at OU 4 Zone 3 are still ongoing. Zone 3 Site 17 includes Former Building 31, which was the Former Battery Overhaul Shop and a hazardous/flammable materials warehouse. Zone 3 soil contains lead levels that pose potentially unacceptable risk to residential and industrial/commercial (I/C) receptors. The selected remedy included institutional controls (including CERCLA risk-based engineering controls and CTDEEP Remediation Standard Regulations [RSR] engineered controls).

Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at OU 4, Zone 3 (Site 17) will be protective of human health and the environment upon completion. CERCLA risk-based engineering controls (existing building foundations and pavement) and CTDEEP RSR engineered controls (pavement installed as a component of the remedy) are in place, and LUCs and long-term monitoring will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

#### ***Zone 4 (Sites 13 and 19) and Outer Pier 1***

Zone 4 includes Sites 13 (Former Building 79 Waste Oil Pit) and 19 (Former Solvent Storage Building), the Thames River between Piers 2 and 6, and the Quay Wall Study Area. Outer Pier 1, at the south end of Lower Subase, includes the middle and south end of former Pier 1 and the adjoining Thames River sediment; former Pier 1 was subdivided into Inner and Outer subareas based on contaminant distribution. Zone 4 and Outer Pier 1 are separated by buildings and remnants of Inner Pier 1.

**SOIL** — Remedial actions at OU 4 Zone 4 soil are still ongoing. Sources of soil contamination include releases of petroleum products, waste oil, and solvents from Sites 13 and 19, and layers of petroleum contamination in soil in the quay wall area. Zone 4 soil COCs — primarily lead and polynuclear aromatic hydrocarbons (PAHs) — exceed CTDEEP Residential and I/C RSRs. The selected soil remedy included excavation to meet CTDEEP I/C direct exposure criteria and pollutant mobility criteria RSRs, institutional controls (including CERCLA risk-based engineering controls), and long-term groundwater monitoring.

**SEDIMENT** — Remedial actions at OU 4 Zone 4 sediment are still ongoing. Storm sewer outfalls discharge runoff from industrial areas within Lower Subase to the Thames River and ship maintenance activities (e.g., sandblasting, paint scraping, and ship maintenance) occur at the former Pier 1 marine railway. Releases from these sources and other sources throughout Lower Subase may have contributed to contamination in Thames River sediment in Zone 4 and Outer Pier 1. Metals, PAHs, pesticides, and polychlorinated biphenyls (PCBs) pose unacceptable ecological risks to benthic invertebrates and piscivorous birds. The COCs exceed site-specific remedial goals: an ERM-Q (1.17) and total PCB cogener 1 mg/kg). The selected sediment remedy includes dredging in Zone 4 and maintaining the existing clean cover in Outer Pier 1, sediment LUCs, and long-term surface water and sediment monitoring to confirm contaminants are not migrating.

**SOIL AND SEDIMENT** — Currently, human, but not ecological exposures are under control. No human health risks are occurring but ecological risks are still present. The remedy at OU 4, Zone 4 (Sites 13 and 19) and Outer Pier 1, will be protective of human health and the environment upon completion. Soil and sediment removal actions will have been completed, CERCLA risk-based engineering controls (existing building foundations and pavement) are in place, and LUCs and long-term monitoring will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

#### ***Zone 7 (Sites 21 and 25)***

Remedial actions at OU 4 Zone 7 are still ongoing. Suspected contaminant sources in Zone 7 include the Former Classified Materials Incinerator (Site 25), former PCB-containing transformers, a

former Dumpster Washing Area, and a former diesel fuel UST, underground fuel distribution lines, and historical operations associated with Site 21 (Berth 16). Lead detected in Zone 7 soil may also be associated with historical maintenance of submarine batteries, use of lead ballast, and construction debris and ash that remain in the subsurface from the former incinerator. Zone 7 soil COCs exceed Residential and I/C RSRs. The selected remedy components are institutional controls, including installing CTDEEP RSR engineered controls and maintaining CERCLA risk-based engineering controls. The remedy also included storm sewer upgrades to address leachability issues where storm sewers passed through contaminated soil.

Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at OU 4, Zone 7 (Sites 21 and 25) will be protective of human health and the environment upon completion. Storm sewer upgrades have been completed, CERCLA risk-based engineering controls (existing building foundations and pavement) and CTDEEP RSR engineered controls (pavement installed as a component of the remedy) are in place, and LUCs and long-term monitoring will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

### SITE IDENTIFICATION

**Site Name:** Naval Submarine Base New London

**EPA ID:** CTD980906515

**Region:** 1

**State:** CT

**City/County:** Groton, New London

### SITE STATUS

**NPL Status:** Final

**Multiple OUs?**

Yes

**Has the site achieved construction completion?**

No

### REVIEW STATUS

**Lead agency:** Other Federal Agency

**If "Other Federal Agency" was selected above, enter Agency name:** Department of the Navy, Naval Facilities Engineering Mid-Atlantic (NAVFAC MIDLANT)

**Author name (Federal or State Project Manager):** Nicole Cowand

**Author affiliation:** Navy Remedial Project Manager

**Review period:** October 2015 to June 2016

**Date of site inspection:** 14 October 2015

**Type of review:** Statutory

**Review number:** 4

**Triggering action date:** 19 December 2011 (approval letter)

**Due date (*five years after triggering action date*):** As indicated in the 19 December 2011 approval letter, this Fourth Five-Year Review is due 20 December 2016.

Issues/Recommendations				
<b>OU(s) without Issues/Recommendations Identified in the Five-Year Review:</b>				
This five-year review did not identify issues or recommendations/follow-up actions that affect protectiveness at Operable Units (OUs) 1, 3, 4, 5, 9, or 12.				
<b>Issues and Recommendations Identified in the Five-Year Review:</b>				
<b>OU: 2-1 Site 6</b>	<b>Issue Category: Institutional Controls</b>			
	<b>Issue:</b> Subbase New London Instruction (SUBASENLONINST) 5090.25 is not being properly enforced, as indicated by rebar installed through the cap.			
	<b>Recommendation:</b> Ensure proper enforcement of SUBASENLONINST 5090.25. Consider alternatives to prevent recurrence including implementation of enhanced signage, markings, and a storage permit (similar to the one developed for the Area A Landfill [Site 2A]).			
<b>Affect Current Protectiveness</b>	<b>Affect Future Protectiveness</b>	<b>Implementing Party</b>	<b>Oversight Party</b>	<b>Milestone Date</b>
No	Yes	Navy	EPA/State	31 July 2017
<b>OU: 2-2 Site 6</b>	<b>Issue Category: Operations and Maintenance</b>			
	<b>Issue:</b> Rebar penetrated the cap in at least two locations.			
	<b>Recommendation:</b> Seal the rebar in place, if necessary, then investigate and repair any cap damage identified, as necessary.			
<b>Affect Current Protectiveness</b>	<b>Affect Future Protectiveness</b>	<b>Implementing Party</b>	<b>Oversight Party</b>	<b>Milestone Date</b>
No	Yes	Navy	EPA/State	31 July 2017
<b>OU: 4-1 Sites 13 and 19</b>	<b>Issue Category: Remedy Performance</b>			
	<b>Issue:</b> At this time, the soil excavation has not achieved remedial goals and a decision for the scope of additional remedial action has not been documented.			
	<b>Recommendation:</b> Determine the scope of the additional remedial action necessary to achieve the remedial goals and modify the decision documents as appropriate.			
<b>Affect Current Protectiveness</b>	<b>Affect Future Protectiveness</b>	<b>Implementing Party</b>	<b>Oversight Party</b>	<b>Milestone Date</b>
No	Yes	Navy	EPA/State	31 December 2018



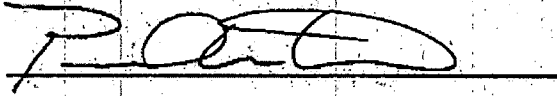
Protectiveness Statement(s)		
<i>Operable Unit:</i> 00001	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Site 2A — Area A Landfill</b>		
<i>Protectiveness Statement:</i> Remedial actions implemented at Site 2A are protective of human health and the environment. Source control actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration and prevent direct contact with soil. An Operations and Maintenance program has been implemented and results verify that the cap is performing as designed. Implementation of Subbase New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		
<i>Operable Unit:</i> 00012	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Site 2B — Area A Wetland</b>		
<i>Protectiveness Statement:</i> Remedial actions implemented at Site 2B are protective of human health and the environment. The sediment removal action (excavation, disposal, and wetland restoration) addressed ecological exposures. An Operations and Maintenance program has been implemented and results verify that the restoration is performing as designed. The Site 2B Land Use Control Remedial Design provides institutional controls for sediment.		
<i>Operable Unit:</i> 00003	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Site 3 — Area A Downstream Water Courses/Overbank Disposal Area</b>		
<i>Protectiveness Statement:</i> Remedial actions implemented at Site 3 are protective of human health and the environment. Soil and sediment actions (excavation and subsequent encapsulation of residual contamination) addressed human health and ecological exposures. An Operations and Maintenance program has been implemented and results verify that the soil and sediment remedy is performing as designed. Implementation of Subbase New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		
<i>Operable Unit:</i> 00002	<i>Protectiveness Determination:</i> Short-term Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Site 6 — Former Defense Reauthorization and Marking Office</b>		
<i>Protectiveness Statement:</i> Remedial actions implemented at Site 6 are currently protective of human health and the environment in the short term. Most of the source was removed and the remaining material was contained by a cap system during a Time Critical Removal Action; the cap system minimizes infiltration and subsequent contaminant migration and prevents direct contact with soil. An Operations and Maintenance program has been implemented and results verify that the remedy and cap are performing as designed. Implementation of Subbase New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized. However, to provide long-term protectiveness, it is necessary to ensure proper enforcement of Subbase New London Instruction 5090.25 by implementation of a storage permit in the LUC RD, improved onsite markings (i.e. painting a line along the cap boundary), and to assess whether cap penetrations will affect cap integrity.		
<i>Operable Unit:</i> 00005	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Site 8 — Goss Cove Landfill</b>		
<i>Protectiveness Statement:</i> Remedial actions implemented at Site 8 are protective of human health and the environment. Remedial actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration, and prevent direct contact with soil. An Operations and Maintenance program has been implemented and results verify that the cap is performing as designed. Implementation of Subbase New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		

Protectiveness Statement(s)		
<i>Operable Unit:</i> 00009	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Basewide Groundwater (Sites 2A, 2B, 3, 9, and 23)</b>		
<i>Protectiveness Statement:</i> The Operable Unit 9 Land Use Control Remedial Design provides institutional controls for Sites 2A, 2B, 3, 9, and 23. The groundwater remedy (groundwater and surface water monitoring and land use controls) remains protective at Sites 2A and 2B. The Operable Unit 9 groundwater remedy (groundwater monitoring and land use controls) remains protective at Site 3. The groundwater remedy for Sites 9 and 23 is protective of human health and the environment; land use controls minimize exposure to groundwater at Sites 9 and 23.		
<i>Operable Unit:</i> 00004	<i>Protectiveness Determination:</i> Will be Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Zone 1 (Sites 10 and 11)</b>		
<i>Protectiveness Statement:</i> Remedial actions at Operable Unit 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at Operable Unit 4 Zone 1 (Sites 10 and 11) will be protective of human health and the environment upon completion. Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls (existing building foundations and pavement) are in place, and land use controls and long-term monitoring will be established to enforce remedy implementation. Implementation of Subarea New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		
<i>Operable Unit:</i> 00004	<i>Protectiveness Determination:</i> Will be Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Zone 3 (Site 17)</b>		
<i>Protectiveness Statement:</i> Remedial actions at Operable Unit 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at Operable Unit 4, Zone 3 (Site 17) will be protective of human health and the environment upon completion. Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls (existing building foundations and pavement) and Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations engineered controls (pavement installed as a component of the remedy) are in place, and land use controls and long-term monitoring will be established to enforce remedy implementation. Implementation of Subarea New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		
<i>Operable Unit:</i> 00004	<i>Protectiveness Determination:</i> Will be Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Zone 4 (Sites 13 and 19) and Outer Pier 1</b>		
<i>Protectiveness Statement:</i> Remedial actions at Operable Unit 4 are still ongoing. Currently, human, but not ecological exposures are under control. No human health risks are occurring but ecological risks are still present. The remedy at Operable Unit 4, Zone 4 (Sites 13 and 19) and Outer Pier 1, will be protective of human health and the environment upon completion. Soil and sediment removal actions will have been completed, Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls (existing building foundations and pavement) are in place, and land use controls and long-term monitoring will be established to enforce remedy implementation. Implementation of Subarea New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.		

Protectiveness Statement(s)		
<i>Operable Unit:</i> 00004	<i>Protectiveness Determination:</i> Will be Protective	<i>Addendum Due Date (if applicable):</i> Not Applicable
<b>Zone 7 (Sites 21 and 25)</b>		
<p><i>Protectiveness Statement:</i> Remedial actions at Operable Unit 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at Operable Unit 4, Zone 7 (Sites 21 and 25) will be protective of human health and the environment upon completion. Storm sewer upgrades have been completed, Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls (existing building foundations and pavement) and Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations engineered controls (pavement installed as a component of the remedy) are in place, and land use controls and long-term monitoring will be established to enforce remedy implementation. Implementation of Subarea New London Instruction 5090.25 provides institutional controls until the Land Use Control Remedial Design is finalized.</p>		

## AUTHORIZING SIGNATURES

By my signature below, I approve the issuance of this Final Fourth Five-Year Review for the Naval Submarine Base New London, in Groton, Connecticut.



Captain Paul Whitescarver  
Commander  
Naval Submarine Base New London



Date

## **1.0 INTRODUCTION**

The United States Department of the Navy (Navy), through the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, is conducting this five-year review of the remedial actions implemented at Naval Submarine Base New London (NSB NLON) in Groton, Connecticut. The National Superfund electronic database identification number for NSB NLON is CTD980906515.

The purpose of this five-year review is to evaluate implementation and performance of remedies at seven operable units (OUs) (OU 1, OU 2, OU 3, OU 4, OU 5, OU 9, and OU 12) to determine if they are protective of human health and the environment. The methods, findings, and conclusions of the review are documented in this five-year review report. In addition, this report will document any issues identified during the review and recommend specific follow-up actions to address them.

### **1.1 Authority for Conducting the Five-Year Review**

This five-year review was prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section §121(c), as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan in Title 40 Code of Federal Regulations §300.430(f)(4)(ii).

Consistent with Executive Order 12580, the Secretary of Defense is responsible for ensuring that five-year reviews are conducted at federal facility sites under jurisdiction, custody, or control of the Department of Defense (DoD). The Navy is the lead agency responsible for this five-year review at NSB NLON, working with the United States Environmental Protection Agency (U.S. EPA) Region 1 and the Connecticut Department of Energy and Environmental Protection (CTDEEP) under a Federal Facility Agreement (FFA) (U.S. EPA October 1994).

This is the fourth five-year review for NSB NLON, and is a statutory review required because hazardous substances, pollutants, and contaminants remain at each OU above levels that allow for unlimited use/unrestricted exposure (UU/UE). The triggering action for the first five-year review was initiation of remedial action at Site 2A — Area A Landfill (OU 1), which began in December 1996. The First, Second, and Third Five-Year Review Reports were signed on 11 November 2001, 20 December 2006, and 14 December 2011, respectively.

#### **1.1.1 Sites Included in this Five-Year Review**

Table 1-1 lists NSB NLON sites and corresponding OUs included in this five-year review.

Table 1-1 Sites Included In This Five-Year Review			
Site	Operable Unit	Media	Construction Complete?
Site 2A — Area A Landfill	OU 1	Soil	Yes <sup>[1]</sup>
	OU 9	Groundwater	Yes
Site 2B — Area A Wetland	OU 12	Sediment	Yes
	OU 9	Groundwater	Yes
Site 3 — Area A Downstream Water Courses/Overbank Disposal Area	OU 3	Soil, Sediment	Yes <sup>[1]</sup>
	OU 9	Groundwater	Yes
Site 6 — Former Defense Reutilization and Marketing Office	OU 2	Soil <sup>[2]</sup>	Yes <sup>[1]</sup>
Site 8 — Goss Cove Landfill	OU 5	Soil, Sediment <sup>[2]</sup>	Yes <sup>[1]</sup>
Site 23 — Former Fuel Farm	OU 9	Groundwater	Yes
	None	Soil <sup>[3]</sup>	No
Site 9 — Former Wastewater Oily Tank 5	OU 9	Groundwater	Yes
	None	Soil <sup>[3]</sup>	No
Site 10 — Fuel Storage Tanks and Former Tank 54-H and Site 11 — Power Plant Oil Tanks — Zone 1	OU 4	Soil <sup>[1],[2]</sup>	No
Site 17 — Former Hazardous Materials/Solvent Storage Area — Former Building 31 — Zone 3	OU 4	Soil <sup>[1],[2]</sup>	No
Site 13 — Building 79 Former Waste Oil Pit, Site 19 — Former Solvent Storage Area (Former Building 316), and Outer Pier 1 — Zone 4	OU 4	Soil <sup>[1],[2]</sup> , Sediment <sup>[1],[4]</sup>	No
Site 21 — Berth 16 and Site 25 — Former Classified Materials Incinerator — Zone 7	OU 4	Soil <sup>[2]</sup>	No

**Notes:**

OU = Operable Unit

<sup>[1]</sup> Land Use Control Remedial Design portion of the selected remedy is pending finalization.

<sup>[2]</sup> Groundwater is not a medium of concern under this operable unit/site, but will be monitored as a component of the soil remedy to ensure the contaminants in soil are not migrating to groundwater and/or to surface water via groundwater.

<sup>[3]</sup> Soil at Site 9 and Site 23 are not part of an OU and therefore do not have remedies to review but are included in this document for discussion purposes. The results of respective Site Assessment Screening Evaluations for soil at these sites is no further action.

<sup>[4]</sup> Surface water is not a medium of concern under this operable unit/site, but will be monitored as a component of the sediment remedy to ensure the contaminants in sediment are not migrating to surface water.

### 1.1.2 Sites Not Included in this Five-Year Review

Table 1-2 lists sites not included in this five-year review, based on Records of Decisions (RODs) that documented No Further Action (NFA) was necessary and findings from previous five-year review reports.

<b>Table 1-2 Sites Not Included In This Five-Year Review</b>			
<b>Site</b>	<b>Operable Unit</b>	<b>Media</b>	<b>Rationale</b>
Site 1 — Former Construction Battalion Unit Drum Storage Area	OU 1	Soil, Groundwater	NFA ROD (NAVFAC July 1996)
Site 4 — Former Rubble Fill at Bunker A-86	OU 10	Soil, Groundwater	NFA ROD (NAVFAC June 1998)
Site 5 — Building A-85 Container Storage Area	NA	Soil, Groundwater	Non-CERCLA (RCRA) (Tetra Tech September 2005)
Site 7 — Torpedo Shops	OU 8	Soil	UU/UE <sup>[1]</sup> (Tetra Tech December 2006)
	OU 9	Groundwater	UU/UE <sup>[2]</sup> (NAVFAC September 2008)
Site 14 — Former Overbank Disposal Area Northeast	OU 8	Soil	NFA ROD (NAVFAC September 2004)
	OU 9	Groundwater	NFA ROD (NAVFAC September 2008)
Site 15 — Former Spent Acid Storage and Disposal Area	OU 6	Soil	NFA ROD (NAVFAC August 1997)
	OU 9	Groundwater	NFA ROD (NAVFAC September 2008)
Site 16 — Former Hospital Incinerators	OU 11	Soil, Groundwater	NFA ROD (NAVFAC September 2004)
Site 18 — Solvent Storage Area (Building 33)	OU 11	Soil	NFA ROD (NAVFAC September 2004)
	OU 9	Groundwater	NFA ROD (NAVFAC September 2008)
Site 20 — Area A Weapons Center	OU 7	Soil, Sediment	UU/UE <sup>[1]</sup> (Foster Wheeler June 2002)
	OU 9	Groundwater	NFA ROD (NAVFAC September 2008)
Site 22 — Pier 33 — Zone 5	OU 4	Soil, Sediment, Groundwater, Surface Water	NFA ROD (NAVFAC August 2012)
Site 24 — Central Paint Accumulation Area (Building 174) — Zone 6	OU 4	Soil, Sediment, Groundwater, Surface Water	NFA ROD (NAVFAC August 2012)
No Site Assigned— Subsurface Oil Distribution, Steam, Condensate, and Electrical Lines — Zone 2	OU 4	Soil, Sediment, Groundwater, Surface Water	NFA ROD (NAVFAC August 2012)

**Notes:**

- OU = Operable Unit  
 NFA = No Further Action  
 ROD = Record of Decision  
 NA = Not Applicable  
 CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act  
 RCRA = Resource Conservation and Recovery Act  
 UU/UE = unlimited use/unrestricted exposure due to remedy completion

<sup>[1]</sup> Soil at Sites 7 and 20 are construction complete and the remedy met UU/UE. Soil at the sites was eliminated from future five-year reviews in the Third Five-Year Review Report (NAVFAC December 2011). The soil remedy for Site 7 was presented in the OU 8 ROD (NAVFAC September 2004) and the soil and sediment remedy for Site 20 was presented in the OU 7 ROD (NAVFAC June 2000).

<sup>[2]</sup> Nine quarters of groundwater monitoring demonstrated that natural attenuation of contaminants reduced concentrations to below the selected remedial goals. Groundwater at the site was eliminated from future five-year reviews in the Third Five-Year Review Report (NAVFAC December 2011).

## **1.2 Report Organization**

This report is organized to meet the general format requirements specified in U.S. EPA's 2001 Comprehensive Five-Year Review Guidance, summarizing the results of the five-year review of each site in a cohesive and comprehensive manner. This report is organized as follows.

- The remainder of Section 1 provides an overview of NSB NLON and five-year review elements common to each OU/site.
- Section 2 describes the five-year review process including administrative components, site inspections, interviews, community involvement, emerging contaminants, vapor intrusion (VI), risk assessment review, and Applicable or Relevant and Appropriate Requirements (ARARs).
- Sections 3 through 13 consist of the five-year reviews for Site 2A, Site 2B, Site 3, Site 6, Site 8, Site 23, Site 9, Zone 1 (Sites 10 and 11), Zone 3 (Site 17), Zone 4 (Sites 13 and 19) and Outer Pier 1, and Zone 7 (Sites 21 and 25).
- Section 14 lists references used during this five-year review.

Each site-specific five-year review section includes background discussions, remedial action progress since the last five-year review, findings, a technical assessment, issues, recommendations, and a protectiveness statement. Individual site historical events and chronologies are tabulated in Appendix A.

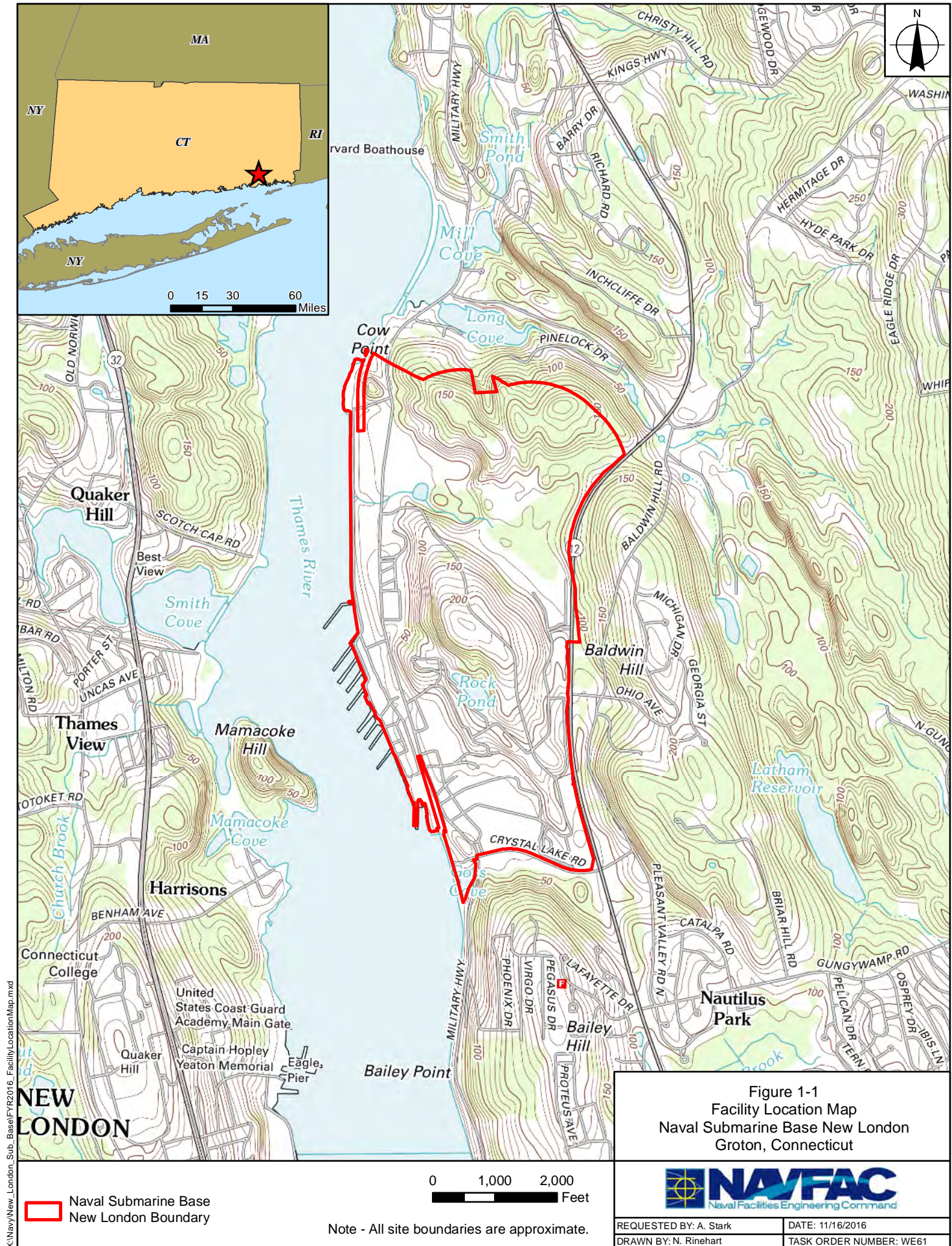
## **1.3 Facility Overview**

NSB NLON provides base operations support for Navy submarine forces and other naval organizations and tenants. NSB NLON accommodates submarine training facilities, military offices, medical facilities, and facilities for submarine maintenance, repair, and overhaul. The base also provides housing and support services for Navy personnel.

### **1.3.1 Location**

NSB NLON is located in southeastern Connecticut in the Towns of Ledyard and Groton and is situated on the eastern bank of the Thames River, as shown on Figure 1-1, approximately 6 miles north of Long Island Sound. NSB NLON is bordered to the east by Connecticut Route 12, to the south by Crystal Lake Road, and to the west by the Thames River. The northern border is a low ridge that trends approximately east-southeast from the Thames River to Baldwin Hill.





X:\Navy\New\_London\_Sub\_Base\FY2016\_FacilityLocationMap.mxd



### **1.3.1.1 Land Use**

NSB NLON consists of approximately 200 buildings on 687 acres, as shown on Figure 1-2, which includes locations of sites listed in Tables 1-1 and 1-2. NSB NLON is surrounded by fencing and access is controlled via gates with armed guards. Industrial, administrative, and training activities occur in the southern portion of NSB NLON (southern valley), and along the Thames River. In the northern portion of NSB NLON (northern valley) are streams, a wetland, and a golf course. The south face of the northern ridge (located in the northeast portion of the base) is heavily developed with the Area A Weapons Center and the Torpedo Shops. The top and northern faces of the northern ridge (in the extreme northeast of the base) are wooded, undeveloped areas. Base housing is in the southeast portion of NSB NLON, along Connecticut Route 12.

Within NSB NLON, the Lower Subbase (shown on Figure 1-3), consists of approximately 33 acres on the eastern bank of the Thames River that extend from just south of Pier 2 to just north of Pier 33. The Lower Subbase contains administrative buildings, 15 piers and berths for submarine docking, and facilities for submarine maintenance, repair, and overhaul.

### **1.3.1.2 Surrounding Area**

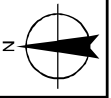
Land use adjacent to the base is residential and commercial. Residential development along Military Highway, Sleepy Hollow Pentway, Long Cove Road, and Pinelock Drive borders the site to the north and extends northward into the Gales Ferry section of Ledyard. Property along Connecticut Route 12 east of the base consists of widely spaced private homes and woods. Farther south along Connecticut Route 12 are mixed commercial and residential developments that include a church, automobile sales and repair facilities, convenience stores, restaurants, and a gas station. Private residences and an automobile service station are located along the south side of Crystal Lake Road. Housing for Navy personnel and families is located farther south of Crystal Lake Road.

### **1.3.2 History and General Chronology**

Table 1-3 lists important NSB NLON historical events and relevant basewide chronology. The identified events are illustrative, not comprehensive. Site-specific histories are provided in subsequent sections of this five-year review report and in Appendix A.<sup>1</sup> Reports that document the events and activities are referenced in Section 14.

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<sup>1</sup> Major OU 9 events noted in Table 1-3 are discussed in more detail (as appropriate) in each site-specific five-year review section.



- SITE 1 - FORMER CONSTRUCTION BATTALION UNIT  
DRUM STORAGE AREA  
SITE 2A - AREA A LANDFILL  
SITE 2B - AREA A WETLAND  
SITE 3 - AREA A DOWNSTREAM WATERCOURSES/  
OVERBANK DISPOSAL AREA  
SITE 4 - FORMER RUBBLE FILL AREA AT BUNKER A-86  
SITE 6 - FORMER DEFENSE REUTILIZATION AND  
MARKETING OFFICE  
SITE 7 - TORPEDO SHOPS  
SITE 8 - GOSS COVE LANDFILL  
SITE 9 - FORMER WASTEWATER OILY TANK 5  
SITE 10 - LOWER SUBASE - FUEL STORAGE TANKS  
AND FORMER TANK 54-H  
SITE 11 - LOWER SUBASE - POWER PLANT OIL TANKS  
SITE 13 - LOWER SUBASE - BUILDING 79 FORMER WASTE OIL PIT  
SITE 14 - OVERBANK DISPOSAL AREA NORTHEAST  
SITE 15 - FORMER SPENT ACID STORAGE AND  
DISPOSAL AREA  
SITE 16 - FORMER HOSPITAL INCINERATORS  
SITE 17 - LOWER SUBASE - FORMER HAZARDOUS MATERIALS/  
SOLVENT STORAGE AREA (FORMER BUILDING 31)  
SITE 18 - SOLVENT STORAGE AREA (BUILDING 33)  
SITE 19 - LOWER SUBASE - FORMER SOLVENT  
STORAGE AREA (FORMER BUILDING 316)  
SITE 20 - AREA A WEAPONS CENTER  
SITE 21 - LOWER SUBASE - BERTH 16  
SITE 22 - LOWER SUBASE - PIER 33  
SITE 23 - FORMER FUEL FARM  
SITE 24 - LOWER SUBASE - CENTRAL PAINT ACCUMULATION  
AREA (BUILDING 174)  
SITE 25 - LOWER SUBASE - FORMER CLASSIFIED  
MATERIALS INCINERATOR
- SITE BOUNDARY  
 ZONE BOUNDARY  
 LOWER SUBASE BOUNDARY  
 NAVAL SUBMARINE BASE  
NEW LONDON BOUNDARY

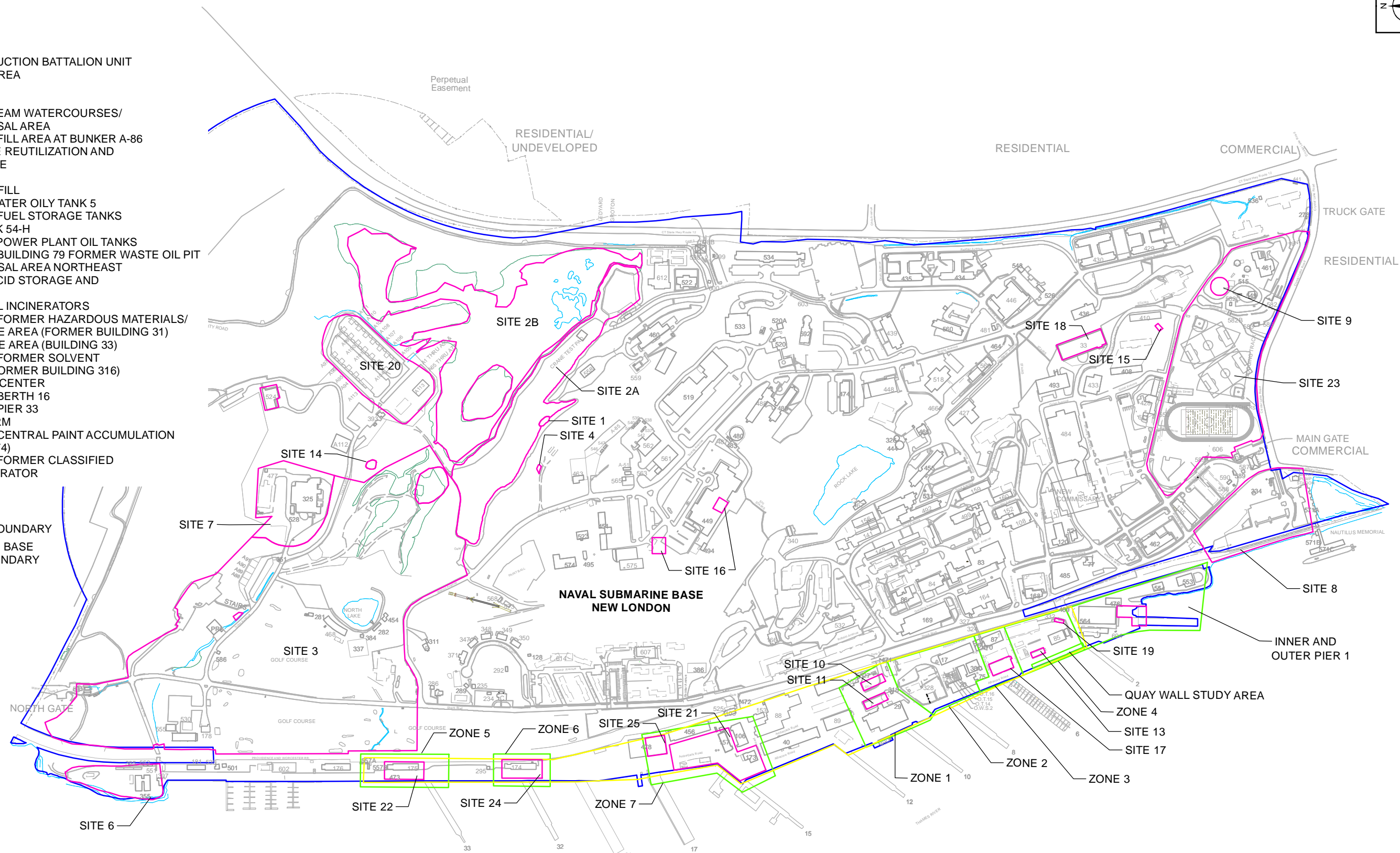


Figure 1-2  
Site Location Map  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/16/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

NOTE - ALL SITE BOUNDARIES ARE APPROXIMATE.





- Site Boundary
- Zone Boundary
- Lower Subbase Boundary

0 600 1,200 Feet

Note - All site boundaries are approximate.

Figure 1-3  
Lower Subbase Layout Map  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/16/2016

DRAWN BY: N. Rinehart

TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/2016

### **1.3.3 Physical Characteristics**

#### **1.3.3.1 Physiography and Topography**

Four bedrock highs form the topographic upland areas at NSB NLON and in the surrounding area. East of the base, Baldwin Hill reaches an elevation of 245 feet above mean sea level (msl). In the northern, central, and southern portions of the base, the bedrock highs reach elevations that also exceed 200 feet above msl. These bedrock highs have a northwest-southeast trend, which is consistent with the regional strike and other bedrock features in the region (United States Geological Survey [USGS] 1967). The western edge of the base borders the Thames River, with elevations near sea level (Brown & Root Environmental [B&RE] March 1997).

At NSB NLON, the bedrock highs slope downward to two small, west-trending valleys. Bedrock outcrops are prevalent along steep topographic slopes. Several small sub-ridges are also visible as bedrock outcrops at NSB NLON. Two principal sub-ridges are east of the Former Defense Reutilization and Marketing Office (DRMO) (Site 6) and northeast of the Goss Cove Landfill (Site 8) (B&RE March 1997).

**Table 1-3  
Naval Submarine Base New London General Chronology**

<b>Event</b>	<b>Date</b>
State of Connecticut donates 112 acres on the east bank of the Thames River to the Department of the Navy (Navy)	1867
Navy officially designates the property as a Navy Yard	1868
Navy officially designates the site as a Submarine Base	1916
Six piers and 81 buildings added	1917-1918
Submarine school established	1917
Submarine Medical Center founded	1918
180 buildings constructed and adjacent land acquired	1935-1945
Medical Research Laboratory established	1946
Submarine School became largest tenant	1968
Naval Submarine Support Facility established	1974
Naval Undersea Medical Institute established	1975
First environmental study for investigation of oil contamination in groundwater at Naval Submarine Base New London (NSB NLON)	February 1979
Navy initiated the Naval Assessment and Control of Installation Pollutants Program	1980
Initial Assessment Study completed at NSB NLON	March 1983
Department of Defense developed the Installation Restoration Program	1986
Inclusion of NSB NLON on the Federal Agency Hazardous Waste Compliance Docket	1988
United States Environmental Protection Agency (U.S. EPA) adds NSB NLON to the National Priorities List (NPL)	August 1990
Resource Conservation and Recovery Act Facility Investigation completed	1992
Phase I Remedial Investigation (RI)	August 1992
Federal Facility Agreement signed by the Navy, U.S. EPA, and Connecticut Department of Energy and Environmental Protection	October 1994
Background Soils Data Report	July 1994
Background Concentrations of Inorganics in Soil Report	April 1995



<b>Table 1-3 Naval Submarine Base New London General Chronology</b>	
<b>Event</b>	<b>Date</b>
Initiation of the remedial action for Site 2A — Area A Landfill soil	December 1996
Phase II RI Report	March 1997
Standard Operating Procedure Administrative (SOPA [ADMIN]) New London Instruction (NLOINST) 5090.18 issued (Established Installation Restoration Site Use Restrictions at NSB NLON)	October 2000
First Five-Year Review Report	November 2001
Basewide Groundwater Operable Unit Remedial Investigation (BGOURI)	December 2001
Operations and Maintenance (O&M) Manual — Volumes I, III, IV, and V (Revision 0 Final)	September 2002
O&M Manual — Volume II (Revision 0 Final)	March 2003
SOPA (ADMIN) NLOINST 5090.18B issued	February 2003
BGOURI Update/Feasibility Study (FS)	July 2004
O&M Manual — Volumes I, II, III, IV, and V	January 2006
Basewide monitoring well inventory	September 2007
Second Five-Year Review Report	December 2006
SOPA (ADMIN) NLOINST 5090.18C issued	December 2006
Basewide Groundwater Operable Unit (OU) 9 Record of Decision signed	September 2008
SOPA (ADMIN) NLOINST 5090.18D issued	September 2008
Letters to Towns of Ledyard (1 September) and Groton (14 September) regarding Land and Groundwater Use Restrictions submitted by the Navy	September 2009
Basewide Groundwater OU 9 Land Use Control Remedial Design	November 2009
SOPA (ADMIN) NLOINST 5090.25 issued (Establishment and Maintenance of Environmental Restoration Land Use Controls and Restrictions at NSB NLON) (replaced SOPA [ADMIN] NLOINST 5090.18D)	June 2009
Basewide Groundwater OU 9 Remedial Action Completion Report	June 2010
O&M Manual — Volumes I, II, III, IV, V, and VI (Revision 2 Final)	July 2011
Third Five-Year Review	December 2011
O&M Manual — Volumes I (Revision 3 Final), VII, and VIII (Revision 0 Final)	November 2012
Subbase New London Instruction 5090.25 issued (Establishment and Maintenance of Environmental Restoration Land Use Controls and Restrictions at NSB NLON) for sites without Land Use Control Remedial Designs (replaced SOPA [ADMIN] NLOINST 5090.25)	April 2013

### 1.3.3.2 Climate

Southeastern Connecticut is in the northern temperate zone and is influenced by cold, dry continental-polar air during the winter and warm, humid maritime air during the summer. During the winter, the area often experiences extensive winter storm activity and variable daily temperatures (B&RE March 1997).

Average monthly temperatures vary from 22 degrees Fahrenheit (°F) in the winter (January) to 78°F in the summer (July). Throughout the year, the wind speeds vary from 0 miles per hour (mph) to 18 mph (weatherspark.com). Annual precipitation ranges from 32 to 65 inches and averages approximately 44 inches as measured at New London over an 81-year period (B&RE March 1997). The greatest quantity of precipitation falls in April and the least in September (weatherspark.com). Annual evaporation averages approximately 23 inches (NAVFAC 1988).

### **1.3.3.3 Geology and Hydrogeology**

#### **Regional Geology**

NSB NLON is situated in the Eastern Uplands region of Connecticut, which has irregular hills of exposed bedrock and poorly drained, uneven valleys. The bedrock consists of metamorphosed rocks of sedimentary and igneous origin which has been faulted and folded. A major east-west trending fault (the Honey Hill Fault) is located approximately 6 miles north of NSB NLON. The fault does not intersect NSB NLON (B&RE March 1997).

NSB NLON is underlain by bedrock of five different formations (USGS 1967):

- Alaskite Gneiss — orange-pink to light gray, medium-grained granitic gneiss
- Granitic Gneiss — orange-pink to light gray, medium-grained granitic gneiss
- Mamacoke Formation — light to dark gray, medium-grained biotite-quartz-feldspar gneiss
- Plainfield Formation — dark green hornblende-biotite-quartz-plagioclase gneiss
- Westerly Granite — gray, fine- to medium-grained equigranular granite

Most of the surficial deposits in the area are unconsolidated glacial materials that were deposited during the Pleistocene Age. There are two types of glacial deposits at NSB NLON: stratified drift and glacial till. Stratified drift consists of sorted silt, sand, and gravel that were deposited by meltwater streams. Stratified drift is located on terraces of the Thames River and is mapped along the western portion of the base (USGS 1960). Glacial till consists of a dense, heterogeneous mixture of clay, silt, sand, and rock fragments as large as boulders. Glacial till is exposed on most of the bedrock highs and most likely underlies outwash materials in the valleys. The thickness varies considerably but averages less than 10 feet (B&RE March 1997).

The uppermost deposits, which vary in both depth and thickness across NSB NLON, are the product of post-glacial river/floodplain processes and manmade modifications. Quaternary alluvium that consists of sand, silt, and gravel was mapped in the Area A Wetland (Site 2B) (USGS 1960). Fill materials are prevalent at many of the sites included in this five-year review (B&RE March 1997).

#### **Regional Hydrogeology**

Regionally, saltwater intrusion impacts groundwater in coastal areas. Groundwater is hard to very hard in 70 percent of the wells in the state's carbonate rock aquifer, 40 percent of the wells in the sedimentary rock aquifer, and 15 percent of the wells in the stratified drift and crystalline bedrock aquifers. High concentrations (up to 46,000 micrograms per liter [µg/L] of iron

and 14,000 µg/L of manganese) are a common natural groundwater quality problem in Connecticut (USGS 1986). NSB NLON is located in the stratified drift and crystalline bedrock aquifers (B&RE March 1997).

#### **1.3.3.4 Groundwater**

##### **Water Quality Classification**

Groundwater at NSB NLON is CTDEEP Class GB, which indicates that groundwater is presumed not suitable for human consumption without treatment (CTDEEP March 1997).<sup>2</sup> Groundwater shall not be extracted or used without documented permission from NSB NLON Environmental Division (Navy April 2013).

##### **Horizontal Groundwater Flow**

Depth to groundwater varies greatly across NSB NLON and ranges in depth from approximately 2 to 20 feet below grade. Groundwater at NSB NLON generally flows from Baldwin Hill to the west (toward the Thames River), but the water table surface locally mimics the bedrock and topographic surfaces. Precipitation infiltrates into the overburden and bedrock and flows radially from the areas of higher bedrock and topographic elevations toward areas of lower bedrock and topographic elevations. Groundwater ultimately flows toward the Thames River from two valleys and directly from the western edges of three bedrock highs (B&RE March 1997).

To the west of Baldwin Hill, surface water and groundwater are part of the Thames Major Basin which ultimately discharges into the Thames River. Hydraulic gradients in the bedrock are greatest where the bedrock surface slope is steepest (along the hillside at Former Rubble Fill at Bunker A86 [Site 4]) and decrease where the bedrock slope is milder (in the valley at Area A Downstream Watercourses [Site 3]) (B&RE March 1997).

East of NSB NLON, a major basin divide occurs along the ridges of Baldwin Hill (Connecticut Geological and Natural History Survey 1974). To the east of Baldwin Hill, surface water and groundwater are part of the Southeast Coast Major Basin, and are not expected to travel toward the facility due to the divide.

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<sup>2</sup> Designated uses for CTDEEP Class GB groundwater include: industrial process water and cooling waters and baseflow for hydraulically connected surface water bodies; presumed not suitable for human consumption without treatment (CTDEEP October 2013).



### **Vertical Components of Groundwater Flow**

The vertical component of groundwater flow is predominantly downward in upland areas of NSB NLON. However, at the base of the hills, the bedrock surface flattens and the overburden thickens. In those areas, upward gradients may occur, resulting in shallow bedrock groundwater discharge into the overburden. Generally, whether an upward or downward gradient develops depends on factors such as seasonal recharge, the bedrock configuration, depth of the overburden, topographic features, permeability, distance to the river, and the tides (B&RE March 1997).

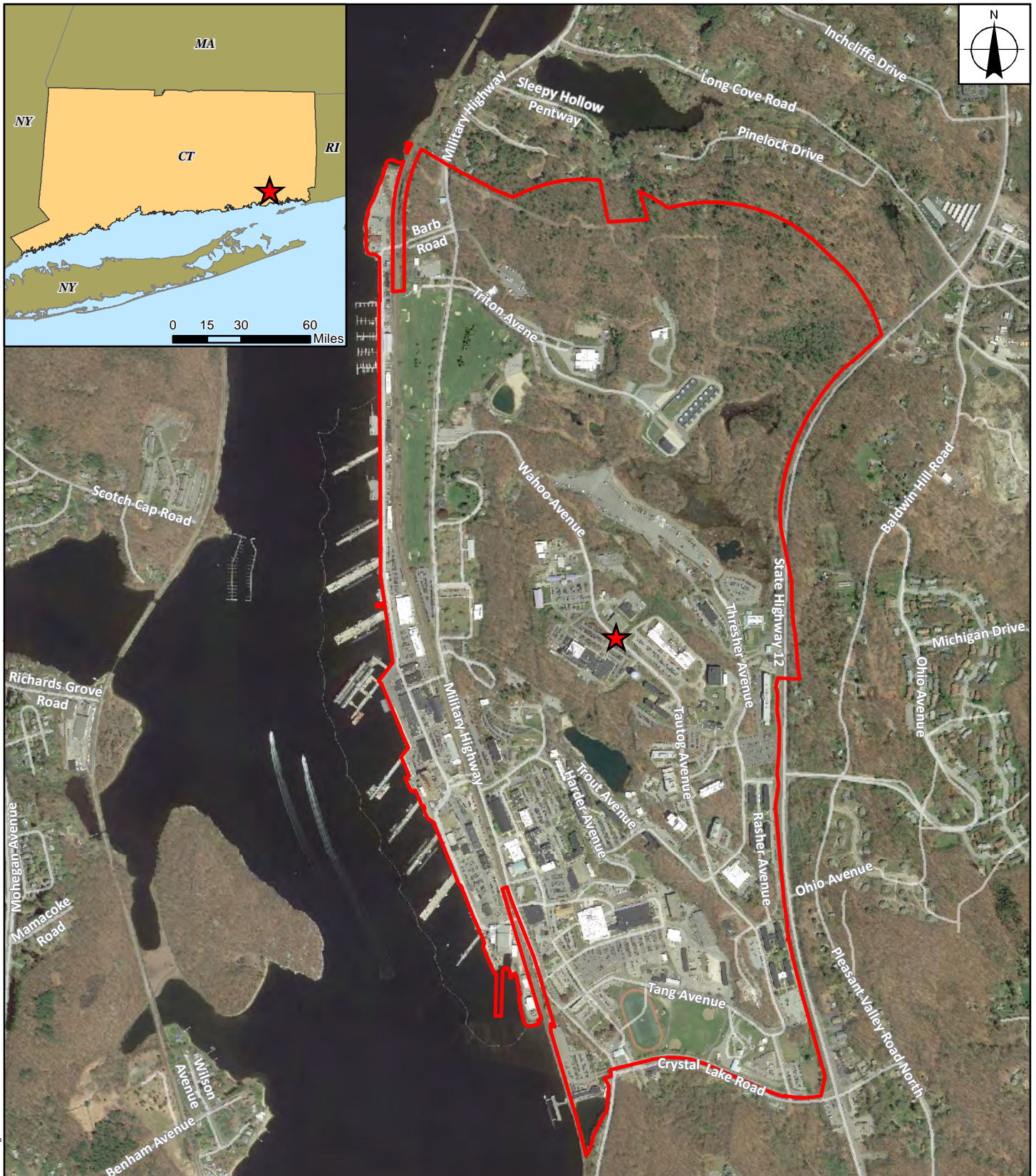
### **Tidal Influences on Groundwater Discharge**

The tides of the Thames River influence groundwater discharge from NSB NLON on a daily basis. Under normal flow conditions, discharge of groundwater to the Thames River is greatest at low tide. During high tide conditions, the elevation of the river is higher than the groundwater elevations observed along the western perimeter of the base, which creates localized reversed flow gradients (B&RE March 1997).

#### **1.3.3.5 Water Supply**

There are several well water users in the vicinity of NSB NLON, including the Groton Water Department, the Southeastern Connecticut Water Authority, the Town of Ledyard, and residences adjacent to the base. Residences on Connecticut Route 12 adjacent to the northeast portion of NSB NLON and on Sleepy Hollow Pentway, Long Cove Road, and Military Highway (these areas are shown on Figure 1-4) have been historically identified to have private water supply wells. Two trailer parks near the base have wells historically classified as public water supply wells. The existence of these private and public water supply wells have not been confirmed since the 1997 RI. The Colonel Ledyard Mobile Home Park, located on Sleepy Hollow Pentway adjacent to the NSB NLON North Gate, has a well that supplies between 15 and 20 families. The Grandview Trailer Park, located at the intersection of Long Cove Road and Connecticut Route 12, has two water supply wells (B&RE March 1997). Previous investigations determined that groundwater from NSB NLON does not contribute to these wells (Atlantic Environmental Services [Atlantic] July 1994).

The Groton Water Department supplies potable water to NSB NLON; the primary water supply sources of the Groton Water Department are reservoirs supplemented by wells. These water sources are located within the Poquonock River Watershed, east of the NSB NLON watershed. There are several NSB NLON golf course irrigation wells that have not been used for several years (B&RE March 1997).



Site Location



Naval Submarine Base New London  
Boundary

0 1,200 2,400  
Feet

Note - All site boundaries are approximate.

Figure 1-4  
Site Setting  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/16/2016

DRAWN BY: N. Rinehart

TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/2016



### **1.3.3.6 Surface Water Hydrology, Quality, and Designation**

#### **Thames River/Thames River Estuary**

NSB NLON is located on the eastern bank of the Thames River within the Thames River Watershed. The Thames River and its tributaries drain approximately 1,500 square miles of eastern Connecticut, western Rhode Island, and south-central Massachusetts. The Thames River originates in the City of Norwich Harbor, at the confluence of the Shetucket and Yantic Rivers, and discharges into Long Island Sound approximately 6 miles south of NSB NLON. Other sources of inflow include wastewater treatment facilities in Norwich, Montville, New London, the City of Groton, and the Town of Groton, as well as combined sewer overflows in Norwich, industrial discharges, and several small streams (B&RE March 1997).

The Thames River estuary extends approximately 16 miles north from Long Island Sound to Norwich. Widths of the river vary from 1.5 miles at New London Harbor (south) to approximately 500 feet at Norwich Harbor (north). A dredged channel runs north to south in the river. Depths in the dredged channel are approximately 40 feet below msl between Long Island Sound and NSB NLON and approximately 25 feet below msl farther upstream. At NSB NLON, the channel widens to approximately 600 to 900 feet and narrows upstream and downstream. Outside the channel, depths are relatively shallow (2 to 10 feet). Upstream of NSB NLON are shallow coves that empty into the river, most of which are at least partially cut off from the river by a railroad bed (B&RE March 1997).

The Thames River is a salt wedge estuary that is highly stratified with fresher water on the surface and denser saline water on the bottom. The north-south alignment, steep banks, and narrow channel prevent wind-induced vertical mixing in the Thames River. Therefore, the freshwater outflows reach Long Island Sound in a well-defined surface layer with saline water on the bottom (B&RE March 1997).

#### **Localized Surface Water Flow**

Surface water from NSB NLON drains west toward the Thames River via streams and storm sewers. The offsite portions of these watersheds include a sparsely developed residential area located to the east along Connecticut Route 12 and an area with limited commercial development located north of the Crystal Lake Road and Connecticut Route 12 intersection (B&RE March 1997).

Significant onsite drainage features include several streams (perennial and intermittent), ponds, Rock Lake, North Lake, and the Area A Wetland (Site 2B). Most of these surface water features are located in the north-central portion of NSB NLON. Six streams, three ponds, and North Lake are included in the Area Downstream Watercourses/Overbank Disposal Area (OBDA) (Site 3). The various

onsite surface water features drain to the Thames River through discharge points located at the Former DRMO (Site 6), the Lower Subase north of Pier 33, and the Goss Cove Landfill (Site 8) (B&RE March 1997).

### **Surface Water Quality and Designation**

CTDEEP classifies surface water to designate the water for marine fish, shellfish, and wildlife habitat, certain aquaculture operations, recreational uses, and industrial and other legitimate uses. The Thames River quality is classified as SC/SB, which indicates it does not meet water quality criteria or does not support one or more designated uses as a result of pollution (CTDEEP October 2013).

## **2.0 FIVE-YEAR REVIEW PROCESS**

The five-year review was conducted using the following U.S. EPA and Navy guidance:

- Chief of Naval Operations Letter 5090 N453 Ser/11U158119 (7 June 2011)
- U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P Comprehensive Five-Year Review Guidance (U.S. EPA June 2001)
- OSWER Directive 9355.7-18 Recommended Evaluation of Institutional Controls: Supplement to the Comprehensive Five-Year Review Guidance (U.S. EPA June 2011)
- OSWER Directive 9200.2-111 Clarifying the Use of Protectiveness Determinations for CERCLA Five-Year Reviews (U.S. EPA September 2012)
- NAVFAC Toolkit for Preparing Five-Year Reviews (NAVFAC April 2013)

### **2.1 Document Review**

This five-year review consisted of reviews of site-specific documentation, including RODs and Remedial Investigation (RI)/Feasibility Study (FS) reports to identify potential risks to human health and the environment. Those documents identified the following information useful to the five-year review process: human health and ecological risk assessments, remedial action objectives (RAOs), interim and final selected remedies, and ARARs.

To confirm remedies are operational and are functioning to meet RAOs, long-term monitoring (LTM) reports, operations and maintenance (O&M) documents, inspection reports, Land Use Control Remedial Design (LUC RD) documents, Site Assessment Screening Evaluations (SASEs), Remedial Action Completion Reports (RACRs), and remedial design (RD) documents were reviewed. These and other documents issued during this five-year review period were reviewed to assess remedy performance and continued protection of human health and the environment. Prior five-year reviews were also reviewed to ensure past issues associated with protectiveness have been addressed in accordance with recommendations. Section 14 lists the documents reviewed, organized by site/zone-specific sections.

## **2.2 Site Inspection**

The five-year review site inspection was performed on 14 October 2015 by the following personnel:

- Nicole Cowand, Navy Remedial Project Manager
- Tracey McKenzie, Navy NSB NLON Environmental Restoration Project Manager
- Kymberlee Keckler, U.S. EPA Region 1 Remedial Project Manager
- Gregory Kemp, U.S. EPA Contractor
- Kenneth Feathers, CTDEEP Remedial Project Manager
- Robert McCarthy, Matthew Panciera, and Alexandra Stark, Resolution Consultants

Inspection findings have been incorporated into each site section discussion. Photographs taken during the site inspection are in Appendix B and inspection forms for Site 2A, Site 2B, Site 3, Site 6, and Site 8 are in Appendix C. Information from annual LTM reports (prepared by H&S Environmental [H&S]) was used to facilitate the completion of the five-year review inspection forms.

## **2.3 Interviews**

Formal interviews were not conducted for this five-year review. However, input from the following personnel was used to complete the inspection forms in Appendix C:

- Nicole Cowand, Navy Remedial Project Manager
- Tracey McKenzie, Navy NSB NLON Environmental Restoration Project Manager
- Kymberlee Keckler, U.S. EPA Region 1 Remedial Project Manager
- Kenneth Feathers, CTDEEP Remedial Project Manager

Findings associated with personnel input have also been incorporated into applicable sections of this five-year review.

## **2.4 Community Involvement**

A public notice announcing the five-year review process was published in The Day, New London's daily newspaper, and the Norwich Bulletin, Norwich's daily newspaper on 14 August 2016. A public meeting was held on 31 August 2016 at the Submarine Force Library and Museum to present the findings of the Draft Fourth Five-Year Review. The public notice, along with an affidavit of publication, and meeting minutes are provided in Appendix D.

The estimated completion date for the final five-year review report is 20 December 2016. The five-year review report will be placed in the Naval Installation Restoration Information Solution (NIRIS) database and in the Information Repositories and Administrative Record File for NSB NLON. Documentation can be found at the following Information Repository locations:

Groton Public Library  
(860) 441-6750  
52 Newtown Road  
Groton, Connecticut 06340

Bill Library  
(860) 464-9912  
718 Colonel Ledyard Highway  
Ledyard, Connecticut 06399

In addition, the Administrative Record can be accessed on-line through the following Navy website:  
[http://www.navfac.navy.mil/products\\_and\\_services/ev/products\\_and\\_services/env\\_restoration/installation\\_map/navfac\\_atlantic/midlant/new\\_london.html](http://www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration/installation_map/navfac_atlantic/midlant/new_london.html).

## **2.5 Costs**

Over the last five years, NSB NLON has conducted LTM of groundwater, landfill sites, and concrete-encapsulated soil. The goal of this LTM program is to:

- Determine if the remedial strategy is effective to meet RAOs in each ROD
- Optimize the remedial strategy, if required
- Conduct O&M of remedial systems and maintain land use controls (LUCs)

The Navy has expended approximately \$714,000 over the last five years on these tasks.<sup>1</sup>

## **2.6 Risk Assessment Review Process**

In support of this five-year review for NSB NLON, the following methodology was used to evaluate each site with regard to current risk assessment methods (Technical Assessment Question B).

Potential human health risks are summarized in this document using the reasonable maximum exposure (RME) scenario; these exposure assumptions simulate conditions whereby potential human receptors are exposed to maximum contaminant concentrations in site media. The RME scenario uses upper bound, conservative assumptions and likely overestimates risk, and is more conservative than a central tendency exposure (CTE) scenario, which simulates exposure to average contaminant concentrations. Two types of estimates are used, carcinogenic risk and noncarcinogenic hazard.

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<sup>1</sup> This total is for O&M contractor costs for 2011-2015 for sampling, inspection, and repair activities and reporting for Sites 2A, 3, 6, and 8.

Carcinogenic risk is expressed as cumulative Incremental Lifetime Cancer Risk (ILCR) estimates, and noncarcinogenic hazard is expressed as cumulative hazard index (HI) estimates or chemical-specific and route-specific hazard quotients (HQs).

Risk Assessment Guidance for Superfund (RAGS) (U.S. EPA December 1991) defines target risk in Volume I — Human Health Evaluation Manual (RAGS Part B). The upper bound of the U.S. EPA target cumulative cancer risk range of  $1.0\text{E-}06$  to  $1.0\text{E-}04$  is considered a generally acceptable risk for an area where multiple chemicals contribute to contamination and individual carcinogenic chemicals contributing more than  $1.0\text{E-}06$  to a cumulative ILCR above  $1.0\text{E-}04$  are identified as chemicals of concern (U.S. EPA September 1994). An HQ is the ratio of a single substance exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period. An HI is the sum of two or more HQs for multiple substances and/or multiple exposure pathways (U.S. EPA December 1991). U.S. EPA uses an HI of 1 where multiple chemicals contribute to contamination. In each site-specific five-year review section, appropriate exposure scenarios (e.g., industrial, construction worker, and trespasser) from original risk assessments are discussed relative to the U.S. EPA acceptable risk ranges.

CTDEEP Remediation Standard Regulations (RSRs) (June 2013) provide detailed standards that may be used at any site to determine whether or not remediation of contamination is necessary to protect human health and the environment. CTDEEP RSRs define an acceptable cumulative cancer risk level of  $1.0\text{E-}05$  where multiple carcinogenic chemicals are present, while individual carcinogenic chemicals should not cause greater than an estimated excess lifetime cancer risk level of  $1.0\text{E-}06$ . For each site, appropriate exposure scenarios (e.g., industrial, construction worker, and trespasser) from original risk assessments are discussed relative to the CTDEEP  $1.0\text{E-}05$  threshold.

The U.S. EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model for lead was designed to facilitate rapid delineation of the relationship between environmental lead and blood lead in children, and the calculation of the risk of elevated blood lead as a function of probability of blood lead concentrations exceeding a specified level of concern, assuming residential exposure parameters (U.S. EPA February 1994). Summaries of the human receptor potential from exposure to lead reference the use of IEUBK blood lead exposure model.<sup>2</sup>

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<sup>2</sup> U.S. EPA's OSWER established a health protection goal that young children exposed to lead at their residences should not encounter a risk of more than 5 percent of exceeding a blood-lead level of 10 micrograms per deciliter ( $\mu\text{g/dL}$ ).



CTDEEP classified groundwater at NSB NLON as GB, which presumes that the water is not suitable for human consumption without treatment. There are no plans to change or expand the use of groundwater beyond the current Navy functions, and no further construction or residential development is planned in the future. Subbase New London Instruction (SUBASENLONINST) 5090.25 prevents extraction of groundwater at NSB NLON (Navy April 2013). As a conservative measure, the risk assessments presented in the OU 9 (Basewide Groundwater) ROD evaluated a hypothetical future human residential exposure scenario under which the base was closed and redeveloped for residential use, and assumed groundwater would be used as a drinking water source. Summaries of risk characterization for OU 9 are presented in applicable five-year review sections.

## **2.7 Applicable or Relevant and Appropriate Requirements, To-Be-Considered Criteria, and Site-Specific Action Levels**

CERCLA Section 121(d)[1] requires that Superfund remedial actions attain “a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment.” Remedial actions must achieve a level of cleanup that at least attains those requirements and that are legally applicable or relevant and appropriate.

- Applicable requirements are those cleanup standards, standards of control and other substantive requirements, criteria or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location, or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those standards that, while not “applicable,” address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards more stringent than federal requirements may be applicable or relevant and appropriate.
- To-Be-Considered (TBC) criteria are non-promulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary remedial action. For example, TBC criteria may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in establishing numerical values. These values represent an

acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Examples of chemical-specific ARARs include Maximum Contaminant Levels (MCLs) under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act.

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a particular remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats, and historic places.

Remedial actions are required to comply with the chemical-specific ARARs identified in the ROD. In performing the five-year review for compliance with ARARs, only those ARARs and TBC Criteria that address the protectiveness of the remedy are reviewed and, if protectiveness is impacted, discussed in the Question B Technical Evaluation. Guidance documents that may be relevant to changes since RODs were signed are discussed throughout each section.

### **2.7.1 Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations**

CTDEEP RSRs (January 1996) were revised in June 2013. The soil Residential Direct Exposure Criteria (DEC) for lead, a contaminant of concern (COC) at several NSB NLON sites (Site 2A, Site 3, Site 6, Site 8, Zone 1 [Sites 10 and 11], Zone 3 [Site 17], Zone 4 [Sites 13 and 19 and Outer Pier 1], and Zone 7 [Sites 21 and 25]), changed from 500 milligrams per kilogram (mg/kg) to 400 mg/kg. For reasons discussed in each site-specific five-year review section, the change does not affect the protectiveness of remedies with lead identified as a COC in soil.

In June 2013, CTDEEP updated the 2008 proposed RSR Volatilization Criteria for volatile organic compounds (VOCs) referenced in Volume II of the O&M Manual (Tetra Tech July 2011). This change does not affect protectiveness of any site remedy (none of which is based on volatilization), but may affect groundwater monitoring criteria at Site 3, Site 6, and Site 8, as discussed in Sections 5, 6, and 7, respectively.

In June 2013, CTDEEP also updated the 2008 proposed RSR Surface Water Protection Criteria (SWPC) for phenanthrene identified in Volume II of the O&M Manual (Tetra Tech July 2011). This change does not affect protectiveness of any site remedy or the groundwater monitoring criteria at Site 6 and Site 8 (where phenanthrene is a COC) because groundwater criteria was based on site-specific SWPC.

### **2.7.2 Connecticut Department of Energy and Environmental Protection Water Quality Standards**

CTDEEP Water Quality Standards (WQS) were revised in October 2013 (CTDEEP October 2013). The WQS for Aquatic Life for semivolatile organic compounds (SVOCs)/polynuclear aromatic hydrocarbons (PAHs) were revised. This does not affect protectiveness of any site remedy, but may affect the surface water and groundwater monitoring criteria at Site 2A, as discussed in Section 3.

## **2.8 Emerging Contaminants**

A review of emerging contaminants comprising dioxins/furans, perfluorinated compounds (PFCs) (specifically, perfluorooctanoic acids [PFOAs]/perfluorooctanesulfonic acids [PFOSs]), and 1,4-dioxane was completed as part of this five-year review.

- Dioxins and furans or dioxin/furan-like compounds are potentially present where burning/combustion activities have occurred. The U.S. EPA has reviewed toxicological data and literature on the health effects of dioxin 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and related compounds as a class of emerging contaminants since the Third Five-Year Review. In February 2012, the U.S. EPA released the final Reanalysis of Key Issues Related to Dioxin Toxicity. The toxicity data published therein was integrated into the Integrated Risk Information Systems database. The development of November 2015 U.S. EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites (RSLs) criteria updates incorporate the Integrated Risk Information Systems database.

TCDD is one of the most toxic members of the dioxin class of compounds and has a robust toxicological database (U.S. EPA February 2012). Therefore, TCDD may be used conservatively as a surrogate compound in cases where unknown mixtures of dioxin-like compounds may have occurred due to historical uses related to former landfills. Recommended Toxicity Equivalence Factors (TEF) methodology for risk assessments involving mixtures of dioxins, furans, and polychlorinated biphenyls (PCBs) was published in December 2010. Available historical dioxin data were reviewed for former landfilling/burning sites (Site 2A, Site 3, Site 6, Site 8, Site 16, and Site 20); results of this review are discussed

in the Question B Technical Evaluation, where applicable; a comparison of appropriate dioxin RSLs is provided in Appendix E.

- PFCs, specifically PFOAs/PFOSs are emerging contaminants commonly associated with former Fire Fighter Training Areas and other areas where Aqueous Film-Forming Foam (AFFF) was routinely used, stored, or released (including bulk fuel storage), and plating shop applications. The Naval Research Laboratory developed AFFF firefighting foam for use on Navy ships and submarines; PFOAs/PFOSs were used in AFFF from the 1960s to 2001. There is no documented use of PFOAs/PFOSs/AFFF at NSB NLON sites included in this five-year review; however, based on a preliminary review of site drawings and piping diagrams, PFOAs/PFOSs are potentially present at Site 9. A NSB NLON-wide PFOA/PFOS desktop study/preliminary assessment, currently underway, will be performed in accordance with Navy policy.

In May 2016, U.S. EPA published an updated Public Health Advisory for PFOAs and PFOSs in drinking water; information from this Public Health Advisory will be utilized in the basewide PFC desktop study/preliminary assessment.

- 1,4-Dioxane was used as a solvent stabilizer, most commonly associated with 1,1,1-trichloroethane (1,1,1-TCA) therefore, 1,4-dioxane is considered potentially present at sites contaminated with this chlorinated solvent and its daughter compounds (U.S. EPA January 2014) and at landfill sites where disposal of solvents potentially containing 1,4-dioxane may have occurred. Historical data were reviewed for 1,1,1-TCA, 1,1-dichloroethane (DCA) and chloroethane detections, and the potential for 1,4-dioxane as an emerging contaminant is discussed in the Question B Technical Evaluation in each site-specific five-year review section.

## **2.9 Vapor Intrusion**

VI is the general term given to migration of VOCs from contaminated soil and groundwater into indoor air spaces of overlying buildings (U.S. EPA January 2012). VI screening has been performed for select sites covered by this five-year review, as noted in Table 2-1, in general accordance with the OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (U.S. EPA November 2015). A qualitative Vapor Intrusion Screening Level (VISL) evaluation was conducted as part of this five-year review for sites where VOCs or naphthalene were present in shallow groundwater near structures. Due to recent changes in toxicity values for site COCs (discussed in Section 2.6), screening was performed for all sites, even those with prior evaluations conducted using the Johnson and Ettinger (J&E) Model for Subsurface Vapor Intrusion into Buildings (U.S. EPA 1991). This evaluation consisted of the following:

**Table 2-1  
Vapor Intrusion Screening Evaluation**

Site/Zone Operable Unit	Previous Vapor Intrusion Study	Vapor Intrusion Screening Conclusions <sup>[1]</sup>						Recommendation
Site 2A OU 1 and OU 9	Yes; OU 9 Record of Decision (ROD), Appendix E.3  • 2008 Human Health Risk Assessment (HHRA) update: — Groundwater concentrations were identified in excess of screening criteria, so Johnson & Ettinger (J&E) modeling was performed. <sup>[2]</sup> — Under both the industrial and a hypothetical residential scenario, the J&E model indicated that incremental lifetime cancer risk (ILCR) was less than 1.0E-06, indicating vapor intrusion (VI) was not a concern at Sites 2A and 2B.	• Current conditions: — The site is a landfill (Site 2A) with adjacent wetlands (Site 2B). — Development is prohibited by land use restrictions.						No further screening required.
Site 2B OU 12 and OU 9								No further screening required.
Site 3 OU 3 and OU 9	Yes; OU 9 ROD, Appendix E.3  • 2008 HHRA update: — Groundwater concentrations were identified in excess of screening criteria, so J&E modeling was performed. — The J&E model identified ILCR of 5.0E-06 for the industrial scenario and 3.0E-05 for the hypothetical residential scenario, primarily due to vinyl chloride and chloroform.	• 2015 data were screened against vapor intrusion screening levels (VISLs): — Neither trichloroethene (TCE) nor vinyl chloride exceed industrial VISLs; however, TCE exceeded the residential VISL (1.2 micrograms per liter [µg/L]) in one well (2.2 µg/L in 2DMW16D) and the detection limit for vinyl chloride exceeds the residential VISL. — Chloroform is not currently monitored. • Five-year review screening evaluation: — Construction of inhabited buildings/structures is prohibited due to Explosive Safety Quantity Distance arcs. — The vinyl chloride detection limit is below the Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSR) Residential Volatilization Criteria for groundwater (2 µg/L); the VISL screening criterion is more stringent than state Applicable or Relevant and Appropriate Requirements. — VI is not a concern at this site due to low concentrations and lack of inhabited structures. — The Basewide Groundwater (OU 9) LUC RD (Section 2.11.2) that includes Site 3 prohibits construction within 100 feet of monitoring well 2DMW29S due to VI concerns. The site-specific remedial goal (RG) protective of volatilization at Site 3 was established as 1.6 µg/L in the OU 9 ROD. Groundwater concentrations are currently below detection limits (1 µg/L) in this well and have been below RGs during this entire five-year review monitoring period.						No further screening required.  Review Subase New London Instruction (SUBASENLONINST) 5090.25 to determine whether construction provisions require VI assessment and mitigation; incorporate these changes into the pending Land Use Control Remedial Design (LUC RD), if necessary.
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2015 Analytical Data</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		Trichloroethene	1.2	7.4	< 1.0	No	No	
		Vinyl Chloride	0.15	2.5	< 1.0	No	No	
Site 6 OU 2	No	• 2014 data were screened against VISLs: — All constituents were either non-detect or below residential VISLs; however, the detection limit for vinyl chloride exceeds the residential VISL. • Five-year review screening evaluation: — Site 6 is a landfill, covered with asphalt and concrete. Land use is restricted. Buildings 355, 385, and 397 are located onsite, outside of the landfill cap limits. Building 355, located upgradient of the landfill, is occupied, Building 385 is planned for demolition, and Building 397 is vacant and will likely be demolished. • Two former storage buildings • The former battery storage and battery acid handling building — The vinyl chloride detection limit onsite is below the CTDEEP RSR Residential Volatilization Criteria for groundwater (2 µg/L); the VISL screening criterion is more stringent than state Applicable or Relevant and Appropriate Requirements. — VI is not a concern at this site due to low concentrations and location of and groundwater flow away from inhabited structures.						No further screening required.
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2014 Analytical Data</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		1,1,2,2-Tetrachloroethane	3.7	16	< 0.25	No	No	
		1,1-Dichloroethane	7.6	33	< 0.25	No	No	
		Trichloroethene	1.2	7.4	< 0.25	No	No	
		Vinyl chloride	0.15	2.5	< 0.5	No	No	
		Naphthalene	4.6	20	0.13	No	No	
Site 8 OU 5	No	• Current conditions: — Tetrachloroethene is present at concentrations above industrial groundwater VISL screening criteria (65 µg/L) in one shallow well (68 µg/L in 8MW10S) located more than 100 feet from any structure at Site 8, and is hydraulically side-gradient from the Nautilus Museum building; therefore, it was not considered during VI screening. Groundwater flow is to the west/northwest, away from the Nautilus Museum building. — Shallow wells adjacent to the Nautilus Museum and site out-buildings (8MW6S, 8MW7S) were screened against VISLs. — All constituents in 8MW6S and 8MW7S were either non-detect or below residential VISLs. • Five-year review screening evaluation: — VI is not a concern at this site due to low concentrations and lack of inhabited structures.						No further screening required.  Review SUBASENLONINST 5090.25 to determine whether construction provisions require VI assessment and mitigation; incorporate these changes into the pending LUC RD, if necessary.
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2015 Analytical Data</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		Tetrachloroethene	15	65	< 5.0	No	No	
		Methylene chloride	760	9,200	< 1.0	No	No	
		Xylenes	380	1,600	14	No	No	

**Table 2-1  
Vapor Intrusion Screening Evaluation**

Site/Zone Operable Unit	Previous Vapor Intrusion Study	Vapor Intrusion Screening Conclusions <sup>[1]</sup>						Recommendation
Site 23 OU 9	<p>Yes; OU 9 ROD, Appendix E.3 and 2016 Site 23 Site Assessment Screening Evaluation (SASE), Appendix G (March 2016)</p> <ul style="list-style-type: none"> <li>2008 HHRA update: <ul style="list-style-type: none"> <li>Groundwater concentrations were identified in excess of screening criteria, so J&amp;E modeling was performed.</li> <li>The J&amp;E model identified ILCR 6.0E-06 for the hypothetical residential scenario, primarily due to TCE and chloroform. Risks associated with the industrial scenario were less than 1.0E-06.</li> <li>Groundwater concentrations were compared to CTDEEP RSRs for VI for chloroform. Because groundwater concentrations did not exceed the RSR for VI, the 2008 HHRA concluded VI was not a concern.</li> </ul> </li> <li>The 2016 Site 23 SASE re-evaluated the vapor pathway: <ul style="list-style-type: none"> <li>The J&amp;E model identified ILCR of 8.0E-06 for the industrial scenario and 4.0E-05 for the hypothetical residential scenario, primarily associated with ethylbenzene and naphthalene.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>2013 Site 23 SASE Exposure Point Concentrations (EPCs) screened against 2015 VISLs, below. <ul style="list-style-type: none"> <li>Benzene, ethylbenzene, and naphthalene exceed both residential and industrial VISLs.</li> </ul> </li> <li>Five-year review screening evaluation: <ul style="list-style-type: none"> <li>Based on historical information in the SASE, the depth to water generally ranges from 5 to 7 feet at the site.</li> <li>Free product was identified at the site during the 1990s in the vicinity of Oily Tank 8, and again during construction of the running track in 2012 near Oily Tank 1. Free product was not observed vertical or horizontal exclusion distances of current structures.</li> <li>The site is currently used for recreational facilities (baseball fields, running track, soccer field, etc.). A limited number of structures are present. In accordance with the VI guidance for petroleum products, assuming structures do not overlay free product, 6 feet of vadose soil is expected to be sufficient to degrade any petroleum-related vapor products; therefore, VI is not expected to be a concern at this site.</li> </ul> </li> </ul>						<p>No further screening required.</p> <p>Edit the OU 9 LUC RD to require VI assessment and mitigation as necessary for any new building construction at Site 9 and 23.</p>
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2013 SASE EPC</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		Benzene	1.6	6.9	8.3	Yes	Yes	
		Bromomethane	17	73	1	No	No	
		Chloroform	0.81	3.6	2	Yes	No	
		Ethylbenzene	3.5	15	78	Yes	Yes	
		Tert-amyl methyl ether	5,500	23,000	1	No	No	
		Methy tert-butyl ether	450	2,000	9.3	No	No	
		Tetrachloroethene	15	65	10	No	No	
		Toluene	19,000	81,000	4	No	No	
		Trichloroethene	1.2	7.4	0.4	No	No	
		Xylene	380	1,600	61	No	No	
		Naphthalene	4.6	20	293	Yes	Yes	
Site 9 OU 9	<p>Yes; Screened as part of Site 23 in the OU 9 ROD Appendix E.3 and 2013 Site 9 SASE</p> <ul style="list-style-type: none"> <li>See discussion for Site 23 for the 2008 HHRA.</li> <li>Pathway deemed incomplete in the 2013 Site 9 SASE; however future potential for VI contributed a potential vapor risk of 4.0E-05 ILCR under a hypothetical residential scenario due to bromodichloromethane and chloroform.</li> </ul>	<ul style="list-style-type: none"> <li>2013 Site 9 SASE EPCs screened against 2015 VISLs, below. <ul style="list-style-type: none"> <li>Bromodichloromethane and chloroform exceed both residential and industrial VISLs. Exceedances, however, are within the same order-of-magnitude as the industrial VISL, and do not suggest significant sub-slab source strength, particularly given that VISL conservatively over-estimates VI potential.</li> <li>The site is currently used for recreational facilities (baseball fields, running track, soccer field, etc.). A limited number of structures are present (none near Site 9); therefore, the VI pathway is not complete.</li> <li>Bromodichloromethane and chloroform are typically found in municipal water supplies and may be associated with numerous potable water lines which are located near the site, and not associated with waste handling/disposal activities.</li> </ul> </li> <li>Five-year review screening evaluation: <ul style="list-style-type: none"> <li>Based on historical information in the SASE, the depth to water generally ranges from 5 to 7 feet at the site.</li> <li>The site is currently used for recreational facilities (baseball fields, running track, soccer field, etc.). A limited number of structures are present (none near Site 9; the nearest is more than 100 feet to the south).</li> <li>Bromodichloromethane and chloroform may be associated with numerous potable water lines which are located near the site, and not associated with waste handling/disposal activities.</li> <li>VI is not a concern at this site due to low concentrations and migration of plume away from inhabited structures.</li> </ul> </li> </ul>						<p>No further screening required.</p> <p>Edit the OU 9 LUC RD to require VI assessment and mitigation as necessary for any new building construction at Sites 9 and 23.</p>
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2013 SASE EPC</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		Acetone	23,000,000	95,000,000	18	No	No	
		Bromodichloromethane	0.88	3.8	9	Yes	Yes	
		Chloroform	3.5	15	18	Yes	Yes	
		Tetrachloroethene	15	65	6	No	No	
Sites 10 and 11/Zone 1 OU 4	<p>Yes; screening performed in 2011 for OU 4 HHRA addendum using benzene and ethylbenzene.</p> <ul style="list-style-type: none"> <li>J&amp;E modeling performed in the OU 4 HHRA addendum indicated risk to the hypothetical future resident of 3.2E-06 due to benzene and ethylbenzene.</li> </ul>	<ul style="list-style-type: none"> <li>2011 HHRA EPCs screened against 2015 VISLs, below. <ul style="list-style-type: none"> <li>Benzene, ethylbenzene, and naphthalene are the only constituents to exceed residential VISLs.</li> <li>Naphthalene is the only constituent to exceed industrial VISLs. Exceedances, however, are within the same order-of-magnitude as the industrial VISL, and do not suggest significant sub-slab source strength, particularly given that VISL conservatively over-estimates VI potential.</li> </ul> </li> <li>Five-year review screening evaluation: <ul style="list-style-type: none"> <li>Remedial Investigation (RI) sampling generally identified naphthalene in groundwater near the northern half of Building 29; this structure remains.</li> <li>The depth to water in Zone 1 ranges from 4 to 10 feet (shallowest at the Thames River, deepest to the east).</li> <li>Based on a review of the OU 4 RI, no free product was identified at the site.</li> <li>In accordance with VI guidance for petroleum products, 6 feet of vadose soil is expected to be sufficient to degrade any petroleum-related vapor products, therefore VI is not expected to be a concern at this site.</li> </ul> </li> </ul>						<p>No further screening required.</p> <p>Edit the pending OU 4 Soil LUC RD to require VI assessment and mitigation as necessary for any new building construction at Sites 10 and 11.</p>
		<b>Constituent</b>	<b>Residential VISL</b>	<b>Industrial VISL</b>	<b>2011 HHRA EPC</b>	<b>Exceeds Residential VISL?</b>	<b>Exceeds Industrial VISL?</b>	
		1,1-Dichloroethane	7.6	33	4	No	No	
		Benzene	1.6	6.9	2.83	Yes	No	
		Ethylbenzene	3.5	15	8	Yes	No	
		Xylenes	380	1,600	24.5	No	No	
		Naphthalene	4.6	20	21.3	Yes	Yes	



Table 2-1  
Vapor Intrusion Screening Evaluation

Site/Zone Operable Unit	Previous Vapor Intrusion Study	Vapor Intrusion Screening Conclusions <sup>[1]</sup>						Recommendation
Site 17/Zone 3 OU 4	No	No VI concerns.						No further screening required.
Sites 13 and 19/Zone 4 and Outer Pier 1 OU 4	Yes; screening performed in 2011 for OU 4 HHRA addendum using ethylbenzene and vinyl chloride.  • J&E modeling performed in the OU 4 HHRA addendum indicated an incremental risk due to vinyl chloride under a residential scenario of 4.4E-05.	<ul style="list-style-type: none"><li>2011 HHRA EPCs screened against 2015 VISLs, below.<ul style="list-style-type: none"><li>1,1-dichloroethane, ethylbenzene, and vinyl chloride are the only constituent to exceed residential VISLs.</li><li>Vinyl chloride is the only constituent to exceed industrial VISLs. Exceedances, however, are within the same order-of-magnitude as the industrial VISL, and do not suggest significant sub-slab source strength, particularly given that VISL conservatively over-estimates VI potential.</li></ul></li><li>Five-year review screening evaluation:<ul style="list-style-type: none"><li>Free product was removed in the mid-1990s.</li><li>Maximum exceedances (based on the OU 4 RI) appear to have been adjacent to Building 79 (now demolished), approximately 100 feet north of the only structure left onsite (Building 85). This area is now a parking lot.</li><li>Residential use is prohibited by land use restrictions.</li><li>VI is not a concern at this site due to low concentrations and lack of inhabited structures.</li></ul></li></ul>						No further screening required.  Edit the pending OU 4 Soil LUC RD to require VI assessment and mitigation as necessary for any new building construction at Sites 13 and 19.
		Constituent	Residential VISL	Industrial VISL	2011 HHRA EPC	Exceeds Residential VISL?	Exceeds Industrial VISL?	
		1,1-Dichloroethane	7.6	33	8.3	Yes	No	
		1,1-Dichloroethene	200	820	27.3	No	No	
		Ethylbenzene	3.5	15	5.2	Yes	No	
		Methylene chloride	760	9,200	5.5	No	No	
		Xylenes	380	1,600	11.5	No	No	
		Vinyl chloride	0.15	2.5	7.33	Yes	Yes	
		Naphthalene	4.6	20	3.77	No	No	
Sites 21 and 25/Zone 7 OU 4	Yes; screening performed in 2011 for OU 4 HHRA addendum.  • J&E modeling performed in the OU 4 HHRA addendum indicated no excess risk due to VI.	<ul style="list-style-type: none"><li>2011 HHRA EPCs screened against 2015 VISLs, below.<ul style="list-style-type: none"><li>Chloroform is the only constituent to exceed residential VISLs.</li></ul></li><li>Five-year review screening evaluation:<ul style="list-style-type: none"><li>Residential use is prohibited by land use restrictions.</li><li>VI is not a concern at this site due to low concentrations.</li></ul></li></ul>						No further screening required.
		Constituent	Residential VISL	Industrial VISL	2011 HHRA EPC	Exceeds Residential VISL?	Exceeds Industrial VISL?	
		Chloroform	0.81	3.6	2	Yes	No	
		Trichloroethene	1.2	7.4	0.6	No	No	
		Naphthalene	4.6	20	0.7	No	No	

Notes:

OU = Operable Unit

<sup>[1]</sup> All concentrations presented in micrograms per liter (µg/L).

<sup>[2]</sup> Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings (U.S. EPA 1991).

- Reviewing available prior VI assessments.
- Performing a VI screening using current VISLs to account for changes in risk assessment methodology since prior VI assessments. Note that this assessment focused on VOCs and naphthalene compounds with vapor inhalation toxicity values; prior VI assessments may have included other compounds using toxicity values which have since been rescinded.
- Reviewing the potential for VI based on site-specific data (site history, physical conditions, LUCs, etc.).

Groundwater VISLs were obtained from the U.S. EPA online calculator, Version 3.4, using November 2015 U.S. EPA RSLs.<sup>3</sup> Further VI screening is not required, based on the findings outlined in Table 2-1. However, for each site with VOCs and/or naphthalene present above residential or industrial VISLs, a general issue/recommendation will be added to review LUC provisions to determine if there are requirements for assessing or mitigating VI potential associated with future construction activities (if allowed).

## 2.10 Operations and Maintenance

Site inspections and groundwater monitoring are performed in accordance with the O&M Manual, which has been revised multiple times. Table 2-2 presents a summary of the sites in the O&M program and the corresponding current governing O&M Volume.

Table 2-2 Summary of Operations and Maintenance Manual		
Site	Site Inspections	Groundwater/Surface Water Monitoring
Site 2A — Area A Landfill	Volume III, Revision 2 (Tetra Tech July 2011)	Volume II, Revision 2 (Tetra Tech July 2011)
Site 2B — Area A Wetland	Volume VII, Revision 0 (Tetra Tech November 2012)	Not Applicable
Site 3 — Area A Downstream Water Courses/Overbank Disposal Area	Volume VI, Revision 0 (Tetra Tech July 2011)	Volume II, Revision 2 (Tetra Tech July 2011)
Site 6 — Former Defense Reutilization and Marketing Office	Volume IV, Revision 2 (Tetra Tech July 2011)	Volume II, Revision 2 (Tetra Tech July 2011)
Site 8 — Goss Cove Landfill	Volume V, Revision 2 (Tetra Tech July 2011)	Volume II, Revision 2 (Tetra Tech July 2011)
Site 9 — Former Wastewater Oily Tank 5 Site 23 — Former Fuel Farm	Volume VIII, Revision 0 (Tetra Tech November 2012)	Not Applicable

**Note:**

Volume I = Introduction governs all O&M activities; its current version is Revision 3 (Tetra Tech November 2012).

<sup>3</sup> Data were compared to residential and industrial scenarios, assuming a target cancer risk of 1.0E-06 and a target HI of 1. VISL calculator available at: <http://www.epa.gov/vaporintrusion>.



## **2.11 Land Use Controls**

While site-specific LUCs are required for soil, sediment, and/or groundwater at most OUs, only two LUC RD documents have been finalized: Site 2B Sediment LUC RD (Tetra Tech January 2012) and OU 9 LUC RD (Tetra Tech November 2009). The OU 9 LUC RD establishes LUCs for groundwater at Sites 2, 3, 9, and 23.

Until site-specific LUC RDs are established at the remaining sites where LUCs are a component of the selected remedy (see Sections 2.11.5 and 2.11.6), LUCs at NSB NLON are provided by SUBASENLONINST 5090.25 (Navy April 2013). SUBASENLONINST 5090.25 prescribes procedures for maintaining LUCs at sites and media for which RODs require LUCs but for which LUC RDs have not yet been developed, and establishes management policies for sites and media still being investigated under the Navy Environmental Restoration (ER) Program (formerly known as the Installation Restoration [IR] Program). SUBASENLONINST 5090.25 provides authority to base personnel to enforce LUCs at NSB NLON and also directs base personnel to site-specific LUC RDs that are finalized. Section 2.11.1 discusses SUBASENLONINST 5090.25. The Navy supplies maps of the areas with LUCs to the municipalities that the restricted areas are located (e.g., the Towns of Groton and Ledyard) when LUC RDs are finalized.

Table 2-3 summarizes the LUCs in place at NSB NLON. General details for existing LUC RDs are discussed in Sections 2.11.2 and 2.11.3, with pertinent site-specific details of required LUCs (including maintenance and inspections) presented in the corresponding five-year review section.

### **2.11.1 Subase New London Instruction 5090.25**

The Navy initially implemented Standard Operating Procedure Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18 in October 2000 to restrict use at ER Program sites at NSB NLON that require LUCs for which site-specific LUC documentation had not been finalized.

This document was revised multiple times and was cancelled by the current instruction, SUBASENLONINST 5090.25, issued in April 2013. SUBASENLONINST 5090.25 gives the NAVFAC Public Works Department Environmental Division the authority to curtail any activity inconsistent with LUCs or that could otherwise violate a selected remedy. SUBASENLONINST 5090.25 prevents groundwater extraction, restricts use of each site for as long as may be necessary to protect human health and the environment, and prohibits the following:

<b>Table 2-3 Summary of Land Use Controls at Naval Submarine Base New London</b>							
Site	Institutional Control Requirements Identified in the Record of Decision				Land Use Control Remedial Design (LUC RD) Documents		
	Groundwater	Soil	Sediment	Building Demolition	Groundwater	Soil	Sediment
2A — Area A Landfill	over entire site	over entire site	not applicable	not applicable	Operable Unit (OU) 9 LUC RD	Draft OU 1 LUC RD	not applicable
2B — Area A Wetland	over entire site	not applicable	over entire site	not applicable	OU 9 LUC RD	Site 2B LUC RD	Site 2B LUC RD
3 — Area A Downstream Watercourses/Overbank Disposal Area	over entire site	over a portion of the site	none	not applicable	OU 9 LUC RD	none existing, LUC RD needed <sup>[1]</sup>	not applicable <sup>[2]</sup>
6 — Former Defense Reutilization and Marketing Office	over entire site	over entire site	not applicable	not applicable	none existing, LUC RD needed <sup>[1]</sup>	none existing, LUC RD needed <sup>[1]</sup>	not applicable
8 — Goss Cove Landfill	over entire site	over entire site	none	not applicable	none existing, LUC RD needed <sup>[1]</sup>	none existing, LUC RD needed <sup>[1]</sup>	not applicable <sup>[2]</sup>
9 — Former Oily Tank 5	over entire site	none	not applicable	not applicable	OU 9 LUC RD	non-CERCLA	not applicable
23 — Former Fuel Farm	over entire site	none	not applicable	not applicable	OU 9 LUC RD	non-CERCLA	not applicable
Zone 1 — Sites 10 and 11	no site-specific LUCs due to GB groundwater	over a portion of the zone	none	existing building foundations that cover Connecticut Department of Energy and Environmental Protection (CTDEEP) environmentally isolated and inaccessible soil to be maintained	not applicable <sup>[2]</sup>	Draft-Final OU 4 Soil LUC RD	not applicable <sup>[2]</sup>
Zone 3 — Site 17	no site-specific LUCs due to GB groundwater	over a portion of the zone	none		not applicable <sup>[2]</sup>	Draft-Final OU 4 Soil LUC RD	not applicable <sup>[2]</sup>
Zone 4 — Sites 13 and 19, and Outer Pier 1	no site-specific LUCs due to GB groundwater	over a portion of the zone	Zone 4 and Outer Pier 1		not applicable <sup>[2]</sup>	Draft-Final OU 4 Soil LUC RD	Draft-Final OU 4 Sediment LUC RD
Zone 7 — Sites 21 and 25	no site-specific LUCs due to GB groundwater	over a portion of the zone	none		not applicable <sup>[2]</sup>	Draft-Final OU 4 Soil LUC RD	not applicable <sup>[2]</sup>

**Notes:**

<sup>[1]</sup> SUBASENLONINST 5090.25 is the current LUC document for sites that require but do not have final LUC RD documents,

<sup>[2]</sup> SUBASENLONINST 5090.25 prohibits disturbance of soil and sediment and extraction of groundwater at any NSB NLON Environmental Restoration Program site.

- Ground-disturbing activity without approval from the Environmental Division and an excavation permit
- Groundwater extraction for any purpose or surface water extraction from the Thames River without approval from the Environmental Division
- Damage to specialized landfill caps (at Site 2A, Site 6, and Site 8), concrete-encapsulated soil (at Site 3), and buildings, foundations, and pavement (at OU 4)
- Disturbance of Thames River sediment in certain areas without approval from the Environmental Division
- Damage or modification of monitoring wells without approval from the Environmental Division

Importantly, SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification. Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 will be updated to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks. These updates will occur once LUC RDs for Site 2A, Site 3, Site 6, and Site 8 are finalized, so that pertinent LUC information can also be included. The LUC RD documents should also be reviewed to ensure that they provide sufficient clarity to prevent both residential and industrial/non-potable exposures.<sup>4</sup>

Completion of individual LUC RD documents is in progress for each site. Once complete, the LUC RD document will become the primary LUC document at its respective site; each existing LUC RD will be referenced in SUBASENLONINST 5090.25 and identified on a basewide map.

### **2.11.2 Operable Unit 9 Land Use Control Remedial Design**

The Basewide Groundwater (OU 9) LUC RD applies to groundwater at Sites 2A, 2B, 3, 9, and 23 and was finalized in 2009; the RACR for OU 9 was finalized to document the completion of site remedies in 2010. In September 2009, a table and map were filed in the land record offices of the Towns of Groton and Ledyard, Connecticut, to show the location of monitoring wells, note the remedy in place, and list COCs and LUCs (Navy September 2009).

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<sup>4</sup> This includes a review of the current OU 9 LUC RD.

The OU 9 LUC Performance Objectives are summarized in Table 2-4.

<b>Table 2-4 Operable Unit 9 — Land Use Control Performance Objectives</b>	
<b>Sites 2A and 2B Groundwater</b>	Prevent the withdrawal and/or use of groundwater from Sites 2A and 2B for potable water purposes or other purposes that may result in unacceptable risks to human health or the environment as long as it is required under the Operable Unit (OU) 1 Record of Decision (ROD).
	Ensure that groundwater extracted from Sites 2A and 2B during groundwater monitoring or construction dewatering activities is handled, stored, and disposed in accordance with applicable State and Federal regulatory requirements as long as it is required under the OU 1 ROD.
	Maintain the integrity of the groundwater monitoring system for Sites 2A and 2B as long as it is required under the OU 1 ROD.
<b>Site 3 Groundwater</b>	Prevent the withdrawal and/or use of groundwater from Site 3 for potable water purposes or other purposes that may result in unacceptable risks to human health or the environment until the Remedial Goals (RGs) identified in the OU 9 ROD are met.
	Ensure that groundwater extracted from Site 3 during groundwater monitoring or construction dewatering activities is handled, stored, and disposed in accordance with applicable State and Federal regulatory requirements until the RGs identified in the OU 9 ROD are met.
	Maintain the integrity of the groundwater monitoring system for Site 3 until the RGs identified in the OU 9 ROD are met.
	Complete additional evaluation or initiate mitigation measures to meet Residential Volatilization Criteria for the area encompassed within 100 feet of monitoring well 2DMW29S if future residential construction is proposed for the area. <sup>[1]</sup>
<b>Sites 9 and 23 Groundwater</b>	Prevent the withdrawal and/or use of groundwater from Site 9 and Site 23 for potable water purposes until concentrations in groundwater meet criteria acceptable for unrestricted use and unlimited exposure.
	Ensure that groundwater extracted from Site 9 and Site 23 during construction dewatering activities is handled, stored, and disposed in accordance with applicable State and Federal regulatory requirements until concentrations in groundwater meet criteria acceptable for unrestricted use and unlimited exposure.

**Note:**

<sup>[1]</sup> This Performance Objective was due to vinyl chloride concentrations at 2DMW29S in excess of the RG, based on volatilization criteria. As noted in Table 2-1, vinyl chloride concentrations in this well are currently below detection limits (1 microgram per liter), which is below the site-specific RG.

### 2.11.3 Site 2B Land Use Control Remedial Design

The LUC RD for Site 2B — Sediment at Area A Wetland was finalized in 2012. The performance objective of the LUC RD is to prohibit residential use (including any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities) of the site.

Allowable activities at Site 2B, as presented in the LUC RD, are:

- Activities related to wetland restoration and monitoring
- Environmental investigations and/or remedial actions conducted per approved work plans

#### **2.11.4 Draft-Final Operable Unit 4 Land Use Control Remedial Designs**

The Draft and Draft-Final OU 4 Soil and Sediment LUC RDs (Resolution Consultants, October 2012, November 2012, January 2013, and February 2013) were submitted to meet requirements in the OU 4 ROD (i.e., LUC RDs submitted within 90 days of ROD issuance). These LUC RDs will be finalized and implemented once the remedial actions are completed at Zone 4 (see Section 12.0). These LUC RDs will become the primary LUC documents at OU 4; LUC information will also be incorporated into SUBASENLONINST 5090.25.

#### **Soil**

The Draft-Final OU 4 Soil LUC RD identifies LUC Performance Objectives for OU 4 Zones 1, 3, 4, and 7 and are summarized below (Resolution February 2013).

- Prohibit residential use of the site including any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities. (Zones 1, 3, 4, and 7)
- Maintain current site features such as buildings, pavement, and impervious surfaces; ensure regular maintenance of building foundations and paved areas; and restrict disturbance of contaminated soil/ prevent hypothetical future residential development. (Zones 1, 3, 4, and 7)
- Institute dig restrictions and provide requirements for proper management of excavated soil as part of any future construction and maintenance activities. (Zones 1, 3, 4, and 7)
- Prevent unacceptable risk from direct exposure to contaminated soil for industrial/commercial uses. (Zones 3, 4, and 7)

#### **Sediment**

The selected remedy for Zone 4 and Outer Pier 1 sediment includes implementing LUCs via a LUC RD to require maintenance of the sediment cover in Outer Pier 1, restrict unauthorized dredging or disruption of sediment within Outer Pier 1 and under the Zone 4 quay wall and pier LUC areas, identify inspection requirements, and document responsible parties. The principal LUC will include prohibiting disturbance of sediment in the Outer Pier 1 clean cover area, under the structure between the Thames River and the most inland quay wall sheet pile, and under the Pier 2 structure in Zone 4.

#### **2.11.5 Draft Operable Unit 1 Land Use Control Remedial Design**

The Draft LUC RD for source control at Site 2A (OU 1) was submitted in March 2015 (Resolution Consultants March 2015). LUC Performance Objectives are to reduce exposure of persons and biota to contaminants within the landfill and prevent erosion of and infiltration through the landfill soil/contents. Once finalized, the LUC RD will become the primary LUC document at Site 2A; information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25.

#### **2.11.6 Draft Land Use Control Remedial Designs**

Draft LUC RDs are also in progress for the concrete encapsulated soil at Site 3, soil and groundwater at Site 6, and soil and groundwater at Site 8. SUBASENLONINST 5090.25 is the current LUC document for these sites; the LUC RDs will become the primary LUC documents at these sites once finalized, as discussed above.

#### **2.12 Next Five-Year Review**

The next five-year review, which will be conducted pursuant to CERCLA using U.S. EPA and Navy five-year review guidance, will be due within five years of the signature date on the cover of this five-year review report. The Navy will be responsible for completing the next five-year review, planning and development of which should begin at least 18-months prior to the due date to ensure statutory deadlines are met.

### 3.0 SITE 2A — AREA A LANDFILL, OPERABLE UNITS 1 AND 9

Site 2A is the former Area A Landfill, commonly referred to as the “Alpha Lot”, included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 3-1 shows the site layout of the Area A Landfill, which is a paved equipment storage area and parking lot located within the northeast and north-central section of NSB NLON. At Site 2A, source control (the landfill) is managed under OU 1 and groundwater is managed under OU 9 (Basewide Groundwater). Due to the proximity of Site 2A and Site 2B, groundwater at both sites are collectively discussed together, and are referred to as Sites 2A and 2B in this five-year review, where appropriate.

#### Site 2A

- Former landfill
  - Accepted NSB NLON wastes including: residues from the former base incinerator, refuse, and debris
- COCs: VOCs, SVOCs/PAHs, PCBs, dioxins, pesticides, and metals
- Remedy:
  - Source Control (OU 1) ROD (September 1995)
    - Cap installation (Subtitle C Landfill)
    - Access restrictions
    - Site grading and storm water management
    - Groundwater and surface water monitoring
  - Groundwater (OU 9) ROD (September 2008)
    - Continuation of institutional controls and groundwater monitoring as described in OU 1 ROD

### 3.1 Site History and Background

Table A-1 in Appendix A summarizes the chronology of events at Site 2A.

### 3.2 Conceptual Site Model

Access to Site 2A is limited to gates on Wahoo Avenue and Thresher Avenue; the Deployed Parking Area is accessed through a separate gate off Thresher Avenue. (Figure 3-1). Access through these gates is granted by NSB NLON Security; gates are locked outside of business hours.

An additional gate provides access to the Salt Storage Building from Site 2A.

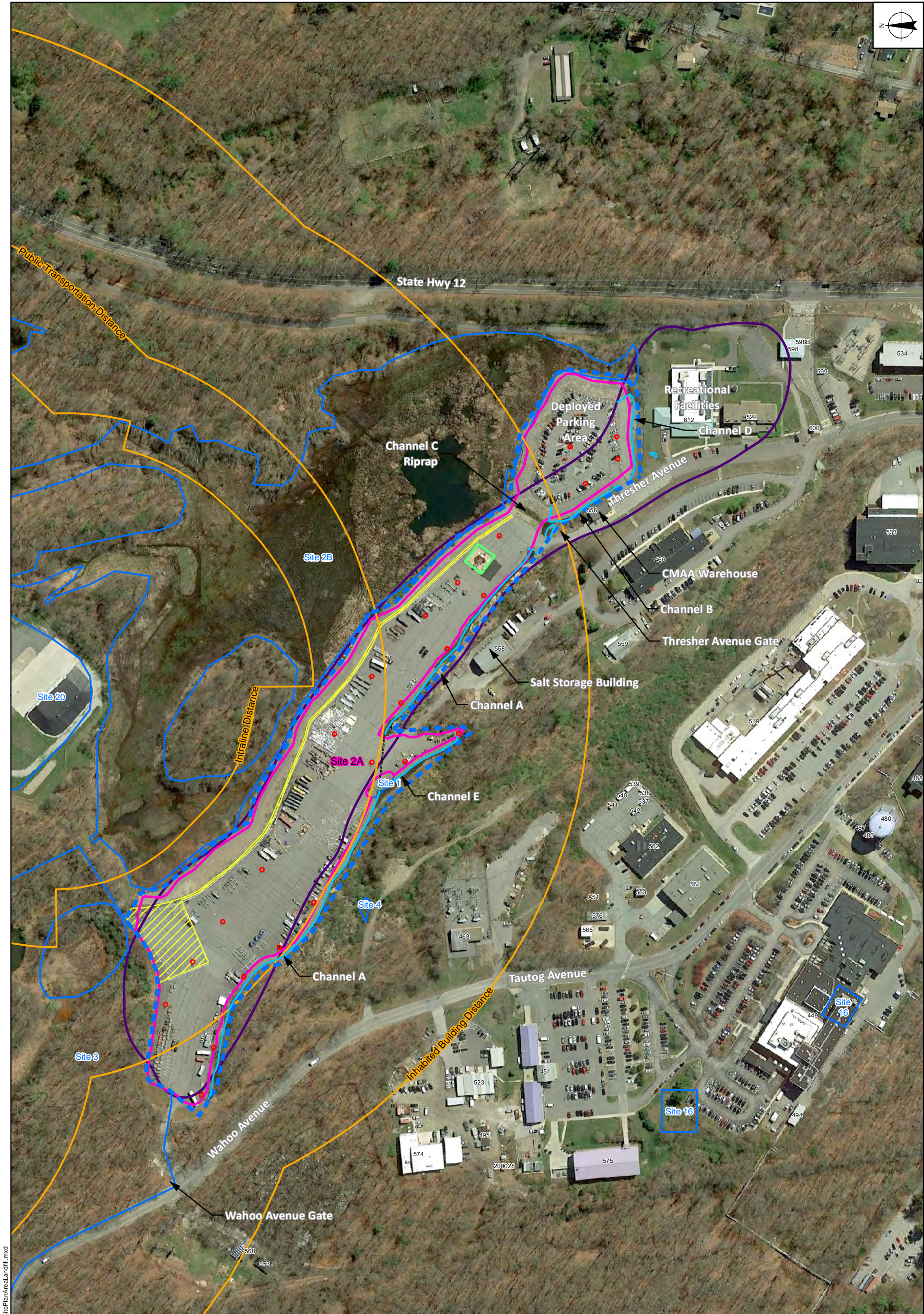
#### Site 2A Physical Characteristics

- Relatively flat area (plateau) bordered by a steep wooded hillside that rises to the south, a steep wooded ravine to the west, a gently sloped wooded area to the east, and the Area A Wetland (Site 2B) and the Area A Downstream Watercourse/Overbank Disposal Area (Site 3) to the north.
- A crane test area, which includes a concrete pad, is also located within Site 2A.

#### 3.2.1 Nature and Extent of Contamination

The primary source of contamination at the Area A Landfill is NSB NLON waste added from 1957 to 1973. Materials discarded at the landfill contributed to contamination at the site (NAVFAC September 1995). COCs included VOCs, SVOCs (predominantly PAHs), pesticides, PCBs, and inorganics (predominantly heavy metals). The Phase I RI concluded that several risk exposure scenarios exceeded acceptable regulatory levels, and the Phase II RI recommended the installation of a cap over the landfill in conjunction with LUCs including access restrictions and groundwater monitoring.





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- Vent Pipe
- HDPE Culvert
- Paved Drainage Channel
- Landfill Cover System and LUC Boundary
- Approximate No Loading Zone
- Approximate Original Site 2A Boundary
- Crane Test Pad
- Site 2A Boundary

Explosive Safety Quantity Distances  
245 Building Number

0 150 300 Feet

Note - All site boundaries are approximate.

Figure 3-1  
Site 2A - Area A Landfill - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/16/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: ArcGIS Online Imagery Basemap



The cap was completed in 1997, and the area is currently used for materials, equipment, and vehicle storage; long-term vehicle parking for deployed personnel (referred to as the Deployed Parking Area); and crane test operations.

**Contaminants of Concern at  
Site 2A Identified in Phase II RI**

- VOCs (groundwater)
- SVOCs/PAHs (soil)
- Pesticides (soil)
- PCBs (soil and groundwater)
- Dioxins (soil)
- Metals (soil and groundwater)

CTDEEP classified groundwater beneath NSB NLON, including Site 2A, as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is available.

### **3.2.2 Basis for Taking Action**

A baseline Human Health Risk Assessment (HHRA), performed during the Phase II RI, evaluated full-time workers, older child trespassers, and construction workers as possible receptor scenarios. That assessment determined that construction workers could incur ILCR exceeding the upper bound of the U.S. EPA's target risk range and estimated noncarcinogenic hazards were elevated. As a result, the HHRA indicated that Site 2A may pose unacceptable risk to public health and the environment, primarily due to the presence of PCB concentrations in soil (B&RE March 1997). The baseline HHRA was performed using data collected prior to installation of the landfill cap.

The OU 9 ROD included an updated HHRA (NAVFAC September 2008). As a conservative measure, the risk assessments presented in the OU 9 (Basewide Groundwater) ROD evaluated a hypothetical future human residential exposure scenario under which the base was closed and redeveloped for residential use, and assumed groundwater would be used as a drinking water source. The ILCR to construction workers was below both U.S. EPA's target risk range and CTDEEP's acceptable risk threshold; noncarcinogenic hazard was also below threshold levels. Risks to hypothetical future residents using groundwater at Sites 2A and 2B as a drinking water supply were also evaluated during the updated HHRA; those risks exceeded the upper bound of the U.S. EPA's target risk range.<sup>1</sup> The updated HHRA also determined that risks from VI were below U.S. EPA and CTDEEP acceptable levels for residential and industrial scenarios (NAVFAC September 2008).

Ecological risk was originally identified at the Area A Landfill; however, installation of the engineered cap eliminated the need to evaluate ecological exposure pathways resulting from direct contact with surface soils in the landfill by wildlife receptors (NAVFAC September 1995). Little potential for unacceptable risk to benthic invertebrates and terrestrial vegetation in sediment was expected

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<sup>1</sup> The updated HHRA included the residential risk scenario for comparison purposes only (e.g., if the facility were closed and redeveloped), as residential use of Sites 2A and 2B is prohibited (NAVFAC September 2008).

because PCB concentrations in sediments were lower than risk-based screening levels (NAVFAC September 1995).

### **3.3 Remedial Actions**

The OU 1 ROD for the Area A Landfill was signed by the Navy on 15 September 1995 and by U.S. EPA Region 1 on 26 September 1995. The OU 9 ROD, which included groundwater at Sites 2A and 2B, was signed by the Navy on 24 September 2008 and by U.S. EPA Region 1 on 30 September 2008.

#### **3.3.1 Remedial Action Objectives**

##### **3.3.1.1 Source Control**

The following RAOs were selected at OU 1 to mitigate existing and future potential threats to human health and the environment from contamination in the Area A Landfill (NAVFAC September 1995):

- Reduce exposure of persons and biota to contaminants within the landfill, in particular regarding exposure of workers to PCBs in soil located near the crane test pad.
- Prevent erosion of and infiltration through landfill soils/contents.

The OU 1 ROD deferred management and migration of contaminants in groundwater to a separate OU (later determined to be OU 9).

##### **3.3.1.2 Groundwater**

The OU 9 ROD identified no unacceptable risks for Sites 2A and 2B groundwater and did not establish RAOs; the OU 9 ROD recommended continuing the groundwater monitoring and institutional controls implemented as part of the OU 1 source control remedy.

#### **3.3.2 Remedial Goals**

Because a presumptive remedy was selected, chemical-specific remedial goals (RGs) were not developed as part of the remedy for soil at Site 2A or groundwater at Sites 2A and 2B (NAVFAC September 1995, September 2008). According to the OU 9 ROD, analytical data indicated that there were no unacceptable health effects anticipated from exposure to groundwater at Sites 2A and 2B; therefore, RGs for Sites 2A and 2B groundwater were not established. However, criteria for the groundwater monitoring program were developed to monitor post-closure contaminant migration from the Area A Landfill (Site 2A), as described in Section 3.3.4.2.

### **3.3.3 Remedy Selection**

#### **3.3.3.1 Source Control**

The selected presumptive source control remedy included the following components:

- Capping the site with a Resource Conservation and Recovery Act (RCRA) Subtitle C multi-layer cap with reinforced concrete crane test platform
- Landfill gas controls to manage landfill gas migration
- Surface controls to minimize erosion and manage runoff
- Fencing and institutional controls to control site access and future site use
- Provisions for conducting additional studies, including determining if additional measures beyond capping, such as a leachate/groundwater collection system, must be taken to further contain contaminants and enhance stability
- A leachate/groundwater collection system to further contain landfill wastes and to stabilize the cap if pre-design studies indicate that one is necessary<sup>2</sup>
- Post-closure groundwater and surface water monitoring
- Five-year reviews

#### **3.3.3.2 Groundwater**

The final selected remedy for groundwater at Sites 2A and 2B was continuation of the OU 1 source control groundwater monitoring program and institutional controls in accordance with the O&M Manual; the OU 9 ROD proposed no changes to the OU 1 ROD (NAVFAC September 2008).

### **3.3.4 Remedy Implementation**

#### **3.3.4.1 Source Control**

##### **Cover System**

Engineered caps were designed with different cover systems appropriate for the surface (plateau areas and side slope areas). The cover system in the plateau areas includes, in ascending

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<sup>2</sup> Pre-design studies determined this component was not necessary and therefore not part of the remedial action (B&RE October 1996).

order, a bedding/gas management layer with a passive gas vent system, geosynthetic clay liner and low-density polyethylene (LDPE) geomembrane, granular drainage layer, woven geotextile, base course, and bituminous concrete surface. The cover system in the side slope areas includes, in ascending order, a bedding/gas management layer with a passive gas vent system, non-woven geotextile, cohesive backfill, LDPE geomembrane, granular drainage layer, non-woven geotextile, and rip rap/gabion baskets.

Preliminary construction activities began in December 1996, and the remedial action was completed in September 1997. Details regarding the remedial action are summarized in the Final Report for Interim Remedial Action (B&RE March 1998).<sup>3</sup> The most significant change that occurred during implementation of the remedial action was inclusion of soil and debris excavated from Site 4 (OU 10) under the cap.

The remedial action was intended to be final for soils and landfill contents only, because evaluation of risks from contaminated groundwater were deferred to a separate OU. A post-closure groundwater monitoring program was developed shortly after the cap was constructed (Tetra Tech January 1999).

### **Land Use Controls**

SUBASENLONINST 5090.25 (Navy April 2013) defines the Navy's policy regarding ground surface disturbance of soils or any subsurface disturbance of soils and/or groundwater at ER Program sites. Additional information is provided in Section 2.11.1. The Draft LUC RD for source control at Site 2A (OU 1) was submitted in March 2015 (Resolution Consultants March 2015), as described in Section 2.11.5. Once finalized, the LUC RD will become the primary LUC document for source control at Site 2A (the LUC RD will also be referenced in SUBASENLONINST 5090.25 and identified on a basewide map) and will continue to reduce exposure to persons and biota to contaminants within the landfill and prevent erosion of and infiltration through the landfill soil/contents.

### **Operations and Maintenance**

Volume III of the O&M Manual details requirements for Site 2A inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech July 2011).<sup>4</sup> Inspection activities for Site 2A include:

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<sup>3</sup> Note that some historical documents reference installation of the RCRA cap and supporting landfill activities as an interim action because groundwater was not addressed; this terminology has not been used since the 1997 Final Report for Interim Remedial Action and is therefore not used in this five-year review.

<sup>4</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are in Volume I, Section 1.7 (Tetra Tech November 2012).

- Assessing access controls (e.g., fencing)<sup>5</sup>
- Assessing compliance with LUCs including the Alpha Area Storage Permit; this permit and approval is required to store materials at the site
- Assessing cap elements and verifying that storage limitations (i.e. no loading zones and weight limitations) are being enforced
- Inspecting drainage features
- Inspecting gas vents
- Inspecting monitoring wells

#### **3.3.4.2 Groundwater**

##### **Land Use Controls**

Groundwater at Sites 2A and 2B was included in the OU 9 LUC RD, which is discussed in Section 2.11.2.

##### **Groundwater and Surface Water Monitoring**

The Navy implemented a groundwater and surface water monitoring program at Site 2A in October 1999 (Tetra Tech January 1999). Background groundwater concentrations, CTDEEP SWPC, and CTDEEP WQs were used to develop monitoring criteria. The monitoring criteria for the Site 2A groundwater monitoring program, which includes monitoring locations at Site 2B, as documented in Volume II of the O&M Manual, are shown in Appendix F.

Since 2002, sampling activities at the site have been completed in accordance with the Groundwater Monitoring Plan (GMP) in Volume II of the O&M Manual; groundwater monitoring is currently performed in accordance with Revision 2 (Tetra Tech July 2011). The results of the program are being used to confirm that contamination is not migrating from the site at concentrations in excess of monitoring criteria.

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<sup>5</sup> Access controls are in place to enforce LUCs, not due to exposure concerns.

### **3.3.5 System Operation/Operations and Maintenance**

#### **3.3.5.1 Groundwater and Surface Water Monitoring Program**

Twenty-eight rounds of sampling have been performed over 16 years, and both the number of wells and the analytical suite have been optimized over time. Currently, groundwater and surface water monitoring at Site 2A is performed annually, with samples collected from five wells and five surface water locations (located at four permanent staff gauges and one seep) analyzed for select SVOCs/PAHs and metals (total and dissolved). Sampling activities performed during this five-year review period are summarized in Section 3.5.1.1.

#### **3.3.5.2 Operations and Maintenance**

Inspections of Site 2A are performed annually in accordance with Volume III of the O&M Manual (Tetra Tech July 2011). In recent years, the inspections were conducted in the spring, and corrective actions completed during the following summer. Inspection activities performed during this five-year review period are summarized in Section 3.5.1.3.

### **3.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 2A. Table 3-1 provides a list and status of the recommendations that were made for Site 2A in the last five-year review.

<b>Table 3-1 Site 2A — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Continue enforcement of Standard Operating Procedure — Administrative New London Instruction 5090.25 until a Land Use Control Remedial Design can be completed.	The Draft Land Use Control Remedial Design was submitted in March 2015, see Sections 3.5.1.2. Subase New London Instruction (SUBASENLONINST) 5090.25 (cancelled Standard Operating Procedure — Administrative New London Instruction 5090.25) is being enforced.
Continue operations and maintenance (O&M) (annual inspections and monitoring) and address the O&M issues noted.	Annual inspections and monitoring occurred and the O&M issues were addressed as described in the Annual Inspection and Repair Reports.
Complete and implement Revision 2 of the O&M Manual.	Revision 2 of the O&M Manual, which includes Site 2A, was finalized in 2011 and implemented in 2012.
Complete a Remedial Action Completion Report to document completion of the remedial action.	A Remedial Action Completion Report is in progress.
Mark and enforce the “no loading” zones for the capped area. Develop, implement, and enforce an equipment storage plan that would organize storage, provide safe methods for storage of equipment on the cap, and eliminate storage of overweight equipment and materials on the cap.	These areas have been marked (markings were updated in summer 2015) and are being enforced appropriately. The Environmental Division manages equipment storage; in order to store materials at the site, an Alpha Area Storage Permit must be approved by the Environmental Division.
Ensure that access gates are secured at all times.	Access gates are secured outside of business hours and formal quarterly checks are to confirm. It should be noted more frequent informal inspections are also performed by means of weekly “drive-throughs.”

<b>Table 3-1</b> <b>Site 2A — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Investigate warning signs and update as needed.	Warning signs are maintained and updated, as needed.
Continue control of the site by Command Master at Arms (CMAA). A meeting should be scheduled with CMAA/1 <sup>st</sup> Lieutenant personnel to communicate Environmental Restoration (ER) Program requirements at Site 2A.	The CMAA controls site access and meets with ER Program personnel; the most recent meeting occurred in August 2015.
An ER Program reference document should be placed at the gate with CMAA/1 <sup>st</sup> Lieutenant personnel so that personnel at Area 2A can be made aware of all site requirements.	A copy of SUBASENLONINST 5090.25 has been placed at the CMAA warehouse located at the Thresher Avenue gate.
Implement the following corrective actions for land use control (LUC) compliance: <ul style="list-style-type: none"> <li>Environmental Division to perform quarterly LUC inspections.</li> <li>Dig permits to require concurrence of Environmental Division.</li> <li>Environmental Division to use Geospatial Information and Services and Naval Installation Restoration Information Solution to identify LUC areas and wells for planners.</li> <li>Revise Mid-Atlantic Regional Instruction (5090.2).</li> </ul>	<ul style="list-style-type: none"> <li>During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012; they were in 2013, 2014, and 2015.</li> <li>The Environmental Division reviews and approves all Naval Submarine Base New London dig permits.</li> <li>LUC areas and wells were documented in Naval Installation Restoration Information Solution on 30 November 2011.</li> <li>Naval Submarine Base New London does not have jurisdiction to update the Mid-Atlantic Regional Instruction, however SUBASENLONINST 5090.25 was updated in April 2013.</li> </ul>
Label all gas vents.	All gas vents have been labeled; labeling was confirmed during the five-year review site visit.
Abandon 15 idle wells associated with Site 2A compliance monitoring: 2WMW21S, 2WMW21D, 2WMW3S, 2WMW3D, 2WMW38DS, 2WMW39DS, 2WMW40DS, 2WMW41DS, 2WMW42DS, 2WMW43DS, 2WMW44DS, 2WMW45DS, 2WMW46DS, 2WMW47DS, and 4MW4D.	Monitoring well abandonment was deferred while other site maintenance activities were completed; these wells will not be abandoned until the completion of emerging contaminant assessments and investigations.

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Annual groundwater monitoring and O&M inspection reports for Site 2A are summarized in Table 3-2; complete document references are in Section 14.

<b>Table 3-2</b> <b>Site 2A — Summary of Groundwater Monitoring and Operations and Maintenance Inspection Reports</b>		
<b>Year</b>	<b>Groundwater Monitoring</b>	<b>Operations and Maintenance Inspection</b>
2011	Sovereign Consulting (December 2012)	Sovereign Consulting (December 2012)
2012	H&S Environmental [H&S] (December 2013)	H&S (September 2012)
2013	H&S (July 2015)	H&S (April 2014)
2014	H&S (March 2015)	H&S (May 2015)
2015	H&S (March 2016)	H&S (March 2016)

### 3.5 Technical Assessment

The following information supports the determination that the selected remedies for source control at Site 2A and groundwater at Sites 2A and 2B are functioning as intended, except as noted below.



Areas in which remedy performance can be improved are listed in the Issues and Recommendations Table referenced in Section 3.6.

### 3.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?

#### 3.5.1.1 Monitoring Data Summary

Figure 3-2 shows the location of monitoring wells and surface water sampling points in the active monitoring program. Analytical results for annual groundwater and surface water monitoring activities were provided in their respective annual reports, listed in Table 3-2.

#### Surface Water Monitoring

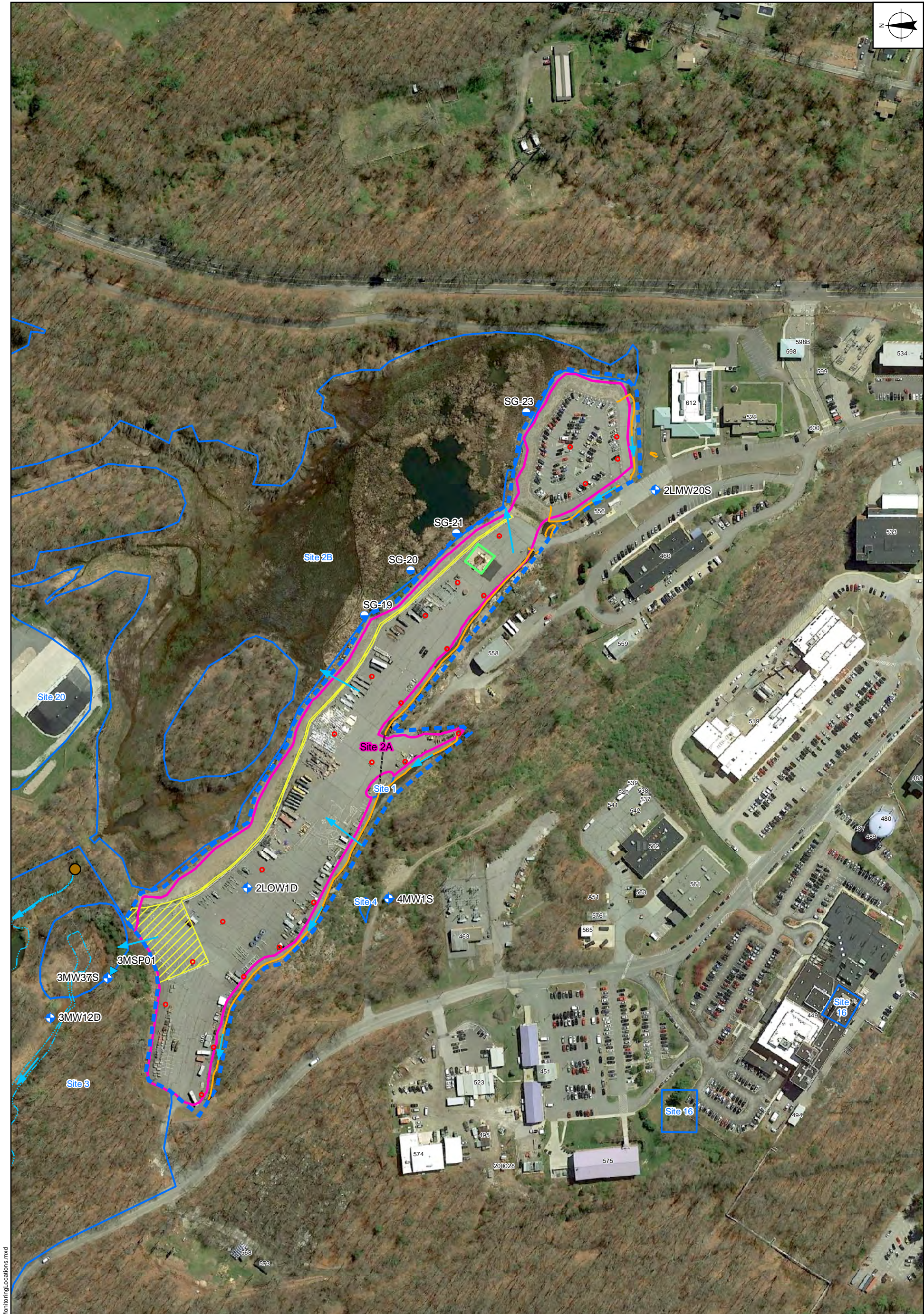
During the five-year review period, surface water samples were collected from four staff gauges and at a seep. Combinations of benzo(a)pyrene, total and dissolved zinc, and total and dissolved cadmium exceeded monitoring criteria at three staff gauges (SG-20, SG-21, and SG-23) between 2011 and 2015.

Concentrations of COCs were below monitoring criteria during the most recent sampling event in 2015 except for total and dissolved cadmium and total and dissolved zinc at SG-21. Total and dissolved cadmium were detected at estimated values just above detection limits.

At the seep (3MSP01), while select PAHs exceeded monitoring criteria in 2011, 2012, and 2013, they were not detected in 2014 or 2015. Total and dissolved cadmium and total lead were detected above monitoring criteria in the seep during this five-year review period. Concentrations of these COCs were below monitoring criteria during the most recent sampling event (2015) except for total and dissolved cadmium.

Location	Frequency	Detections > Monitoring Criteria?
<b>SURFACE WATER</b>		
<b>3MSP01</b>	annual	PAHs (2011, 2012, 2013) Total/dissolved cadmium (2011, 2012, 2015) Total lead (2012)
<b>SG-19</b>	annual	None
<b>SG-20</b>	annual	Benzo(a)pyrene (2012, 2013) Total zinc (2012)
<b>SG-21</b>	annual	Total/dissolved cadmium (2015) Total/dissolved zinc (2015)
<b>SG-23</b>	annual	Total cadmium (2012) Total/dissolved zinc (2011, 2014)
<b>GROUNDWATER</b>		
<b>Upgradient of Landfill</b>		
<b>2LMW20S</b>	annual	Total cadmium (2012, 2014) Total lead (2012) Total zinc (2014)
<b>4MW1S</b>	annual	Total/dissolved cadmium (2011, 2012, 2013, 2014, 2015)
<b>Landfill</b>		
<b>2LOW1D</b>	annual	Total/dissolved cadmium (2011, 2014, 2015) Total/dissolved zinc (2011, 2014)
<b>Downgradient of Landfill</b>		
<b>3MW12D</b>	annual	Total/dissolved cadmium (2012, 2013, 2014, 2015)
<b>3MW37S</b>	annual	Total/dissolved cadmium (2011, 2012, 2013, 2014, 2015)





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- |  |                             |
|--|-----------------------------|
| ● Active Surface Water Location                | Streams and Ponds           |
| ▲ Seep   | Concrete Encapsulated Soil  |
| ● Vent Pipe                                    | Approximate No Loading Zone |
| ◆ Active Monitoring Well                       | Crane Test Pad              |
| === HDPE Culvert                               | Site 2A Boundary            |
| → Groundwater and Surface Water Flow Direction | 245 Building Number         |
| — Paved Drainage Channel                       |                             |
| ■ Landfill Cover System and LUC Boundary       |                             |

0 150 300  
Feet

Note - All site boundaries are approximate.

Figure 3-2  
Site 2A - Monitoring Locations  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/16/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



Based on a qualitative review of data, COC concentrations in surface water during this five-year review period are consistent with historical data and do not exhibit increasing trends. The cadmium exceedances and the potential effect of hardness on these concentrations are being addressed under the LTM program pursuant to the O&M Manual.

### **Groundwater Monitoring**

During the five-year review period, samples were collected from five monitoring wells. In upgradient wells, total and dissolved cadmium, total lead, and total and dissolved zinc were detected above monitoring criteria. Total and dissolved cadmium and total and dissolved zinc exceeded monitoring criteria in well 2LOW1D, which is located in the landfill. In downgradient wells 3MW12D and 3MW37S, physically located within Site 3, total and dissolved cadmium were consistently detected above monitoring criteria. Concentrations of these COCs were below monitoring criteria during the most recent sampling event (2015) except for total and dissolved cadmium. Based on a qualitative review of data, COC concentrations during this five-year review period are consistent with historical data and do not exhibit increasing trends. Groundwater conditions at the landfill are consistent with those upgradient and downgradient. The cadmium exceedances and the potential effect of hardness on these concentrations are being addressed under the LTM program pursuant to the O&M Manual.

### **Conclusions**

The data continue to indicate there is no concern for contaminant migration from soil to groundwater at Site 2A; cadmium exceedances should be further reviewed under the LTM program and monitoring should continue per the decision diagram presented in Volume II of the O&M Manual.

#### **3.5.1.2 Land Use Control Status**

The Draft LUC RD for source control at Site 2A was submitted in March 2015. In the interim, SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils at Site 2A; see Sections 2.11.1 and 2.11.5.

The OU 9 LUC RD that includes Sites 2A and 2B groundwater requires that inspections and certifications be performed annually (Tetra Tech November 2009). During this five-year review period, annual LUC inspections and certifications (as required by the OU 9 LUC RD) were not performed or documented in 2011 and 2012; they were in 2013, 2014, and 2015. NSB NLON is currently modifying its procedures to ensure compliance with the LUC RD.

### **3.5.1.3 Operations and Maintenance Summary**

Inspections have been conducted annually as part of O&M activities associated with Site 2A since 2003; five inspections were performed at Site 2A during this five-year review period. Review of Site 2A O&M inspection checklists and findings for 2011 through 2015 (as provided in their respective annual reports) indicated that communication of maintenance requirements and subsequent repairs and documentation/re-inspection were not performed early in the review period. Further review of O&M procedures should be performed to clarify and document roles and responsibilities, based on lessons learned during the latter part of the five-year review period and to ensure timely submittals/responses. Appropriate revisions should be incorporated into the next O&M Manual update.

As noted in the last five-year review, there has been a history of improper storage on the cap. The May 2015 inspection concluded that the cap is functioning as designed and use of the site for storage is being conducted in accordance with SUBASENLONINST 5090.25 requirements. However, several O&M issues were noted: cracks in the asphalt cap; vegetation and sedimentation in drainage channels; and damage to fencing, gas vents, staff gauges, and monitoring wells. These O&M issues were addressed in summer 2015 except for sealing all cracked asphalt.<sup>6</sup> The cracks will be sealed as part of future maintenance activities.

### **3.5.1.4 Five-Year Review Site Visit Findings**

The site visit included visual observations of several Site 2A features (i.e., cap surface, drainage channels, gas vents, and monitoring wells). The land use of Site 2A had not changed since the remedy was implemented and the Third Five-Year Review was completed; the area remains a storage facility and parking lot.

During the site visit, the landfill cap and associated remedy components (e.g., fencing and signs) appeared to be in good condition except for cracks in the asphalt noted in Section 3.5.1.3. The cracks in the Deployed Parking Area asphalt had some vegetation growth (see photos #2A-2 through #2A-4 in Appendix B). The cracks are believed to be caused by normal seasonal expansion and contraction of the asphalt, but they can also be caused by improper storage of equipment/materials, heavy use of the area by vehicles/trucks, snow removal equipment storage, and use as a temporary contractor lay down area (see photo #2A-7). Improper storage has been reduced substantially at the site since the last five-year review period due to improved communications,

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<sup>6</sup> Specific areas which have not been repaired include the slope at Channel A, in locations at the Deployed Parking Area, and near the crane test pad.

inspection procedures, and the Alpha Area Storage Permit (see photos #2A-9 through #2A-12) and the site is inspected regularly to discourage improper use of the area. During the site inspection, some vehicles were parked close to and/or partially on the slope of Channel A; the slopes were not designed for equipment storage, and vehicles should be moved away from the slope and a line painted and labeled “No Parking” (see photos #2A-13 and #2A-14).

The drainage channels were paved in 2015, but some ponding was noted (see photos #2A-8 and #2-15); this ponding was determined to be a result of sedimentation in the drainage channels and removal of this sediment has been initiated. Erosion was noted along the slope near the Thresher Avenue gate, outside of the landfill boundary, likely due to heavy equipment used to perform drainage channel paving (see photo #2A-6).

Access to Site 2A is controlled by fencing and gates, which were locked during the five-year review site inspection, with the exception of the Deployed Parking Area gate. Signage indicates storage and access requirements at the Thresher Avenue Gate (see photo #2A-5 in Appendix B).

### 3.5.1.5 Technical Evaluation

Table 3-3 summarizes the technical evaluation for Question A.

<b>Table 3-3</b> <b>Site 2A — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	The engineered landfill cap system installed is currently effective in limiting direct exposure to contaminated soil and minimizing infiltration and contaminant migration from the site.
	Results from the groundwater and surface water monitoring program have remained consistent with historical data, indicating there are no contaminant migration concerns.
Systems Operation/ Operations and Maintenance (O&M)	Annual O&M inspections and the five-year review inspection verify that the landfill cap is in good condition; crack maintenance activities are ongoing.
	Corrective actions to improve communication of maintenance requirements and subsequent repairs and documentation/re-inspection have been implemented, but need to be reviewed and documented in the next revision of the O&M Manual; however, all issues identified in 2011 to 2015 inspections have been addressed. Repairs to the cracks in the asphalt cover are ongoing.
Implementation of Land Use Controls and Institutional/ Engineering Controls	Institutional controls associated with Site 2A source control are in Subase New London Instruction 5090.25. Site 2A is fenced and access is restricted. The Draft Land Use Control Remedial Design (LUC RD) for Site 2A is in was submitted in March 2015.
	The LUC RD for Operable Unit (OU) 9 Basewide Groundwater, which includes Sites 2A and 2B groundwater, was completed and the controls have been implemented. However, during this five-year review period, inspections and certifications were only performed in 2013, 2014, and 2015 which is not in accordance with the OU 9 LUC RD (annual certifications). Naval Submarine Base New London is currently modifying its procedures to ensure that OU 9 land use control inspections and certifications are performed.

Table 3-3 Site 2A — Technical Evaluation — Question A	
Question	Summary
Opportunities for Optimization	Based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 2A should be reviewed and potentially optimized.
Early Indicators of Potential Remedy Problems	Asphalt cracks are a recurring problem at Site 2A; the asphalt should be evaluated to determine if repair activities in addition to crack sealing are required.

### **3.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

#### **3.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Site 2A was summarized in Section 3.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Direct contact risks for both human and ecological receptors are eliminated by the engineered landfill cap installed at Site 2A. The paved surface of the cap is used for equipment and vehicle storage, and access to the site is restricted to NSB NLON personnel. The O&M program ensures that the cap system does not have deficiencies or other issues that could negatively affect long-term performance.

Direct exposure to contaminants in groundwater at Sites 2A and 2B is not an identified concern because LUCs prohibit disturbance of soil and groundwater, as discussed in Section 3.5.1.2.

As discussed in Section 3.5.1.1, groundwater and surface water monitoring has verified that no significant contaminant migration from soil to groundwater has occurred. During the most recent sampling event (2015) concentrations of total and dissolved cadmium were above monitoring criteria, so groundwater and surface water monitoring will continue. The OU 9 LUC RD prevents withdrawal or use of groundwater for potable purposes and ensures that groundwater extracted during construction activities is managed appropriately (Tetra Tech November 2009).

VI is not an issue at Site 2A because there are no buildings and LUCs prevent future building construction over the former landfill. A VI evaluation for Site 2A conducted as part of this five-year review (discussed in Section 2.9 and Table 2-1) concluded that no further evaluation of the VI pathway is necessary.

#### **3.5.2.2 Technical Evaluation**

The technical evaluation for Question B is in Table 3-4.

**Table 3-4  
Site 2A — Technical Evaluation — Question B**

<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	<p>Groundwater monitoring criteria are shown in Appendix F. When the most recent version of the Operations and Maintenance Manual (Tetra Tech July 2011) was developed, the selected groundwater and surface water monitoring criteria for semivolatile organic compounds and polynuclear aromatic hydrocarbons were based on Connecticut Department of Energy and Environmental Protection (CTDEEP) Water Quality Standards (WQS) for Aquatic Life. CTDEEP WQS were amended in October 2013 and the WQS for semivolatile organic compounds and polynuclear aromatic hydrocarbons monitored at Site 2A were revised. These values should be revised during the next revision of the Operations and Maintenance Manual.</p> <p>CTDEEP also revised Remediation Standard Regulations, updating the Residential Direct Exposure Criteria for lead in soil. This change does not affect the protectiveness of the remedy because land use controls prevent future residential development of Site 2A.</p>
Changes in Exposure Pathways	Groundwater is not used for drinking water. Volatilization via vapor intrusion (VI) has been reassessed since the last five-year review because of recent changes in guidance. VI is not expected to be an issue at this site; see Table 2-1 for further details.
Changes in Land Use	There have been no changes in land use since the last five-year review. Subase New London Instruction 5090.25 and the Operable Unit (OU) 9 Land Use Control Remedial Design (LUC RD) prevent land use changes without notification.
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins were not retained as contaminants of concern at Site 2A in the Record of Decision. The Focused Feasibility Study (Atlantic May 1995) detected dibenzofuran as the only dioxin-like compound (one detection of 0.083 milligrams per kilogram (mg/kg) out of 12 subsurface samples and one detection of 1 mg/kg out of 9 sediment samples). The CTDEEP GB Mobility Criteria for dibenzofuran is 5.6 mg/kg, and the United States Environmental Protection Agency Regional Screening Level for Industrial Soil is 100 mg/kg, so updates to this class of emerging contaminants does not affect the protectiveness of the remedy. Land use at Site 2A is restricted, as discussed previously.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 2A; however, due to the lack of documentation of materials disposed of at the landfill, it is likely that the basewide perfluorinated compound (PFC) desktop study/preliminary assessment will conclude that additional action is required at Site 2A in regard to PFCs.</p> <p><b>1,4-Dioxane</b> — 1,1,1-trichloroethane and its daughter compounds (1,1-dichloroethane and chloroethane) have not been detected at Sites 2A and 2B and previous investigations did not include soil or groundwater analysis for 1,4-dioxane. However, due to the lack of documentation of materials disposed of at the landfill, presence/absence sampling for 1,4-dioxane will be performed in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as the OU 9 LUC RD prevents potable use of groundwater.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for volatile organic compounds, which may affect some sites where volatile organic compounds are a concern in groundwater if groundwater could be used as a potable source in the future. VI information for Site 2A was reviewed as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.

Table 3-4 Site 2A — Technical Evaluation — Question B	
Question	Summary
Expected Progress towards Meeting Remedial Action Objectives	The remedial action objectives for source control at Site 2A (OU 1) were met by installing and maintaining the engineered cap system and conducting groundwater and surface water monitoring. The Draft LUC RD for source control at Site 2A was submitted in March 2015; until implementation, land use controls are implemented via Subase New London Instruction 5090.25.
	A LUC RD was prepared for OU 9 groundwater, which includes Site 2A.
	Groundwater and surface water monitoring during the last five annual sampling events demonstrate that contaminants are not migrating from soil to groundwater.

### 3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

## 3.6 Issues and Recommendations

Issues and recommendations are identified in Table 3-5.

## 3.7 Protectiveness Statement

Remedial actions implemented at Site 2A are protective of human health and the environment. Source control actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration and prevent direct contact with soil. An O&M program has been implemented and results verify that the cap is performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized. The OU 9 groundwater remedy (groundwater and surface water monitoring and LUCs) remains protective at Sites 2A and 2B.

**Table 3-5  
Site 2A — Issues and Recommendations/Follow-Up Actions**

Site 2A – Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	Annual groundwater LUC inspections and certifications were not performed in accordance with the OU 9 LUC RD at Sites 2A and 2B in 2011 and 2012.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 9 LUC RD at Sites 2A and 2B.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
2	During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012 as recommended by the Third Five-Year Review Report.	There is no LUC RD for the landfill; until the LUC RD is finalized, modify procedures to ensure that inspections are performed quarterly and properly documented.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
3	The Site 2A Source Control LUC RD has not been finalized.	Finalize and implement the LUC RD. In the interim, continue enforcement of the SUBASENLONINST 5090.25 to ensure remedy protectiveness.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
4	SUBASENLONINST 5090.25 cites CTDEEP’s GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
5	ARARs used to develop monitoring criteria have changed and based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 2A should be reviewed and potentially optimized.	Update the O&M Manual to reflect: <ul style="list-style-type: none"><li>• Changes to monitoring criteria based on ARAR changes</li><li>• Any changes to the monitoring program based on an optimization review</li></ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
6	The contaminant 1,1,1,-TCA and its daughter compounds have not been detected at Sites 2A and 2B. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA and previous investigations did not include soil or groundwater analysis for 1,4-dioxane. However, there is a lack of documentation of materials disposed of at the landfill.	Perform presence/absence sampling for 1,4-dioxane at Sites 2A and 2B in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	



Table 3-5 Site 2A — Issues and Recommendations/Follow-Up Actions							
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)	
						Current	Future
7	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 2A; however, there is a lack of documentation of materials disposed of at the landfill. A basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N
<b>Operations and Maintenance</b>							
8	Cracks in the landfill cap, some with vegetation growth, are persistent problems at Site 2A.	Remove vegetation and seal cracks identified in the 2015 O&M Site Inspection and this five-year review.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N
9	Vehicles parked on slope of Channel A; the slope areas are not designed for equipment storage.	Move vehicles and paint a line labeled "No Parking or Storage."	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N
10	The Third Five-Year Review Report recommended 15 idle monitoring wells for abandonment; they have not been abandoned.	Following the completion of emerging contaminant assessments and investigations, evaluate and abandon wells, and document the decision as necessary.	Navy	U.S. EPA, CTDEEP	To Be Determined <sup>[2]</sup>	N	N
11	Further review of O&M procedures should be performed to clarify and document roles and responsibilities to ensure timely reporting and repair activities.	Revise O&M Manual to clarify roles and responsibilities and other issues identified in this five-year review (i.e., reduction in COCs and changes to monitoring criteria).	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N
<b>Other</b>							
12	The Site 2A Source Control Remedial Action Completion Report has not been finalized, as recommended by the Third Five-Year Review Report.	Finalize the Remedial Action Completion Report upon completion of the LUC RD.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittal dates, where applicable.

<sup>[2]</sup> Well abandonment activities are dependent on results of the emerging contaminant assessments/investigations and long-term monitoring program; a date for well abandonment cannot be estimated at this time.

LUC	=	Land Use Control	OU	=	Operable Unit
LUC RD	=	Land Use Control Remedial Design	U.S. EPA	=	United States Environmental Protection Agency
CTDEEP	=	Connecticut Department of Energy and Environmental Protection	SUBASENLONINST	=	Subase New London Instruction
VOC	=	Volatile Organic Compound	ARAR	=	Applicable or Relevant and Appropriate Requirement
TCA	=	Trichloroethane	O&M	=	Operations and Maintenance
PFC	=	Perfluorinated Compound	COC	=	Contaminant of Concern

#### **4.0 SITE 2B — AREA A WETLAND, OPERABLE UNITS 12 AND 9**

Site 2B is the Area A Wetland, included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 4-1 shows the site layout of the Area A Wetland, which is located north of the Area A Landfill (Site 2A). At Site 2B, sediment is managed under OU 12 and groundwater is managed under OU 9 (Basewide Groundwater). Due to the proximity of Site 2A and Site 2B, groundwater at both sites are collectively discussed together, and are referred to as Sites 2A and 2B in this five-year review, where appropriate.

##### **Site 2B**

- Sources of contamination: surface releases such as pre-cap runoff from the Area A Landfill (Site 2A) and placement of pesticide bricks within the wetland.
- COCs: Total PAHs, Total DDT (includes 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD), and Total Aroclors
- Remedy:
  - Site 2B (OU 12) ROD (August 2010)
    - Excavation
    - Restoration
    - Seeding
    - Restoration monitoring
    - LUCs

#### **4.1 Site History and Background**

Table A-2 in Appendix A summarizes the chronology of events at Site 2B.

#### **4.2 Conceptual Site Model**

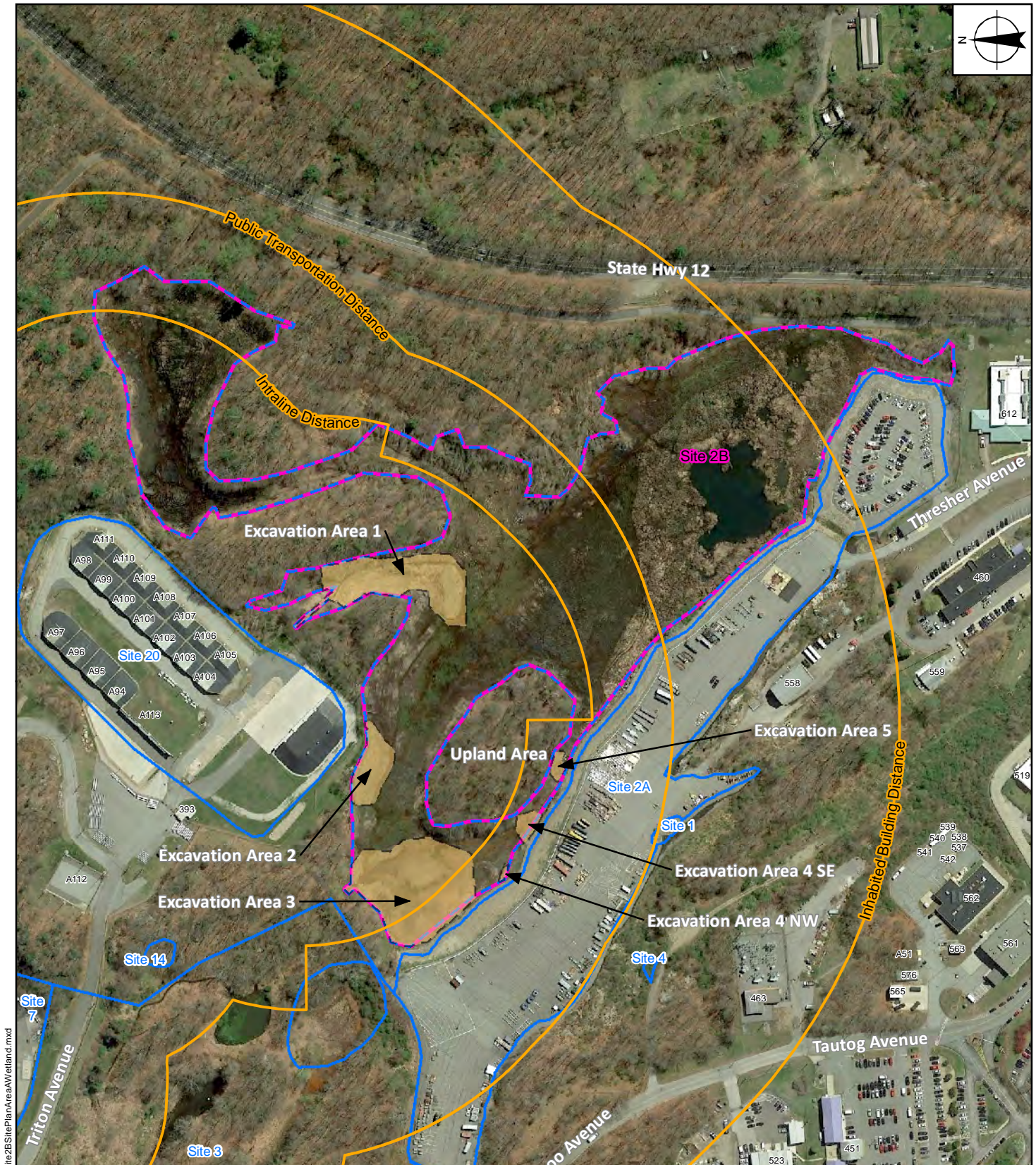
The Area A Wetland was undeveloped, wooded land, until the late 1950s when dredge spoils from the Thames River were pumped and contained within an earthen dike to form the present-day wetland. The Area A Wetland is approximately 26 acres and is relatively flat-lying, swampy, and vegetated with scattered areas of open water (generally shallow). The soft organic sediments that characterize this wetland support a monoculture of the reed *Phragmites* that dominate all other vegetative forms. The Navy, in cooperation with the CTDEEP Wetlands Habitat and Mosquito Management Program's *Phragmites* Control Team, initiated a program in 2010 to control *Phragmites* within excavation areas in the Area A Wetland through mechanical and chemical methods.<sup>1</sup>

The Area A Weapons Center (Site 20) is located northwest of the Area A Wetland, and the Area A Landfill (Site 2A) is south and west of Site 2B. Water from Site 2B drains to a channel located in the western portion of Site 2A and then discharges through an earthen dike via four 24-inch metal culverts to the Area A Downstream Watercourses (Site 3) which subsequently discharge into the Thames River (NAVFAC August 2010).

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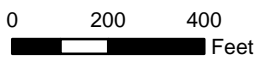
<sup>1</sup> This effort was not conducted as part of a CERCLA investigation or remedial action.





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- Explosive Safety Quantity Distances
- Site 2B Boundary
- LUC Boundary
- Approximate Excavation Limits
- 245 Building Number



Note - All site boundaries are approximate.

Figure 4-1  
Site 2B - Area A Wetlands - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/16/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



#### **4.2.1 Nature and Extent of Contamination**

The three most significant sources of contamination to Site 2B were: placement of 4,4'-dichlorodiphenyltrichloroethane (DDT) bricks in the Area A Wetland, former runoff from the Area A Landfill (Site 2A), and former runoff from the Area A Weapons Center (Site 20). Pesticides (4,4'-DDT, 4,4'-dichlorodiphenyldichloroethane [DDD], and 4,4'-dichlorodiphenyldichloroethylene [DDE]), Aroclor-1260, and several metals were detected at concentrations that exceeded their respective screening benchmarks (Tetra Tech February 2008). The chemical concentrations in subsurface sediment are much lower than concentrations in surface sediment (Tetra Tech February 2008).

An RA was conducted at Site 20 in 2001 to address PAH and arsenic contamination in soil and sediment during which approximately 200 cubic yards of soil and sediment were removed to mitigate direct exposures. During the RA, elevated levels of PAHs were detected in some of the sediment samples, which suggest that Site 20 is a source of PAHs to the Area A Wetland (Tetra Tech February 2008).

#### **4.2.2 Basis for Taking Action**

The Phase II RI evaluated older child trespasser and construction worker receptors (B&RE March 1997). Cumulative ILCR estimates for the trespasser ( $4.2\text{E-}05$ ) and construction worker ( $1.2\text{E-}05$ ) receptors were within the U.S. EPA's target risk range but above CTDEEP's  $1.0\text{E-}05$  risk threshold. The Phase II RI estimated the HQ for manganese (1.7), which was primarily attributed to dermal exposure in groundwater; however, the RI Update/FS re-examined chemical-specific risks and determined that manganese was not a COC for groundwater (Tetra Tech June 2010). The IEUBK model estimated lead levels below the U.S. EPA level of concern (B&RE March 1997).

The HHRA conducted as part of the RI Update/FS calculated potential risks for construction workers and adolescent trespassers exposed to soil, sediment, surface water, and groundwater (Tetra Tech June 2010). Because Site 2B is a jurisdictional wetland and thus will likely remain a wetland, because most of the wetland is within the Navy's Explosive Safety Quantity Distance (ESQD) arcs for the Area A Weapons Center (Site 20), and because the wetland is underlain by dredge spoils, residential and industrial land use were not evaluated (Tetra Tech June 2010).<sup>2</sup> Cumulative ILCR for construction workers ( $1.0\text{E-}05$ ) and older child trespassers ( $3.0\text{E-}05$ ) were equal to or above the

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<sup>2</sup> The Area A Wetland is both a federal jurisdictional wetland regulated under Section 404 of the Clean Water Act and a state jurisdictional wetland regulated under the Connecticut Inland Wetlands and Watercourses Act.

CTDEEP acceptable cancer risk level, and the HI for older child trespassers was less than 1. The cumulative HI for construction workers exposed to all media was 2. As noted in the ROD, because the HHRA did not include a residential scenario, LUCs will be required for the entire wetland until it is demonstrated that contaminants in sediment are acceptable for UU/UE (NAVFAC August 2010).

A screening ecological risk assessment (ERA) evaluated indicator species for birds, mammals, and sediment invertebrates to assess the potential for ecological effects. The screening ERA found unacceptable risks to sediment invertebrates due to PAHs, pesticides, PCBs, and metals concentrations above sediment screening levels (Tetra Tech February 2008); RGs were developed for Total PAHs, Total DDT (includes 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT), and Total Aroclors.

### **4.3 Remedial Actions**

The OU 12 ROD for Site 2B — Area A Wetland was signed by the Navy on 23 August 2010 and by U.S. EPA Region 1 on 2 September 2010. Remedial actions for Sites 2A and 2B groundwater, which was included in the OU 9 ROD, were discussed in Section 3.3. The OU 9 ROD was signed by the Navy on 24 September 2008 and by U.S. EPA Region 1 on 30 September 2008.

#### **4.3.1 Remedial Action Objectives**

The following RAOs for Area A Wetland sediment were selected to mitigate existing and future potential threats to human health and the environment (NAVFAC August 2010):

- Reduce risks to sediment invertebrates from exposure to COCs in the Area A Wetland.
- Mitigate the potential for COCs in Area A Wetland sediment to migrate to less impacted areas of the Area A Downstream Watercourses (specifically Site 3, which was previously remediated) and cause adverse effects to receptors in those areas.
- Prevent residential exposure to contaminants in the Area A Wetland sediments.

#### **4.3.2 Remedial Goals**

Table 4-1 summarizes the RGs for OU 12 sediment, which were derived based on ecological values. The Navy also agreed that samples with 10 or more chemicals (total PAHs, 4,4'-DDT, total DDT, arsenic, cadmium, chromium, copper, lead, nickel, and zinc) that exceed threshold effects concentrations would be considered impacted unless toxicity testing at that location indicated the sample was not toxic (NAVFAC August 2010).

Table 4-1 Site 2B — Remedial Goals for Sediment		
Contaminant of Concern	Remedial Goal (micrograms per kilogram)	Basis
Total Polynuclear Aromatic Hydrocarbons	6,585	Ecological
Total DDT (4,4'-DDT + 4,4'-DDE + 4,4'-DDD)	1,504	Ecological
Total Aroclors	532	Ecological

**Notes:**

DDT = Dichlorodiphenyltrichloroethane  
DDE = Dichlorodiphenyldichloroethene  
DDD = Dichlorodiphenyldichloroethane

### 4.3.3 Remedy Selection

The selected remedy included the following components:

- Excavation of sediment with contaminants greater than RGs and sediment considered impacted by toxicity testing, and transport of sediment offsite for proper disposal
- Restoration of excavated areas to pre-existing elevations with clean organic soil
- Seeding the restored area to establish native wetland vegetation
- Monitoring of the area to ensure that the native wetland vegetation has been established and that Phragmites are being controlled within the restored area
- LUCs to prevent future residential use of the Area A Wetland
- Five-year reviews because contamination would remain in excess of levels that allow for UU/UE

### 4.3.4 Remedy Implementation

#### 4.3.4.1 Excavation and Restoration

The remedial action for OU 12 was completed July 2012 through January 2013. The details of the remedial action were documented in the Final RACR for Area A Wetland (CB&I Federal Services, LLC [CB&I] June 2015). Approximately 3,283 tons of soil and sediment were excavated from six non-contiguous locations and disposed offsite during the remedial action. Before backfilling, confirmation samples were collected from each excavation and analyzed to document that RGs had been met.

#### **4.3.4.2 Long-Term Restoration Monitoring**

The Final Area A Wetland Site 2B Restoration Plan required a minimum of three years of onsite restoration monitoring due to the risk of invasive and noxious species (Resolution Consultants November 2012). Annual monitoring was conducted between 2013 and 2015 to ensure achievement of the following Restoration Plan and general United States Army Corps of Engineers (USACE) performance standards:

- Restored wetland areas must have target hydroperiod, patterns of inundation, and drawdown corresponding to similar conditions in adjacent wetlands.
- All installed trees and shrubs in the constructed elevated areas must achieve 75 percent survival for two years (2013 to 2015); trees and shrubs will be replanted if mortality exceeds 25 percent.
- In the elevated areas, the planted tree height in the third and final year must be at least 4 feet.
- Elevated areas, constructed within the restored wetland areas, shall have at least 60 percent vegetative cover of hydrophytic plants. All other restored and enhanced wetland areas shall have at least 50 percent vegetative cover of hydrophytic plants and at least 85 percent areal cover by native species with bare areas not exceeding 100 square feet.
- All invasive species contribute less than 15 percent of vegetative cover (common reed, reed canary, and purple loosestrife).

Annual monitoring began in 2013, the results of which are discussed in Section 4.5.1.1.

#### **4.3.4.3 Land Use Controls**

The performance objective of the Site 2B LUC RD is to prohibit residential use of the site including any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities.

Allowable activities at Site 2B, as presented in the LUC RD (Tetra Tech January 2012), are:

- Activities related to wetland restoration and monitoring.
- Environmental investigations and/or remedial actions conducted per approved work plans.



Requirements of the Site 2B LUC RD are discussed in Section 2.11.3.

#### **4.3.4.4 Operations and Maintenance**

Volume VII of the O&M Manual details requirements for Site 2B inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech November 2012).<sup>3</sup> Inspection activities for Site 2B include:

- Assessing compliance with the Site 2B LUC RD
- Inspecting monitoring wells

#### **4.3.5 System Operation/Operations and Maintenance**

O&M inspections of Site 2B have been performed annually since 2015 in accordance with Volume VII of the O&M Manual (Tetra Tech November 2012). The inspections focus on LUCs and Sites 2A and 2B monitoring well conditions. Inspection activities performed during this five-year review period are summarized in Section 4.5.1.3.

### **4.4 Progress Since the Last Five-Year Review**

This is the second five-year review of Site 2B. Table 4-2 provides a list and status of the recommendations that were made for Site 2B in the last five-year review.

<b>Table 4-2 Site 2B — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Complete and implement design of the selected remedy.	The remedy was designed in 2012 and implemented in 2013.
After the remedy has been implemented, perform at least yearly monitoring of Institutional Control compliance and incorporate monitoring reports into future five-year reviews.	The Land Use Control Remedial Design was finalized in January 2012. Post construction monitoring was performed during 2013, 2014, and 2015. Annual land use control compliance monitoring has not begun but is scheduled to commence in 2016.
Abandon monitoring wells 2WMW5D and 2WMW5S.	Monitoring well abandonment was deferred while other site maintenance activities were completed.
Continue to manage Phragmites in the Area A Wetland during the planned remedial action, and subsequently under the Navy's Natural and Cultural Resources Program.	Phragmites management is ongoing as described in the Final Area A Wetland Site 2B Restoration Plan (Resolution Consultants November 2012) and long-term restoration monitoring reports (CB&I October 2015, January 2016, August 2016). Beginning 2017, invasive species control will be managed under a to-be-developed wetland enhancement/restoration program.

<sup>3</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are in Volume I, Section 1.7 (Tetra Tech November 2012).

Since the last five-year review, the LUC RD for Site 2B sediment was finalized (Tetra Tech January 2012) and the remedial action was designed and completed at Site 2B (January 2013). Table A-2 in Appendix A summarizes information from documents generated that included Site 2B since the last five-year review and were reviewed for this five-year review: Site 2B LUC RD (Tetra Tech January 2012), Site 2B 30 Percent Design (Tetra Tech July 2012), Site 2B Remedial Action Work Plan (RAWP) (Shaw July 2012), Site 2B Restoration Plan (Resolution Consultants November 2012), Volume VII of the O&M Manual (Tetra Tech November 2012), and Final Site 2B RACR (CB&I June 2015). Annual wetland monitoring reports (CB&I October 2015, January 2016, and August 2016) summarize long-term restoration monitoring activities from 2013 to 2015 at Site 2B. Complete document references are in Section 14.

## **4.5 Technical Assessment**

The following information supports the determination that the selected remedy for sediment at Site 2B is functioning as intended. The technical assessment of groundwater at Sites 2A and 2B is discussed in Section 3.5.

### **4.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

#### **4.5.1.1 Monitoring Data Summary**

The findings of visual inspections conducted for long-term restoration monitoring from 2013 through 2015 are documented in Annual Wetland Monitoring Reports (CB&I October 2015, January 2016, and August 2016). The 2015 inspection report documented the following conditions at the restoration area:

- Woody plant survival exceeded the required 75 percent survival rate at 78 percent (73 percent for trees and 82 percent for shrubs). The site has reached a density of greater than 500 woody stems per acre.
- Average total percent areal coverage for herbaceous species is approximately 95 percent, with 5 percent open water. Herbaceous vegetation exceeded the required 75 percent survival rate at all areas except for Area 5, likely due to herbicide applications and deer herbivory.
- Several invasive plant species—predominantly common reed, mile-a-minute, and Japanese stiltgrass—have been observed within every restored wetland area.
- Shallow pits were dug in June and September 2015 to verify the hydrology and hydric soil conditions. Indicators of wetland hydrology were observed in June, including saturation and

high water table; groundwater levels were low in September which was attributed to the typically dry summer months. It is anticipated that hydric soil indicators will continue to develop over time.

- Since restoration activities, wildlife have been observed more frequently including deer, coyote, red fox, black bear; and many bird species. Amphibians and reptiles, including frogs, turtles, and snakes were also observed within the wetland.

The 2015 restoration monitoring inspections indicate that the wetland meets the performance standards. Due to the high potential for common reed and other invasive plant species to spread into the restored wetland, invasive species control should continue (CB&I August 2016). Due to low plant survival in Area 5 and invasive species concerns, additional monitoring will be performed in 2016. Beginning in 2017, NSB NLON Natural Resources Program will implement the necessary invasive species control.

#### **4.5.1.2 Land Use Control Status**

The Site 2B LUC RD for sediment was finalized in 2012 and is being implemented; the site remains a wetland and is not used for residential purposes. The LUC RD requires that inspections and certifications be performed annually; three years of post-construction monitoring was completed in 2015; LUC inspections and certifications will begin in 2016.

#### **4.5.1.3 Operations and Maintenance Summary**

O&M inspections are to be conducted annually, in accordance with Volume VII of the O&M Manual (Tetra Tech November 2012), to maintain existing Area A Landfill (Site 2) monitoring wells located within Site 2B. The first O&M inspection, performed in November 2015, determined that the monitoring wells are in good condition. The O&M inspection checklist is provided in the 2015 Annual Inspection Memorandum (Resolution Consultants July 2016).

#### **4.5.1.4 Five-Year Review Site Visit Findings**

The site visit included visual observations of the current condition of the Site 2B wetland (i.e., vegetative cover and invasive species). The land use of Site 2B had not changed since the OU 12 ROD; the area remains an undeveloped wetland area (see photos #2B-1 and #2B-2 in Appendix B). During the site visit, the wetland appeared to be in good condition with no apparent indications of remedy failure.

#### **4.5.1.5 Technical Evaluation**

Table 4-3 summarizes the technical evaluation for Question A.

<b>Table 4-3 Site 2B — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	<p>All contaminated wastes were removed and wetland restoration has occurred.</p> <p>The effectiveness of the Operable Unit 12 remedial action and site restoration activities have been monitored for three years. The results of monitoring performed to date show that restoration activities have been generally successful, are progressing appropriately, and meet performance standards (CB&amp;I August 2016). Due to low plant survival in Area 5 and invasive species concerns, additional monitoring will be performed in 2016.</p>
Systems Operation/ Operations and Maintenance	<p>Restoration inspections are performed annually and have verified that the restoration activities are generally successful and performance standards (CB&amp;I August 2016).</p> <p>Operations and maintenance inspections of Sites 2A and 2B monitoring wells located within the Area A Wetland are performed annually and verify that monitoring wells are in good condition.</p>
Implementation of Land Use Controls and Institutional/ Engineering Controls	Institutional controls associated with sediment in the Site 2B Land Use Control Remedial Design restrict residential land use; the site remains a wetland.
Opportunities for Optimization	<p>Introduce weevils to control mile-a-minute, which has been observed at the site.</p> <p>Plans are currently underway to design and implement a new wetland enhancement/restoration program at Site 2B (outside of the Environmental Restoration Program). This program would address invasive species and create a more diverse habitat and vegetation structure.</p>
Early Indicators of Potential Remedy Problems	None identified.

#### **4.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

##### **4.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Site 2B was summarized in Section 4.2.2. The site remains a wetland and land use has not changed. An HHRA determined that the potential risks associated with current and future land use scenarios were within U.S. EPA's acceptable risk range, but above CTDEEP's 1.0E-05 risk threshold (Tetra Tech June 2010). Potentially unacceptable risks to sediment invertebrates from Total PAHs, Total DDT, and Total Aroclor in sediment were addressed through remedial action detailed in the RACR (CB&I June 2015). Annual wetland restoration monitoring ensures that the wetland restoration remains effective.

The Site 2B LUC RD prohibits disturbance of sediment and future residential development of the wetland. The potential for unacceptable risks to hypothetical future residents is mitigated through the LUC RD. Site 2B is located within the ESQD arc zones for the Area A Weapons Center (Site 20) and Navy regulations prohibit construction of inhabited buildings or structures. VI is not an issue at Site 2B because there are no buildings and LUCs prevent future building construction within the wetland. A VI evaluation for Site 2B conducted as part of this five-year review (discussed in Section 2.9 and Table 2-1) concluded that no further evaluation of the VI pathway is necessary.

#### 4.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 4-4.

<b>Table 4-4</b> <b>Site 2B — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	There have been no applicable or relevant and appropriate requirement changes that affect the remedy at Site 2B.
Changes in Exposure Pathways	Groundwater is not used as drinking water. Volatilization via vapor intrusion has been reassessed since the last five-year review because of recent changes in guidance. Vapor intrusion is not expected to be an issue at this site; see Table 2-1 for further details.
Changes in Land Use	There have been no changes in land use since the last five-year review. The Site 2B Land Use Control Remedial Design prevents land use changes without notification.
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins are not probable contaminants at Site 2B due to its site history. Samples have not been collected for dioxin analysis.</p> <p>The potential for emerging contaminants (perfluorinated compounds and 1,4-dioxane) in groundwater at Sites 2A and 2B are addressed in Section 3.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. No volatile compounds are present in Site 2B.
Expected Progress towards Meeting Remedial Action Objectives	The remedial action objectives for Operable Unit 12 were met by excavation and successful restoration of the wetland documented in Remedial Action Completion Report and long-term restoration monitoring reports. A Land Use Control Remedial Design was prepared for Site 2B.

#### 4.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

#### 4.6 Issues and Recommendations

Issues and recommendations are identified in Table 4-5.

#### 4.7 Protectiveness Statement

Remedial actions implemented at Site 2B are protective of human health and the environment. The sediment removal action (excavation, disposal, and wetland restoration) addressed ecological exposures. An O&M program has been implemented and results verify that the restoration is performing as designed. The Site 2B LUC RD provides institutional controls for sediment.

Table 4-5 Site 2B — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
2	Annual sediment LUC inspections and certifications were not performed in accordance with the OU 12 LUC RD at Site 2B in 2013, 2014, or 2015.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 12 LUC RD at Site 2B.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
Monitoring								
3	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 2B; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	
Operations and Maintenance								
4	The Third Five-Year Review Report recommended two monitoring wells for abandonment; they have not been abandoned.	Following the completion of emerging contaminant assessments and investigations, evaluate and abandon wells, and document the decision as necessary.	Navy	U.S. EPA, CTDEEP	To Be Determined <sup>[2]</sup>	N	N	

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

<sup>[2]</sup> Well abandonment activities are dependent on results of the emerging contaminant assessments/investigations and long-term monitoring program; a date for well abandonment cannot be estimated at this time.

SUBASENLONINST	=	Subase New London Instruction	VOC	=	Volatile Organic Compound
CTDEEP	=	Connecticut Department of Energy and Environmental Protection	U.S. EPA	=	United States Environmental Protection Agency
LUC	=	Land Use Control	OU	=	Operable Unit
LUC RD	=	Land Use Control Remedial Design	PFC	=	Perfluorinated Compound



## **5.0 SITE 3 — AREA A DOWNSTREAM WATERCOURSES/OVERBANK DISPOSAL AREA, OPERABLE UNITS 3 AND 9**

Site 3 is the Area A Downstream Watercourses (historically referred to as Site 3A), and the OBDA (historically referred to as Site 3B), included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Sites 3A and 3B are collectively referred to as Site 3 in this five-year review. Figure 5-1 shows the site layout of Site 3. At Site 3, soil and sediment are managed under OU 3 and groundwater is managed under OU 9 (Basewide Groundwater).

### **5.1 Site History and Background**

Table A-3 in Appendix A summarizes the chronology of events at Site 3.

### **5.2 Conceptual Site Model**

The Area A Downstream Watercourses include three ponds (Upper Pond, Lower Pond, and OBDA Pond) and six interconnected streams (Streams 1 through 6). The Area A Downstream Watercourses receive surface water and groundwater recharge from the Area A Landfill (Site 2A), Area A Wetland (Site 2B), Torpedo Shops (Site 7), OBDA, and OBDA Northeast (Site 14). The OBDA is located on the slope of a dike (Area A Dike) adjacent to the Area A Landfill (Site 2A) and the Area A Wetland (Site 2B). North Lake, used for swimming by NSB NLON personnel and their families, is a man-made lake in the central portion of Site 3.<sup>1</sup> A nine-hole golf course occupies most of the western portion of Site 3.

#### **Site 3 – Soil and Sediment**

- Suspected sources of contamination:
  - Historical application of pesticides to surface water bodies
  - Contaminant migration from placing Thames River dredge spoils at upland sites
- COCs: pesticides and metals
- Remedy:
  - Soil and Sediment (OU 3) ROD (March 1998)
    - Removal, treatment, and discharge of standing water from ponds and streams
    - Clearing/grubbing contaminated soil areas
    - Dredging/excavating, onsite dewatering, and offsite disposal of contaminated sediment and soil
    - Placing clean soil backfill and borrow in dredged sediment areas
    - Post-construction restoration monitoring
  - Explanation of Significant Difference for OU 3 ROD (May 2007) was issued for pipes and soil unable to be removed during the soil/sediment remedy
    - LUCs
    - Inspections
  - OU 3 New Source Area Soil ROD (September 2004)
    - NFA under CERCLA (petroleum)
    - Removal action under CTDEEP regulations

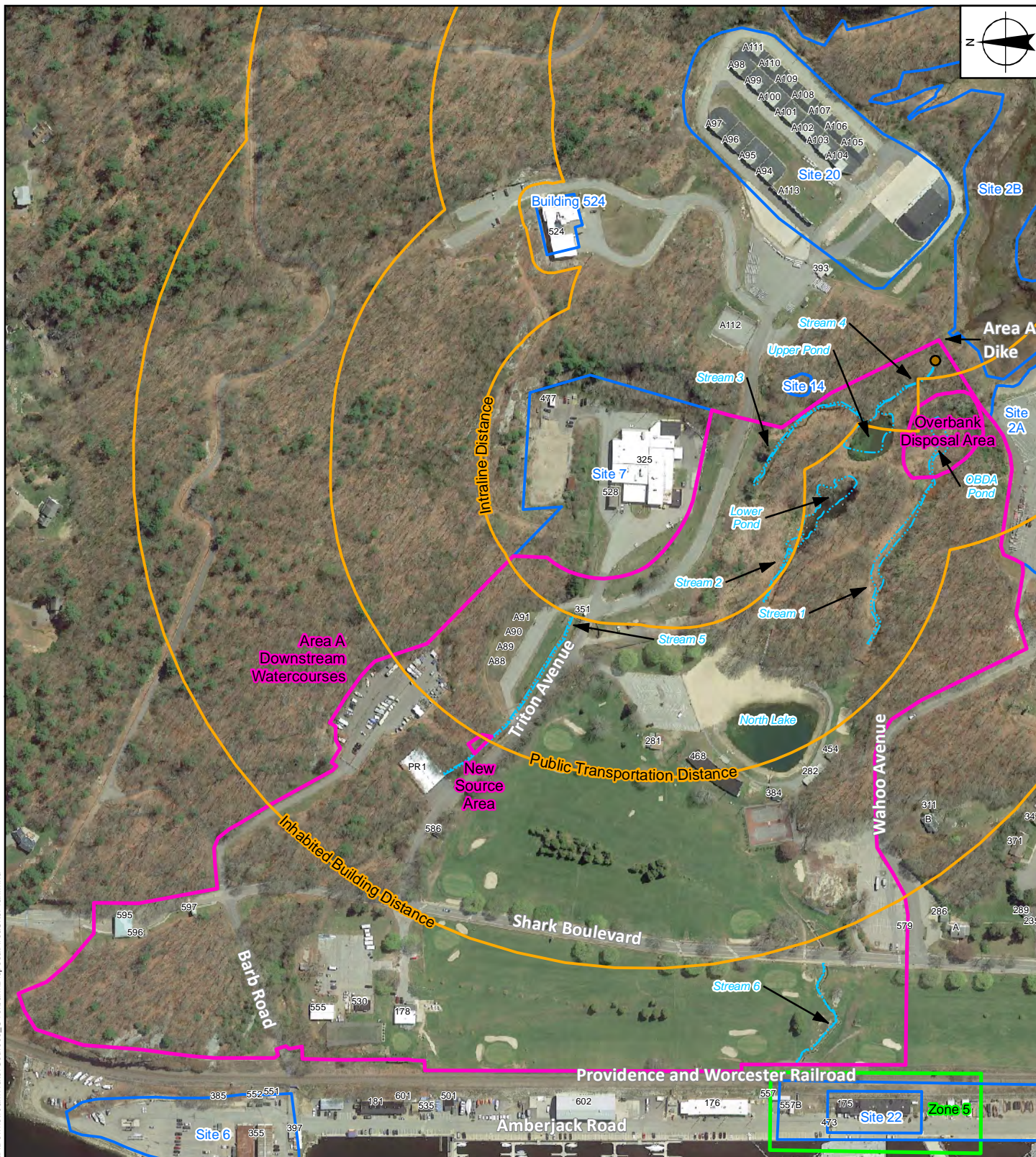
#### **Site 3 – Groundwater**

- Suspected source of contamination is migration from upgradient sites (e.g., Site 7)
- COCs: TCE and vinyl chloride
- Remedy:
  - IROD (December 2004)
    - Institution controls
    - Monitoring
  - Basewide Groundwater (OU 9) ROD (September 2008)
    - Institutional controls
    - Monitoring

<sup>1</sup> North Lake is filled with municipal water during warm-weather months and drained in cold-weather months.



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- Streams and Ponds
- Concrete Encapsulated Soil
- Zone Boundary
- Site 3 Boundary
- Explosive Safety Quantity Distances
- 245 Building Number

0 250 500  
Feet

Note - All site boundaries are approximate.

Figure 5-1  
Site 3 - Area A Downstream Watercourses/  
Overbank Disposal Area/New Source  
Area - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark  
DRAWN BY: N. Rinehart

DATE: 11/16/2016  
TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



Most of Site 3 is located within designated ESQD arcs of the Area A Weapons Center (Site 20). Navy regulations prohibit construction of inhabited buildings or structures within these arcs and, although existing buildings operate under a waiver of these regulations, no further construction is planned.

### **5.2.1 Nature and Extent of Contamination**

Historical applications of pesticides to surface water bodies adjacent to North Lake and the golf course are the primary source of contamination at the Area A Downstream Watercourses. Dredge spoil piles placed upgradient of Site 3 (at the Area A Wetland [Site 2B]) likely resulted in downgradient migration of metals due to storm water runoff and migration in streamflow. Additional sources of contamination are abandoned disposal areas (OBDA) and abandoned septic system leach fields at Torpedo Shops (Site 7) (NAVFAC December 1997).

#### **Site 3 Physical Characteristics**

Area A Downstream Watercourses/OBDA drain the Area A Landfill and Area A Wetland through water bodies and streams that ultimately flow into the Thames River.

- Discharge from the Area A Wetland flows through the Area A Dike to Stream 4 to the Upper Pond. Stream 3 is the primary outlet for Upper Pond; however, during periods of high flow, it also discharges to Stream 1.
- Streams 3 and 5 are interconnected via multiple culverts and discharge to the Thames River via a storm drain that follows Triton Avenue.
- Groundwater seeps from the northwest slope of the adjacent Area A Landfill into the OBDA Pond.
- Stream 1 flows between the OBDA Pond outlet and Stream 6, a culverted stream that is formed by Stream 1, Stream 2, and the outflow of North Lake, and discharges to the Thames River.
- The Lower Pond is formed by groundwater inflow but is not hydrologically connected to the Upper Pond.

The OBDA was used as a disposal area after the earthen Area A Dike was constructed in 1957 until sometime before 1982, when the Initial Assessment Study (IAS) identified the wastes in this area (Envirodyne 1983). A Non-Time Critical Removal Action (NTCRA) at the OBDA was completed in March 1997. Tanks, drums, large metal items, timbers, and miscellaneous construction debris resting on or protruding through the existing ground surface were removed from the OBDA. The NTCRA at the OBDA was completed to eliminate the potential threat to human and ecological receptors caused by the migration of contamination from potentially leaking tanks, drums, or other containers (Navy September 1999).

During the OU 3 RA, performed in 1999 and 2000, a secondary source area (Site 3 — New Source Area) was identified; subsequent investigation identified petroleum-related compounds at this site. In 2004, the ROD for Site 3 — New Source Area determined NFA was required under CERCLA; however, additional removal actions were pursued under CTDEEP regulations. Additional details are provided in Appendix A, Table A-3; however, because Site 3 — New Source Area is not a CERCLA site, it is not discussed further in this five-year review.

CTDEEP classified groundwater beneath NSB NLON, including Site 3, as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is available.

### **5.2.2 Basis for Taking Action**

Older child trespassers and recreational users exposed to surface soil, surface water, and sediment, and construction workers exposed to surface and subsurface soil, sediment, and groundwater were evaluated in the HHRA performed for the Phase II RI (B&RE March 1997). Carcinogenic risks (generally ranging from 1E-05 to 7E-05) exceeding the CTDEEP-acceptable cumulative risk level due primarily from exposure to pesticides (4,4'-DDD, 4,4'-DDT, and dieldrin) and inorganics (arsenic and beryllium) for the older child trespasser and the construction worker for soil/sediment media (B&RE December 1997).

Soil/sediment cumulative HIs for the older child trespasser and construction worker exceeded 1, due primarily to 4,4'-DDT concentrations present in soil/sediment (B&RE December 1997). HIs associated with dermal exposure to groundwater exceeded 1 for the construction worker, were due primarily to antimony and manganese concentrations, the latter of which was considered reflective of naturally occurring conditions at NSB NLON (NAVFAC December 1997). Groundwater was subsequently reevaluated under OU 9 (Basewide Groundwater) in the BGOURI (Tetra Tech December 2001) and again after a data-gap investigation (DGI) in the BGOURI Update/FS (Tetra Tech July 2004). As a conservative measure, the risk assessments presented in the OU 9 (Basewide Groundwater) ROD evaluated a hypothetical future human residential exposure scenario under which the base was closed and redeveloped for residential use, and assumed groundwater would be used as a drinking water source. Vinyl chloride exceeded the CTDEEP-acceptable carcinogenic cumulative risk level, and vinyl chloride and TCE exceeded federal and state Maximum Contaminant Levels (MCLs). Petroleum product was found in subsurface soil at the soil/groundwater interface; total petroleum hydrocarbons (TPH) was retained due to migration from groundwater to surface water (Tetra Tech July 2004). As noted previously, TPH was managed under CTDEEP.

An ERA evaluated aquatic organisms, terrestrial vegetation, soil invertebrates, and terrestrial vertebrates exposed to surface soil, surface water and sediment. By incorporating refined exposure parameters into a food chain model, the ERA determined that exposure to soils presents potential unacceptable risk to terrestrial vertebrate indicator species (short-tailed shrew, barred owl, mallards, and raccoons) due primarily to concentrations of pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin) (B&RE March 1997). Results from toxicity tests conducted on samples collected from

Site 3 indicated that sediments within the Area A Downstream Watercourses/OBDA represented a significant risk to benthic macroinvertebrates (B&RE December 1997). Subsequent evaluations of terrestrial invertebrates, plants, and aquatic receptors as endpoint receptors were used to refine exposure assumptions.

### 5.3 Remedial Actions

Table 5-1 lists decision documents applicable to Site 3.

Table 5-1 Site 3 — Decision Documents			
Decision Document	Site 3 Area	Signature Dates	
		Navy	U.S. EPA Region 1
Record of Decision for Soil and Sediment (Operable Unit [OU] 3)	Area A Downstream Watercourses/Overbank Disposal Area (OU 3)	14 March 1998	31 March 1998
Record of Decision for Site 3 — New Source Area Soil — OU 3	New Source Area (OU 3)	4 November 2004	9 November 2004
Interim Record of Decision for Sites 3, 7, 14, 15, 18, and 20 Groundwater	Groundwater (OU 9)	23 December 2004	30 December 2004
Explanation of Significant Difference for the Record of Decision for Soil and Sediment	Area A Downstream Watercourses/Overbank Disposal Area (OU 3)	10 May 2007	5 June 2007
Record of Decision for OU 9 Basewide Groundwater	Groundwater (OU 9)	24 September 2008	30 September 2008

The following sections detail the remedies for Site 3 soil and sediment (Area A Downstream Watercourses/OBDA — OU 3) and groundwater (OU 9). As discussed previously, the Site 3 — New Source Area ROD required NFA under CERCLA since petroleum was the only contaminant and is regulated under CTDEEP authority and is therefore not discussed further in this five-year review.

#### 5.3.1 Remedial Action Objectives

##### 5.3.1.1 Soil and Sediment

The following RAOs for soil and sediment were developed in the OU 3 ROD to mitigate existing and future potential threats to human health and the environment (NAVFAC December 1997):

- Protection of potential human receptors by preventing incidental ingestion of contaminated soil and sediment containing 4,4'-DDT, 4,4'-DDD, and dieldrin at concentrations exceeding 27 milligrams per kilogram (mg/kg), 38 mg/kg, and 0.57 mg/kg, respectively.

- Protection of potential human receptors by preventing incidental ingestion of sediment containing arsenic and beryllium at concentrations exceeding 6.1 mg/kg and 2.1 mg/kg, respectively.
- Protection of ecological receptors by preventing contaminated soil containing dichlorodiphenyltrichloroethane residuals (DDTR) concentrations exceeding 5.0 mg/kg and contaminated sediment containing DDTR concentrations exceeding 2.0 mg/kg and dieldrin concentrations exceeding 0.045 mg/kg to 0.195 mg/kg from entering the food chain.
- Protection of ecological receptors from potential toxicity of sediment containing cadmium, lead, and zinc at concentrations exceeding their respective effects range-medium (ER-M) values of 9.6 mg/kg, 218 mg/kg, and 410 mg/kg.

#### **5.3.1.2 Groundwater**

The following RAOs were developed for groundwater at Site 3 in the OU 9 ROD (NAVFAC September 2008):

- To protect current receptors (construction workers) from incidental exposure to groundwater contaminated with chlorinated hydrocarbons at concentrations greater than preliminary RGs.
- To protect potential future receptors from regular ingestion (potable water supply) of groundwater contaminated with chlorinated hydrocarbons at concentrations greater than preliminary RGs and to protect future residential receptors from exposure to contaminated groundwater via VI.
- To protect aquatic ecological receptors by preventing the migration of groundwater contaminated with petroleum hydrocarbons at concentrations greater than preliminary RGs to surface water.

#### **5.3.2 Remedial Goals**

##### **5.3.2.1 Soil and Sediment**

Table 5-2 lists RGs for Site 3 soil and sediment, which were based on the lower of human health or ecological values presented in Section 5.3.1.1.



Table 5-2 Site 3 — Remedial Goals for Soil and Sediment			
Contaminant of Concern	Soil	Sediment	Basis
DDTR	5.0 mg/kg	2.0 mg/kg	Ecological
Dieldrin <sup>[1]</sup>	0.57 mg/kg	0.045 mg/kg	Ecological
Arsenic <sup>[1]</sup>	Not a COC	6.1 mg/kg	Human Health (older child trespasser)
Beryllium <sup>[1]</sup>	Not a COC	2.1 mg/kg	Human Health (older child trespasser)
Cadmium	Not a COC	9.6 mg/kg	Ecological
Lead	Not a COC	218 mg/kg	Ecological
Zinc	Not a COC	410 mg/kg	Ecological

**Notes:**

DDTR = dichlorodiphenyltrichloroethane residuals; includes 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE

mg/kg = milligram(s) per kilogram

COC = contaminant of concern

<sup>[1]</sup> RGs presented in the ROD incorrectly omitted the arsenic and beryllium sediment RGs for protection of human health and dieldrin RG for ecological protection that were presented in the RAOs. During development of the RD, these errors were identified in U.S. EPA Comments (17 March 1999, 22 July 1999, 12 October 1999, and 26 January 2000) and the RGs were properly documented and used in follow-on documents (e.g., design and construction completion reports) and for the RA. There were no ROD amendments or memorandums to file to document this omission.

### 5.3.2.2 Groundwater

The RGs for groundwater at Site 3 selected in the OU 9 ROD are presented in Table 5-3. These RGs are protective of human health, based on U.S. EPA MCLs and CTDEEP RSRs for groundwater. If multiple criteria existed for a single compound, the most conservative value was selected.

Table 5-3 Site 3 — Remedial Goals for Groundwater		
Contaminant of Concern	Remedial Goal for Protection of Future Potential Receptors	Basis
Trichloroethene	5 µg/L	U.S. EPA MCLs and CTDEEP RSRs <sup>[1]</sup>
Vinyl Chloride	1.6 µg/L	CTDEEP RSR for groundwater volatilization

**Notes:**

µg/L = micrograms per liter

U.S. EPA MCLs = United States Environmental Protection Agency Maximum Contaminant Levels

CTDEEP RSR = Connecticut Department of Energy and Environmental Protection Remediation Standard Regulation

<sup>[1]</sup> Groundwater remedial goals were based on the most conservative groundwater classification (groundwater protection criteria for groundwater classified as GA and groundwater volatilization criteria), although all NSB NLON groundwater is classified GB.

### 5.3.3 Remedy Selection

#### 5.3.3.1 Soil and Sediment

The selected remedy included excavation and dredging, onsite dewatering, and offsite disposal of soil and sediment; restoration of wetlands and waterways; and monitoring. Upon completion of the

remedy, the risks associated with soil and sediment would be eliminated and would be protective of human health and the environment (i.e., UU/UE) (NAVFAC December 1997).

### **5.3.3.2 Groundwater**

The selected remedy was institutional controls with monitoring; the remedy was intended to be protective of human health by placing restrictions on groundwater extraction and use while being compatible with NSB NLON's groundwater classification (GB), which does not allow for groundwater consumption without treatment (NAVFAC September 2008). The selected remedy included:

- Continuation of institutional controls that identify the location and magnitude of groundwater contamination, restrict extraction and use of the groundwater, and control VI based on land use. Institutional controls were initially implemented at Site 3 in December 2006 in accordance with the Interim ROD (NAVFAC December 2004). These interim controls were incorporated into the Final ROD. In the event of property transfer and with confirmation that contaminated groundwater remains at Site 3, an environmental land use restriction pursuant to state law will be used to prohibit the use of groundwater.
- Continued monitoring of the degradation and potential migration of groundwater contaminants until concentrations decrease to levels at which UU/UE to groundwater may be permitted. The monitoring program at Site 3 was initiated in May 2006 in accordance with the Interim ROD.
- Five-year reviews until the results of the monitoring program indicate that RGs have been reached.

### **5.3.4 Remedy Implementation**

#### **5.3.4.1 Soil and Sediment**

##### **Remedial Action**

The remedial action for soil and sediment was completed July 1999 through August 2000. The details of the remedial action were documented in a Remedial Action Report for Area A Downstream/OBDA Remediation (Foster Wheeler Environmental Corporation [FWEC] February 2001).<sup>2</sup>

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<sup>2</sup> The Remedial Action Report is a Construction Completion Report that does not fulfill the requirements of a RACR, which is pending completion based on the recommendation from the Third Five-Year Review as discussed in Table 5-4.

Remediation and restoration activities included the following: dewatering and water management; backfill and waste characterization; excavation, waste stabilization, and transport offsite for disposal; and site restoration. Approximately 18,050 tons of soil and sediment were excavated and disposed offsite during the remedial action. Field sampling and screening for DDTR was used as the decision-making tool regarding excavation depth and area during the remedial action field effort (FWEC February 2001). Post-excavation confirmatory sampling and analysis was performed to confirm that RGs at each excavation had been met prior to closing the excavation.

### **Explanation of Significant Difference**

Two abandoned pipes were uncovered during excavation of soil and sediment at the Stream 4 headwaters, below the existing outfall structure for the Area A Wetland (Site 2B). DDTR was detected at 32.6 mg/kg (above the 5 mg/kg soil RG) in soil from around the pipes and arsenic was detected at 10 mg/kg (above the 6.1 mg/kg sediment RG) in sediment within the pipes (NAVFAC May 2007). Because soil and sediment excavation would have compromised the integrity of the Area A Dike, the area around the piping was isolated and encapsulated using a cement/bentonite grout. In order to minimize erosion immediately beneath the Area A Wetland (Site 2B) outfall structure, concrete was placed to form an apron and anchor the rock discharge structure. The estimated volume of sediment remaining within the culverts is 13 cubic yards, based on assumptions that the each culvert is 18 inches in diameter and 100 feet long, and completely filled with sediment. The estimated volume of contaminated soil left in place around the culverts is a few cubic yards (NAVFAC May 2007).

Based on the field modification described above, an Explanation of Significant Difference (ESD) (NAVFAC May 2007) was prepared to document the change in the remedy presented in the ROD (NAVFAC December 1997). Because this contaminated material was left in place, institutional controls, inspections of the concrete-encapsulated soil, and five-year reviews are required as part of the remedy.

### **Long-Term Restoration Monitoring**

Post-construction long-term restoration monitoring was conducted for three years in accordance with the Final Long-Term Wetland Monitoring Plan (FWEC September 2001) to ensure that vegetation and habitat were properly restored. The performance standards were generally met by the end of Year 3 (2003) and restoration was considered complete; therefore the Navy discontinued the long-term restoration monitoring program (FWEC October 2004).

## **Land Use Controls**

SUBASENLONINST 5090.25 (Navy April 2013) defines the Navy's policy regarding ground surface disturbance of soils or any subsurface disturbance of soils and/or groundwater at ER sites. Additional information is provided in Section 2.11.1. A Draft LUC RD for the concrete-encapsulated soil, in accordance with the ESD, is in progress. Once finalized, the LUC RD will become the primary LUC document for soil and sediment at Site 3 (the LUC RD will also be referenced in SUBASENLONINST 5090.25 and identified on a basewide map) and will continue to protect potential human receptors and ecological receptors from contaminated soil within the concrete encapsulation.

## **Operations and Maintenance**

Volume VI of the O&M Manual details requirements for Site 3 inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech July 2011).<sup>3</sup> Inspection activities for Site 3 include:

- Assessing compliance with LUCs
- Assessing concrete-encapsulated soil
- Inspecting monitoring wells

### **5.3.4.2 Groundwater**

#### **Land Use Controls**

A LUC RD was completed for Site 3 groundwater in June 2005 (Tetra Tech June 2005). The Navy incorporated the information in the LUC RD into SUBASENLONINST 5090.25 (Navy April 2013). The LUC RD for Site 3 groundwater was replaced by the OU 9 (Basewide Groundwater) LUC RD, which was prepared based on requirements of the OU 9 ROD (NAVFAC September 2008). The OU 9 LUC RD is discussed further in Section 2.11.2.

One of the LUC Performance Objectives for Site 3 groundwater outlined in the OU 9 LUC RD included evaluating and initiating mitigation measures to meet residential volatilization criteria for the area encompassed within 100 feet of the monitoring well 2DMW29S because vinyl chloride concentrations in groundwater exceeded the RG. To comply with this performance objective, the Navy submitted a letter to CTDEEP documenting that no buildings or other structures would be constructed within 100 feet of the monitoring well.

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<sup>3</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are in Volume I, Section 1.7 (Tetra Tech November 2012).

## **Groundwater Monitoring**

The Navy implemented a groundwater monitoring program at Site 3 in 2006 (Tetra Tech March 2006). Since 2011, sampling activities at the site have been performed in accordance with the GWP in Volume II of the O&M Manual Revision 2 (Tetra Tech July 2011). The results of the program are being used to monitor degradation and potential migration of COCs until concentrations decrease to levels at which UU/UE of groundwater may be permitted (NAVFAC September 2008). The monitoring program will continue until compliance with RGs within the site boundaries are achieved. According to the decision matrix presented in Volume II of the O&M Manual, monitoring can be discontinued after four years of data that show compliance with the applicable criteria.<sup>4</sup>

### **5.3.5 System Operation/Operations and Maintenance**

#### **5.3.5.1 Groundwater Monitoring Program**

Eighteen rounds of sampling have been performed over nine years, and both the number of wells and sampling frequency have been optimized over time. Currently, groundwater is sampled annually at Site 3, with samples collected from five wells analyzed for TCE and vinyl chloride. Sampling results performed during this five-year review period are summarized in Section 5.5.1.1.

#### **5.3.5.2 Operations and Maintenance**

Inspection of the concrete-encapsulated soil within the Area A Dike is performed annually in accordance with Volume VI of the O&M Manual (Tetra Tech July 2011). In recent years, the inspections were conducted in the spring, and corrective actions completed during the following summer. Inspection activities performed during this five-year review period are summarized in Section 5.5.1.3.

## **5.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 3. Table 5-4 provides a list and status of the recommendations that were made for Site 3 in the last five-year review.

<b>Table 5-4 Site 3 — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Continue enforcement of Standard Operating Procedure — Administrative New London Instruction 5090.25 until a Land Use Control Remedial Design can be completed.	The Land Use Control Remedial Design is in progress, see Section 2.11.6. Subbase New London Instruction 5090.25 (cancelled Standard Operating Procedure — Administrative New London Instruction 5090.25) is being enforced.

<sup>4</sup> One year of compliance monitoring followed by an additional three years of post-remediation monitoring.



<b>Table 5-4 Site 3 — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Continue operations and maintenance (O&M) (annual inspections and monitoring) and repair the broken cover on well 3MW12D.	Annual inspections and monitoring occurred and well cover 3MW12D was replaced in 2014.
Complete and implement Revision 2 of the O&M Manual.	Revision 2 of the O&M Manual, which includes Site 3, was finalized in 2011 and implemented in 2012.
Complete a Remedial Action Completion Report to document completion of the remedial action.	A Remedial Action Completion Report is in progress.
Abandon monitoring wells 2DMW25S, 2DMW28D, 3MW15S, and 3MW15I that are not currently being used in the groundwater monitoring program.	Monitoring well abandonment was deferred while other site maintenance activities were completed; these wells will not be abandoned until the completion of emerging contaminant assessments and investigations.
Continue to manage Phragmites at Site 3 under the Navy's Natural and Cultural Resources Program.	Phragmites management is ongoing. Naval Submarine Base New London treated invasive species in 2015 and 2016; funding has been secured for 2017.

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Annual groundwater monitoring and O&M inspection reports for Site 3 are summarized in Table 5-5; complete document references are in Section 14.

<b>Table 5-5 Site 3 — Summary of Groundwater Monitoring and Operations and Maintenance Inspection Reports</b>		
<b>Year</b>	<b>Groundwater Monitoring</b>	<b>Operations and Maintenance Inspection</b>
2011	Sovereign Consulting (December 2012)	Sovereign Consulting (December 2012)
2012	H&S Environmental [H&S] (December 2013)	H&S (September 2012)
2013	H&S (July 2015)	H&S (April 2014)
2014	H&S (March 2015)	H&S (May 2015)
2015	H&S (March 2016)	H&S (March 2016)

## 5.5 Technical Assessment

The following information supports the determination that the selected remedies for soil, sediment, and groundwater at Site 3 are functioning as intended.

### 5.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?

#### 5.5.1.1 Monitoring Data Summary

Figure 5-2 shows the location of wells sampled annually as part of the active monitoring program (2DMW16S, 2DMW16D, 2DMW29S, 3MW16S, and 3MW16D). Analytical results for annual groundwater monitoring activities were provided in their respective annual report, as listed in Table 5-5. During this five-year review period, TCE and vinyl chloride concentrations have remained below RGs in all wells sampled. Based on these results, the sampling program at Site 3 should be evaluated for further optimization in accordance with the decision diagram in Volume II of the O&M Manual.

#### **5.5.1.2 Land Use Control Status**

The LUC RD for the concrete encapsulated soil at Site 3 has not been finalized. In the interim, SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soil (including concrete-encapsulated soil) at Site 3; see Section 2.11.1.

The OU 9 LUC RD that includes Site 3 groundwater requires that inspections and certifications be performed annually (Tetra Tech November 2009). During this five-year review period, annual LUC inspections and certifications (as required by the OU 9 LUC RD) were not performed or documented in 2011 and 2012; they were in 2013, 2014, and 2015. NSB NLON is currently modifying its procedures to ensure compliance with the LUC RD. No buildings or other structures have been constructed within 100 feet of the 2DMW29S, in accordance with the OU 9 LUC RD.

#### **5.5.1.3 Operations and Maintenance Summary**

Inspections have been conducted annually as part of O&M activities associated with Site 3 since 2003; five inspections were performed at Site 3 during this five-year review period. Review of Site 3 O&M inspection checklists and findings for 2011 through 2015 (as provided in their respective annual reports) indicated that communication of maintenance requirements and subsequent repairs and documentation/re-inspection were not performed early in the review period. Further review of O&M procedures should be performed to clarify and document roles and responsibilities, based on lessons learned during the latter part of the five-year review period and to ensure timely submittals/responses. Appropriate revisions should be incorporated into the next O&M Manual update.

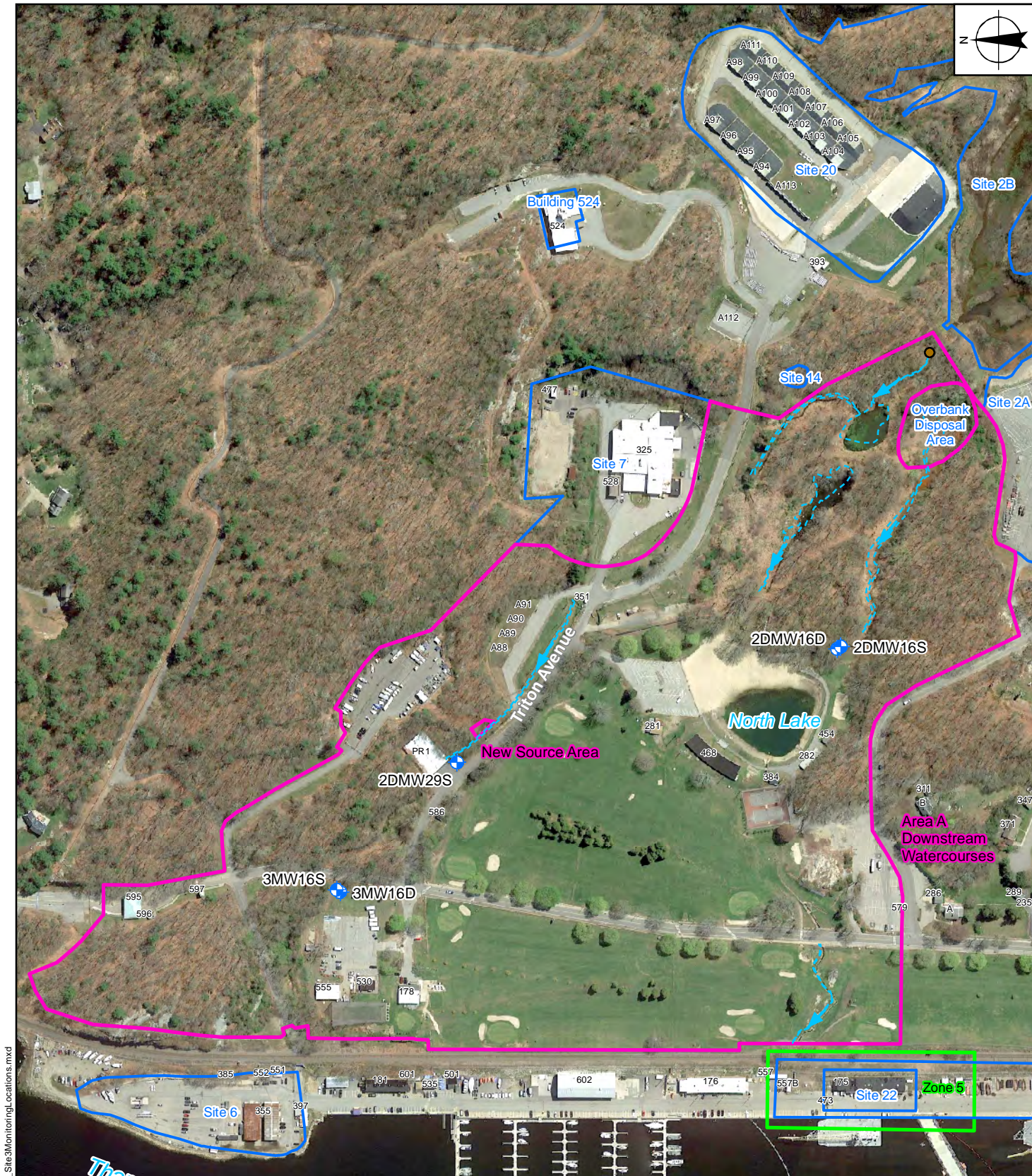
The May 2015 inspection concluded that the concrete-encapsulated soil area was in good condition and functioning as designed by preventing erosion of and exposure to contaminated soil.

#### **5.5.1.4 Five-Year Review Site Visit Findings**

The site visit included visual observations of several Site 3 features (i.e., concrete-encapsulated soil, general condition of the restored wetland, and monitoring wells). The land use of Site 3 had not changed since the remedy was implemented and the Third Five-Year Review was completed.

During the site visit, the concrete-encapsulated soil area appeared to be in good condition and working as intended, and the wetland restoration appeared to have been successful, with planted vegetation and ponds in good condition (see photos #3-1 and #3-2 in Appendix B).





X:\Navy\New\_London\_Sub\_Base\FY2016\_Site3MonitoringLocations.mxd

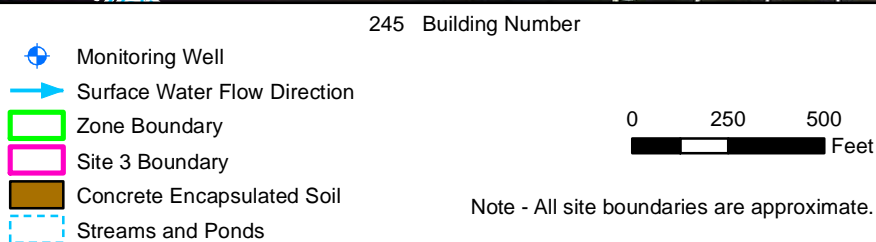


Figure 5-2  
Site 3 - Monitoring Locations  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/16/2016

DRAWN BY: N. Rinehart

TASK ORDER NUMBER: WE61

Data Sources: ArcGIS Online Imagery Basemap



Performance standards were met and post-construction monitoring was completed in 2003 and inspections of the wetland are no longer required (FWEC October 2004). Although no specific issue regarding wetland restoration conditions were noted during the site visit, the U.S. EPA recommended that performance standards for invasive species, as detailed in the Final Long-Term Wetland Monitoring Plan (FWEC September 2001), should be revisited to confirm the site is in compliance. NSB NLON obtained Natural and Cultural Resources funding to assist in invasive species management and, in 2015, invasive species were cut and treated with herbicide at approximately 7.3 acres within Site 3. The U.S. EPA's recommendation been addressed with treatment in 2015, additional invasive species management performed in 2016, and funding being secured for invasive species management in 2017.

#### 5.5.1.5 Technical Evaluation

Table 5-6 summarizes the technical evaluation for Question A.

<b>Table 5-6</b> <b>Site 3 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	<p>All contaminated soil and sediment in excess of remedial goals (RGs) were excavated and disposed offsite, except for the small area in Stream 4, which was encapsulated in concrete. The effectiveness of the Operable Unit (OU) 3 remedial action and site restoration activities was monitored for three years.</p> <ul style="list-style-type: none"> <li>Monitoring showed that restoration activities were successful and that no further excavation or restoration activities were necessary.</li> <li>Invasive species at Site 3 are currently managed under the Navy's Natural and Cultural Resources Program. Herbicide treatment and cutting occurred at in 2015 and 2016, and funding has been secured for 2017.</li> </ul> <p>The groundwater monitoring program indicates that contaminant of concern concentrations have decreased below RGs.</p>
Systems Operation/ Operations and Maintenance (O&M)	<p>Annual O&amp;M inspections verify that the concrete-encapsulated soil and monitoring wells are in good condition.</p> <p>Corrective actions to improve communication of maintenance requirements and subsequent repairs and documentation/re-inspection have been implemented, but should to be reviewed and documented in the next revision of the O&amp;M Manual.</p>
Implementation of Land Use Controls and Institutional/ Engineering Controls	<p>Institutional controls associated with Site 3 soil and sediment are in Subbase New London Instruction 5090.25. Some areas of Site 3 are fenced and access is restricted. A significant portion of the site remains within designated Explosive Safety Quantity Distance arcs of the Area A Weapons Center in which future development is prohibited. The Land Use Control Remedial Design (LUC RD) for the concrete encapsulated soil at Site 3 is in progress.</p> <p>The LUC RD for OU 9 Basewide Groundwater, which includes Site 3 groundwater, was completed and the controls have been implemented. However, during this five-year review period, inspections and certifications were only performed in 2013, 2014, and 2015 which is not in accordance with the OU 9 LUC RD (annual certifications). Naval Submarine Base New London is currently modifying its procedures to ensure that OU 9 land use control inspections and certifications are performed.</p>

<b>Table 5-6 Site 3 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Opportunities for Optimization	<p>The RGs for contaminants of concern trichloroethene and vinyl chloride were met for all wells during the last seven rounds of annual groundwater monitoring (2009 to 2015). Based on recommendations in the last five-year review, the decision diagram in Volume II of the O&amp;M Manual, and groundwater monitoring results during this five-year review period, opportunities for optimization (including monitoring well abandonment, discontinuation of groundwater monitoring, and reduction of groundwater land use controls) should be considered and the results documented, as appropriate. Monitoring wells will not be abandoned until after the completion of emerging contaminant assessments and investigations.</p> <p>The “no construction zone” limitation around monitoring well 2DMW29S may no longer be necessary since vinyl chloride concentrations remain below volatilization criteria. Re-evaluate whether this portion of the OU 9 LUC RD is still required.</p>
Early Indicators of Potential Remedy Problems	None identified.

## 5.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?

### 5.5.2.1 Risk Assessment Review: Current Conditions

The basis for action at Site 3 was summarized in Section 5.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Human health and ecological risks were mitigated by the remedial action conducted Site 3, which included excavation and offsite disposal of contaminated soil and sediment and encapsulating a small amount of contaminated soil/sediment in Stream 4 that could not be removed (FWEC February 2001). Post-construction long-term restoration monitoring was conducted for three years to ensure that vegetation and habitat were properly restored (FWEC October 2004). Land use controls (OU 9 LUC RD and SUBASENLONINST 5090.25) prohibit disturbance of soil and groundwater, as discussed in Section 5.5.1.2.

Risks from groundwater to current human and ecological receptors were determined to be within acceptable levels, but the HHRA determined that potential exposure to hypothetical future residents from long-term consumption of contaminated groundwater due to vinyl chloride and TCE could result in unacceptable risk. Groundwater concentrations have remained below RGs during the last seven rounds of monitoring. The OU 9 LUC RD prevents withdrawal or use of groundwater for potable purposes and ensures that groundwater extracted during construction activities is managed appropriately (Tetra Tech November 2009).



Site 3 is located within ESQD arcs of the Area A Weapons Center (Site 20), and Navy regulations prohibit construction of inhabited buildings or structures within these arcs. COCs were either not detected or were detected in groundwater below industrial VISLs; however TCE exceeded the residential VISL (1.2 µg/L) in one well (2.2 µg/L in 2DMW16D) and the detection limit for vinyl chloride exceeds the residential VISL. The VI evaluation for Site 3 conducted as part of this five-year review (discussed in Section 2.9 and Table 2-1) concluded that no further evaluation of the VI pathway is necessary.

### 5.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 5-7.

<b>Table 5-7</b> <b>Site 3 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	The remedial goals (RGs) for volatile organic compounds (VOCs) in groundwater were developed based on Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) 2008 proposed values for Residential and Industrial/Commercial Volatilization Criteria (CTDEEP 2008). CTDEEP RSRs were amended in June 2013 and the Volatilization Criteria for numerous VOCs, including Site 3 contaminant of concern (COC) vinyl chloride, changed from the 2008 proposed values. The RGs will require modifications to reflect current CTDEEP Volatilization Criteria, should monitoring continue; these values should be revised in a Memorandum to the Administrative File or Explanation of Significant Difference to the OU 9 Record of Decision and during the next revision of the O&M Manual.
	The revised RSRs also updated the Residential Direct Exposure Criteria for lead in soil. This change does not affect the protectiveness of the remedy because lead was not identified as a human health COC in soil at Site 3, and the RG for lead based on ecological risk (218 milligrams per kilogram) is below the updated value.
Changes in Exposure Pathways	Groundwater is not used for drinking water. Volatilization via vapor intrusion (VI) has been reassessed since the last five-year review because of recent changes in guidance. VI is not expected to be an issue at this site; see Table 2-1 for further details.
Changes in Land Use	There have been no changes in land use since the last five-year review. Subase New London Instruction 5090.25 and the OU 9 Land Use Control Remedial Design (LUC RD) prevent land use changes without notification.

<b>Table 5-7</b> <b>Site 3 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins are not probable contaminants at Site 3 due to its site history. Samples have not been collected for dioxin analysis.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 3; however, a basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> — 1,1,1-trichloroethane and its daughter compounds (1,1-dichloroethane and chloroethane) have not been detected at Site 3 and previous investigations did not include soil or groundwater analysis for 1,4-dioxane. However, Site 3 is located downgradient of Site 7, which did have detections of these compounds; therefore, presence/absence sampling for 1,4-dioxane will be performed in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as the OU 9 LUC RD prevents potable use of groundwater.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for VOCs, which may affect some sites where VOCs are a concern in groundwater if groundwater could be used as a potable source in the future. VI information for Site 3 was reviewed as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.
Expected Progress towards Meeting Remedial Action Objectives	The remedial action objectives for OU 3 were met by conducting the remedial action that included excavation and offsite disposal of contaminated soil and sediment and encapsulating a small amount of contaminated soil and sediment in Stream 4. A LUC RD for the concrete encapsulated soil at Site 3 is in progress; until implementation, land use controls are implemented via Subase New London Instruction 5090.25.
	A LUC RD was prepared for OU 9 groundwater, which includes Site 3.
	Groundwater monitoring demonstrates that concentrations of COCs have remained below RGs for the last seven years, indicating groundwater RAOs have been met.

### 5.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

## 5.6 Issues and Recommendations

Issues and recommendations are identified in Table 5-8.

## 5.7 Protectiveness Statement

Remedial actions implemented at Site 3 are protective of human health and the environment. Soil and sediment actions (excavation and subsequent encapsulation of residual contamination) addressed human health and ecological exposures. An O&M program has been implemented and



results verify that the soil and sediment remedy is performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized. The OU 9 groundwater remedy (groundwater monitoring and LUCs) remains protective at Site 3.

Table 5-8 Site 3 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>(1)</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	SUBASENLONINST 5090.25 language does not consider the potential for vapor intrusion during the event of future construction scenarios at Site 3.	Review SUBASENLONINST 5090.25 to determine whether modifications are required. (When the Site 3 LUC RD is finalized, include these provisions as necessary.)	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
2	Annual groundwater LUC inspections and certifications were not performed in accordance with the OU 9 LUC RD at Site 3 in 2011 and 2012.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 9 LUC RD at Site 3.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
3	The LUC around monitoring well 2DMW29S due to volatilization concerns may no longer be necessary since vinyl chloride concentrations have reduced below RGs.	Evaluate site conditions with respect to <i>Naval Submarine Base — New London — Monitoring Well 2DMW29S — Site 3, Letter to CTDEEP from M.S. Ginda, Commanding Officer</i> and propose modification of the OU 9 LUC RD to U.S. EPA and CTDEEP, if necessary.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
4	The Site 3 LUC RD for the concrete encapsulated soil has not been finalized.	Finalize and implement the LUC RD. In the interim, continue enforcement of the Subase New London Instruction 5090.25 to ensure remedy protectiveness.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
5	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
6	ARARs used to develop monitoring criteria have changed and based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 3 should be reviewed and optimized.	Update the O&M Manual and draft an appropriate decision document to reflect: <ul style="list-style-type: none"><li>• Changes to remedial goals based on ARAR changes</li><li>• Any changes to the monitoring program based on an optimization review</li></ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	

Table 5-8 Site 3 — Issues and Recommendations/Follow-Up Actions							
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)	
						Current	Future
7	The contaminant 1,1,1,-TCA and its daughter compounds have not been detected at Site 3. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA and previous investigations did not include soil or groundwater analysis for 1,4-dioxane. Site 3 is located downgradient of Site 7, which did have detections of 1,1,1-TCA and daughter compounds.	Perform presence/absence sampling for 1,4-dioxane at Site 3 in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N
8	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 3; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N
Operations and Maintenance							
9	The Third Five-Year Review Report recommended four idle monitoring wells for abandonment; they have not been abandoned.	Following the completion of emerging contaminant assessments and investigations, evaluate and abandon wells, and document the decision as necessary.	Navy	U.S. EPA, CTDEEP	To Be Determined <sup>[2]</sup>	N	N
10	Further review of O&M procedures should be performed to clarify and document roles and responsibilities to ensure timely reporting and repair activities.	Revise O&M Manual to clarify roles and responsibilities and other issues identified in this five-year review (i.e., reduction in monitoring frequency and changes to remedial goals).	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N
Other							
11	The Site 3 Soil and Sediment Remedial Action Completion Report has not been finalized, as recommended by the Third Five-Year Review Report.	Finalize the Remedial Action Completion Report upon completion of the LUC RD.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

<sup>[2]</sup> Well abandonment activities are dependent on results of the emerging contaminant assessments/investigations and long-term monitoring program; a date for well abandonment cannot be estimated at this time.

LUC	=	Land Use Control	OU	=	Operable Unit
LUC RD	=	Land Use Control Remedial Design	U.S. EPA	=	United States Environmental Protection Agency
CTDEEP	=	Connecticut Department of Energy and Environmental Protection	RGs	=	Remedial Goals
SUBASENLONINST	=	Subase New London Instruction	VOC	=	Volatile Organic Compound
ARAR	=	Applicable or Relevant and Appropriate Requirement	TCA	=	Trichloroethane
O&M	=	Operations and Maintenance	PFC	=	Perfluorinated Compound
COC	=	Contaminant of Concern			



## **6.0 SITE 6 — FORMER DEFENSE REUTILIZATION AND MARKETING OFFICE, OPERABLE UNIT 2**

Site 6, the Former DRMO, is included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 6-1 shows the site layout of Site 6, which is located adjacent to the Thames River in the northwestern section of NSB NLON.

### **6.1 Site History and Background**

Table A-4 in Appendix A summarizes the chronology of events at Site 6.

#### **Site 6**

- Former landfill
  - Accepted NSB NLON wastes including: residues from the base incinerator, refuse, and debris
- COCs: PCBs, PAHs, dioxins, inorganics
- TCRA (January 1995)
  - Excavation of contaminated soils
  - Installation of a geosynthetic clay liner cap
- Remedy:
  - Soil and Groundwater IROD (March 1998)
    - Institutional controls
    - Monitoring
  - Soil and Groundwater ROD (December 2006)
    - Institutional controls
    - Groundwater monitoring

### **6.2 Conceptual Site Model**

Site 6 was used as a landfill and waste-burning area from 1950 to 1969. During that time, non-salvageable waste items including construction materials and combustible scrap were burned along the Thames River shoreline. The residue was pushed to the shoreline and partially covered, eventually creating developable land. By 1988, the site had been completely filled and covered. The southern portion of Site 6 was paved with asphalt, most of which was deteriorated, and the northern portion was unpaved, with a gravel surface.

#### **Site 6 Physical Characteristics**

- The site is located between a bedrock outcrop that runs roughly parallel to the Providence and Worcester Railroad to the east and the Thames River to the west.
- The site covers approximately 3 acres gently sloping toward the Thames River.
- Most of the site is paved and fenced with an asphalt layer, and features buildings, a weighing scale, and a paved area for boat storage.

In the late 1980s, the DRMO began operating a storage and collection facility for selling items such as surplus computers, file cabinets, and other office equipment. In 2007, the DRMO ceased operating at the site, and all equipment was removed from the grounds and buildings.

Site 6 is currently used by Morale, Welfare, and Recreation to store boats for the Navy Yacht Club and by contractors for staging construction trailers that house temporary offices; the remainder of Site 6 within the cap limits is vacant. Buildings 355, 385, and 397 are located onsite, outside of the landfill cap limits. Building 355, located upgradient of the landfill, is occupied, Building 385 is planned for demolition, and Building 397 is vacant and will likely be demolished.

**Control Point Coordinates:**

1: N 710545.873507; E 1180202.150462  
 2: N 710578.379675; E 1180194.320753  
 3: N 710621.699799; E 1180166.884128  
 4: N 710614.027242; E 1180132.026587  
 5: N 710515.742662; E 1180092.123451  
 6: N 710436.126351; E 1180055.522474  
 7: N 710354.883731; E 1180027.422137  
 8: N 710233.595588; E 1180006.847703  
 9: N 710035.772165; E 1180010.003209  
 10: N 710014.383100; E 1180023.457578  
 11: N 709994.231894; E 1180082.633313  
 12: N 710021.627836; E 1180082.105427  
 13: N 710021.627836; E 1180112.119146  
 14: N 710035.427349; E 1180112.119146  
 15: N 710036.105169; E 1180220.258694  
 16: N 710288.030191; E 1180210.076955  
 17: N 710387.520477; E 1180214.607786

Coordinate System: NAD 1983 HARN  
 Connecticut State Plane Feet



Figure 6-1  
 Site 6 - Former Defense Reutilization  
 and Marketing Office - Site Plan  
 Naval Submarine Base New London  
 Groton, Connecticut

- Site 6 Land Use Control Boundary
- Approximate Limit of Cap
- Approximate Location of Jersey Barrier
- HDPE Culvert
- Control Point
- ⊗ Drop Inlet
- Site 6 Boundary
- 245 Building Number

0 50 100  
 Feet

Note - All site boundaries are approximate.



REQUESTED BY: A. Stark	DATE: 11/16/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



### 6.2.1 Nature and Extent of Contamination

Previous investigations (summarized in Table A-4 in Appendix A) identified hotspots with elevated levels of lead, PCBs, and carcinogenic PAHs (CPAHs). A TCRA was performed from 1994 to 1995 to delineate and remove the hotspots, and to place an impervious cap over the excavated area.<sup>1</sup> Removal action goals developed in an Action Memorandum (Atlantic March 1995) were to:

**Carcinogenic PAHs**

- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- dibenzo(a,h)anthracene
- indeno(1,2,3-cd)pyrene

- Limit the opportunity for individuals to encounter hot spots where contaminants may be present at elevated concentrations.
- Ensure overall human health risks associated with activities at Site 6 were below acceptable levels.

Target cleanup levels were established for lead (500), PCBs (10), and CPAHs (100) (OHM September 1995). During the TCRA, approximately 4,700 tons of soil exceeding target cleanup levels were excavated from the northern portion of Site 6 and disposed offsite (OHM September 1995). Excavation extended to an approximate maximum depth of 3 feet bgs or to the water table. However, target cleanup levels were not achieved at all locations prior to backfilling and paving (OHM September 1995).

The excavated areas were backfilled with clean borrow material from an offsite location. A cap consisting of woven geotextile fabric, a geosynthetic clay liner (GCL), and nonwoven geotextile fabric was installed where target cleanup levels were not achieved. Approximately 12 inches of crushed stone and 3 inches of asphalt were placed over the clay/geotextile cover. The remaining (unpaved) portion of Site 6 that did not require a cap was paved with asphalt or was finished with a gravel surface.

### 6.2.2 Basis for Taking Action

After the TCRA, contaminated soil remained in place (NAVFAC March 1998). A baseline HHRA, performed after the TCRA, identified current and future receptors that could be exposed to media at Site 6, and evaluated the potential for unacceptable risk if no action was taken. Current full-time

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<sup>1</sup> The TCRA was also designed to remove a steel-walled, spent-acid UST, which was disposed offsite with excavated soil.

employees and older child trespassers exposed to surface soil and future construction workers and future residents exposed to surface/subsurface soil were evaluated.<sup>2</sup>

Exposure to soil contributed the most to cumulative ILCR. Cumulative ILCR for the future resident (1.4E-04) was estimated to exceed acceptable cancer risks. Soil COCs that drove risk were primarily PCBs and PAHs, especially benzo(a)pyrene. Cumulative HIs for full-time employee (4.5), construction worker (4), older child trespasser (5.2), and future hypothetical resident (3.4) receptors evaluated exceeded 1. The primary contributors to risk were incidental ingestion of and dermal contact with soil, mostly due to exposure to PCBs. Other risks from potential exposure to antimony, cadmium and, to a lesser extent, chromium, were associated with soil at Site 6 (NAVFAC December 2006).

**COCs at Site 6 Identified in Phase II RI**

- VOCs (soil and groundwater)
- SVOCs (PAHs) (soil and groundwater)
- PCBs (soil)
- Dioxins (soil)
- Metals (soil and groundwater)

The presence of the cap installed during the TCRA effectively eliminated direct contact of ecological receptors with contaminated soil, so soil at Site 6 represented little potential for unacceptable risk (NAVFAC December 2006). The primary ecological concern at Site 6 is potential future transport of soil contaminants to groundwater, where discharge into the Thames River could potentially affect ecological receptors.

Risks and hazards due to groundwater were below U.S. EPA and CTDEEP thresholds, assuming only dermal contact with groundwater under the construction worker scenario. The CTDEEP classified groundwater beneath NSB NLON, including Site 6, as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is available; thus, only direct contact (not human consumption) was considered at Site 6 when evaluating human health risk contaminants in groundwater. Residential/potable groundwater use was not evaluated in the HHRA. SUBASENLONINST 5090.25 prevents extraction of the groundwater for use for any purpose.

### **6.3 Remedial Actions**

Following the TRCA, an Interim Record of Decision (IROD) for Site 6 soil and groundwater (OU 2) selected institutional controls (including maintenance of the cap, site access limitations, and

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<sup>2</sup> The HHRA did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered for the construction worker scenario.

land development restrictions) and groundwater monitoring to confirm soil contamination was not migrating to groundwater (NAVFAC March 1998).

The Final OU 2 ROD (NAVFAC December 2006) was signed by the Navy on 18 December 2006 and by the U.S. EPA on 20 December 2006.

### **6.3.1 Remedial Action Objectives**

The following RAOs were developed to mitigate existing and future potential threats to public health and the environment (NAVFAC December 2006):

- Prevent exposure (unacceptable risk) to receptors under either a current industrial or future (although unlikely) residential land use scenario either through institutional controls and/or removal/treatment/disposal.
- Prevent unacceptable risk to ecological receptors in the Thames River from potential migration of contaminants.

### **6.3.2 Remedial Goals**

Chemical-specific RGs were developed for Site 6 soil based on protection of human health, ecological receptors, and groundwater, as presented in Table 6-1. Criteria for the groundwater monitoring program were developed to monitor post-closure contaminant migration from the site, as described in Section 6.3.4.2; no RGs for groundwater were established in the ROD (NAVFAC December 2006).

### **6.3.3 Remedy Selection**

The selected remedy, institutional controls and groundwater monitoring, included the following components:

- Land use restrictions
- Cap maintenance, including inspections, repair, and replacement (as needed), and maintenance of other remedy elements (e.g., monitoring wells)
- Limitations on site access, including maintaining existing fencing, posting signs, and maintaining security during current military operations (locked gates with a security desk)



Table 6-1 Site 6 — Remedial Goals for Soil						
Contaminant of Concern	Protection of Human Health (mg/kg)				Protection of Ecological Receptors (mg/kg)	Protection of Surface Water (mg/kg)
	Full-Time Employees	Construction Workers	Older Child Trespassers	Future Residents		
Benzoic Acid	—	—	—	—	—	8.4
Benzo(a)anthracene	—	—	—	2	—	27
Benzo(a)pyrene	—	—	—	0.2	—	28
Benzo(b)fluoranthene	—	—	—	2	—	75
Dibenzo(a,h)anthracene	—	—	—	0.2	—	—
Indeno(1,2,3-cd)pyrene	—	—	—	2	—	—
Aroclors (-1254 and -1260)	10	6	10	0.35	—	0.38
Hexachlorobiphenyl	—	—	—	0.35	—	0.38
Dioxins (HpCDD and OCDD)	—	—	—	0.00059	—	—
Aluminum	—	—	—	—	50	—
Antimony	—	—	—	—	5	—
Arsenic	—	—	—	0.96	—	—
Barium	—	—	—	—	—	160
Beryllium	—	—	—	0.35	—	—
Boron	—	—	—	—	0.5	—
Cadmium	—	84	—	67	3	48
Chromium	—	—	—	11	0.4	209
Cobalt	—	—	—	—	20	—
Copper	—	—	—	—	50	—
Lead	—	—	—	—	50	—
Mercury	—	—	—	—	0.128	—
Silver	—	—	—	—	2	6.12
Thallium	—	—	—	—	1	—
Vanadium	—	—	—	—	2	—
Zinc	—	—	—	—	50	13,200
DDTR	—	—	—	—	5	—
4,4'-DDD	—	—	—	—	—	0.08

**Notes:**

mg/kg = milligrams per kilogram  
 HpCDD = 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin  
 OCDD = Octachlorodibenzodioxin  
 DDTR = Dichlorodiphenyltrichloroethane Residuals  
 DDD = Dichlorodiphenyldichloroethane

- Groundwater monitoring to evaluate whether contaminants in soil are migrating to the Thames River and causing adverse effects to ecological receptors
- LUCs to limit activities such as excavation, drilling, residential use of the property, and excessive vehicular use
- Groundwater LUCs because contaminants in groundwater are at concentrations that could result in unacceptable risks if the use of groundwater is not controlled or restricted; groundwater LUCs were to be enforced until concentrations decreased to levels that allow for UU/UE
- Performing five-year reviews because contamination will remain in place above levels that allow for UU/UE

#### **6.3.4 Remedy Implementation**

##### **6.3.4.1 Land Use Controls**

SUBASENLONINST 5090.25 (Navy April 2013) defines the Navy's policy regarding ground surface disturbance of soils or any subsurface disturbance of soils and/or groundwater at ER Program sites. Additional information is provided in Section 2.11.1. A draft LUC RD for soil and groundwater at Site 6 (OU 2) is in progress. Once finalized, the LUC RD will become the primary LUC document for soil and groundwater at Site 6 (the LUC RD will also be referenced in SUBASENLONINST 5090.25 and identified on a basewide map) and will continue to protect potential human receptors and ecological receptors from contaminated soil within the landfill and prevent erosion of and infiltration through the landfill soil/contents.

##### **6.3.4.2 Groundwater Monitoring**

The Navy implemented a groundwater monitoring program at Site 6 in April 1998 and annual O&M in 2003 (B&RE February 1998). Since 2002, sampling activities at the site have been completed in accordance with the GMP in Volume II of the O&M Manual; groundwater monitoring is currently performed in accordance with Revision 2 (Tetra Tech July 2011). The results of the program are being used to confirm that contamination is not migrating from the site at concentrations in excess of monitoring criteria.

Background groundwater concentrations, CTDEEP SWPC, site-specific SWPC, and CTDEEP Volatilization Criteria were used to develop the monitoring criteria. The monitoring criteria for the Site 6 groundwater monitoring program are shown in Appendix F (Tetra Tech July 2011).

#### **6.3.4.3 Operations and Maintenance**

Volume IV of the O&M Manual details requirements for Site 6 inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech July 2011).<sup>3</sup> Inspection activities for Site 6 include:

- Assessing access controls (e.g., fencing) and compliance with LUCs
- Assessing cap elements and verifying that materials are stored properly
- Inspecting drainage features
- Inspecting monitoring wells

#### **6.3.5 System Operation/Operations and Maintenance**

##### **6.3.5.1 Groundwater Monitoring Program**

Twenty-three rounds of sampling have been performed over 17 years, and both the number of wells and the analytical suite have been optimized over time. Currently, groundwater monitoring at Site 6 is performed biennially, with samples collected from seven wells analyzed for select VOCs, SVOCs, and metals.<sup>4</sup> Sampling activities during this five-year review period are summarized in Section 6.5.1.1.

##### **6.3.5.2 Operations and Maintenance**

Inspections of Site 6 are performed annually in accordance with Volume IV of the O&M Manual (Tetra Tech July 2011). In recent years, the inspections were conducted in the spring, and corrective actions completed during the following summer. Inspection activities performed during this five-year review period are summarized in Section 6.5.1.3.

#### **6.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 6. Table 6-2 provides a list and status of the recommendations that were made for Site 6 in the last five-year review.

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<sup>3</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are in Volume I, Section 1.7 (Tetra Tech November 2012).

<sup>4</sup> Five wells are located within the Site 6 boundary and two are offsite and upgradient within the Site 3 boundary.

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<b>Table 6-2 Site 6 — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Continue enforcement of Standard Operating Procedure — Administrative New London Instruction 5090.25 until a Land Use Control Remedial Design can be completed.	The Land Use Control Remedial Design is in progress, see Section 2.11.6. Subase New London Instruction (SUBASENLONINST) 5090.25 (cancelled Standard Operating Procedure — Administrative New London Instruction 5090.25) is being enforced.
Continue operations and maintenance (O&M) (annual inspections and biennial monitoring) and address the O&M issues noted.	Annual inspections and biennial monitoring occurred and the O&M issues were addressed as described in the Annual Inspection and Repair Reports.
Complete and implement Revision 2 of the O&M Manual.	Revision 2 of the O&M Manual, which includes Site 6, was finalized in 2011 and implemented in 2012.
Complete a Remedial Action Completion Report to document completion of the remedial action.	A Remedial Action Completion Report is in progress.
Place blocking underneath the supports used to store boats.	Blocking was placed underneath the supports used to store the boats in November 2011; during the five-year review site visit, proper blocking was observed underneath the supports of the only boat stored at Site 6.
Investigate warning signs and update as needed.	Warning signs are maintained and updated, as needed.
Implement the following corrective actions for land use control (LUC) compliance: <ul style="list-style-type: none"> <li>• Environmental Division to perform quarterly LUC inspections.</li> <li>• Dig permits to require concurrence of Environmental Division.</li> <li>• Environmental Division to use Geospatial Information and Services and Naval Installation Restoration Information Solution to identify LUC areas and wells for planners.</li> <li>• Revise Mid-Atlantic Regional Instruction (5090.2).</li> </ul>	<ul style="list-style-type: none"> <li>• During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012; they were in 2013, 2014, and 2015.</li> <li>• The Environmental Division reviews and approves all Naval Submarine Base New London dig permits.</li> <li>• LUC areas and wells were documented in Naval Installation Restoration Information Solution on 30 November 2011.</li> <li>• Naval Submarine Base New London does not have jurisdiction to update the Mid-Atlantic Regional Instruction, however SUBASENLONINST 5090.25 was updated in April 2013.</li> </ul>
Consider abandoning well 6MW1S because it is cross-gradient from the cap and not downgradient. (However, it may be appropriate to retain the well because it may be beneficial for use as the most downgradient well in the Site 6 monitoring program.)	This well has not been abandoned; it will not be abandoned until the completion of emerging contaminant assessments and investigations.

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Biennial groundwater monitoring and annual O&M inspection reports for Site 6 are summarized in Table 6-3; complete document references are in Section 14.

<b>Table 6-3 Site 6 — Summary of Groundwater Monitoring and Operations and Maintenance Inspection Reports</b>		
<b>Year</b>	<b>Groundwater Monitoring</b>	<b>Operations and Maintenance Inspection</b>
2011	Sovereign Consulting (December 2012)	Sovereign Consulting (December 2012)
2012	Not Applicable	H&S Environmental [H&S] (September 2012)
2013	H&S (July 2015)	H&S (April 2014)
2014	Not Applicable	H&S (May 2015)
2015	H&S (March 2016)	H&S (March 2016)

## **6.5 Technical Assessment**

The following information supports the determination that the selected remedy for Site 6 is functioning as intended, except as noted below. Areas in which remedy performance can be improved are listed in the Issues and Recommendations table referenced in Section 6.6.

### **6.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

#### **6.5.1.1 Monitoring Data Summary**

Figure 6-2 shows the location of wells in the active monitoring program. Analytical results for biennial groundwater monitoring activities were provided in their respective biennial reports, listed in Table 6-3.

During this five-year review period, all detections of COCs were below monitoring criteria. These data indicate there is no concern for contaminant migration from soil to groundwater (and ultimately to the Thames River) at Site 6. Monitoring should continue and the GMP for Site 6 evaluated for optimization, consistent with the decision diagram presented in Volume II of the O&M Manual.

#### **6.5.1.2 Land Use Control Status**

The LUC RD for soil and groundwater at Site 6 has not been finalized. In the interim, SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at Site 6; see Section 2.11.1. While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending LUC RD to prevent both potable and industrial/non-potable use; see Section 2.11.1.

#### **6.5.1.3 Operations and Maintenance Summary**

Inspections have been conducted annually as part of O&M activities associated with Site 6 since 2003; five inspections were performed at Site 6 during this five-year review period. Review of Site 6 O&M inspection checklists (as provided in their respective annual reports) indicated that communication of maintenance requirements and subsequent repairs and documentation/re-inspection were not performed early in the review period. Further review of O&M procedures should be performed to clarify and document roles and responsibilities, based on lessons learned during the latter part of the five-year review period and to ensure timely submittals/responses. Appropriate revisions should be incorporated into the next O&M Manual update.





The May 2015 inspection concluded that the landfill cap is functioning as designed. However, several O&M issues were noted: vegetation and debris in the drainage swale and culvert, debris in perimeter channel and drop inlet, vegetation in shoreline riprap, and damage to monitoring wells. These O&M issues were addressed in summer 2015.

#### **6.5.1.4 Five-Year Review Site Visit Findings**

The site visit included visual observations of several Site 6 features (i.e., cap surface, drainage features, fencing, and signs). The land use of Site 6 had not changed since the remedy was implemented and the Third Five-Year Review was completed; the site is mostly empty except for occupied contractor trailers and two boats.

During the site visit, the cap system and associated remedy components appeared to be functioning as intended. Rebar (approximately 3 feet long) had been installed for contractor trailer tie-downs in at least two locations that potentially penetrate the landfill cap (see photo #6-2 in Appendix B); multiple cap penetrations occurred for each tie-down. A location near the edge of the landfill may be outside of the cap. At both locations, there is minimal void space between the rebar and asphalt (i.e., minimal opportunity for water to penetrate the cap) but sealing may be required, until at which time the trailer has been removed and a more permanent repair can be made. Inspections of the culvert discharge in the rip rap are difficult due to site fencing (see photo #6-1 in Appendix B); installation of a man gate along the Thames River could facilitate culvert inspections.

A sign noting land use and dig restrictions is posted at the front gate that provides access to the site. There is no longer a security desk at Site 6; however, the gate is locked overnight.

#### **6.5.1.5 Technical Evaluation**

Table 6-4 summarizes the technical evaluation for Question A.

<b>Table 6-4</b> <b>Site 6 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	A Time-Critical Removal Action was completed and a cap was installed at Site 6. The cap installed remains effective in limiting direct exposure to contaminated soil and minimizing infiltration and contaminant migration from the site.
	Rebar installed in the asphalt within the landfill area may have breached the cap structure, creating infiltration concerns. However, the space between the rebar and the asphalt is minimal. Sealant may be required around the rebar where it penetrates the asphalt, until a more permanent repair can be made.
	Results from the groundwater monitoring program were below monitoring criteria during this five-year review period, indicating there are no contaminant migration concerns (from soil to groundwater and ultimately the Thames River).



<b>Table 6-4</b> <b>Site 6 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Systems Operation/ Operations and Maintenance (O&M)	Annual O&M inspections and the five-year review inspection verify that the landfill cap is in good condition except for the rebar penetration.
	In order to facilitate culvert discharge inspections, an evaluation of the need for a man gate in the fencing should be formed; initial safety approval has been obtained from Port Operations, Security, and Safety.
	Corrective actions to improve communication of maintenance requirements and subsequent repairs and documentation/re-inspection have been implemented, but need to be reviewed and documented in the next revision of the O&M Manual; however, all issues identified in 2011 to 2015 inspections have been addressed.
Implementation of Land Use Controls and Institutional/ Engineering Controls	Institutional controls associated with Site 6 soil and groundwater are in Subbase New London Instruction (SUBASENLONINST) 5090.25. Site 6 is fenced and the front gate is locked at night. The Land Use Control Remedial Design for Site 6 is in progress.
	The breach of the landfill cap indicates that SUBASENLONINST 5090.25 is not being properly enforced at Site 6. Solutions include painting a line showing the cap boundary, enhanced signage, and implementation of a Site 6 storage permit (similar to the one developed for the Area A Landfill [Site 2A]) between the Environmental Division and Naval Submarine Base New London Executive Officer. Additional review of SUBASENLONINST 5090.25 protocols are required to determine appropriate revisions.
	The ROD required check in with a security desk as part of site institutional controls. There is no longer a security desk at the site; security protocols will be reviewed with the Environmental Restoration Manager and documented in the pending Land Use Control Remedial Design.
	While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending Land Use Control Remedial Design to prevent both potable and industrial/non-potable use. Further clarity is also required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.
Opportunities for Optimization	The monitoring criteria were met for all wells during the last two rounds of biennial groundwater monitoring performed in 2012 and 2014 (H&S March 2015). Based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, opportunities for optimization (including reduction in groundwater monitoring frequency) should be considered and the results documented, as appropriate.
Early Indicators of Potential Remedy Problems	None identified.

## 6.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?

### 6.5.2.1 Risk Assessment Review: Current Conditions

The basis for action at Site 6 was summarized in Section 6.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Human health and ecological risks associated with the former landfill/burn area were mitigated by installation of an engineered cap system, which eliminates direct contact with contaminated soil at

the site and minimizes infiltration and contaminant migration from the site. SUBASENLONINST 5090.25 prohibits disturbance of soil and groundwater at Site 6, as discussed in Section 6.5.1.2. As discussed in Section 6.5.1.1, groundwater monitoring results have verified that no significant contaminant migration from soil to groundwater has occurred. A VI evaluation for Site 8, conducted as part of this five-year review (discussed in Section 2.9 and Table 2-1), concluded that no further evaluation of the VI pathway is necessary.

Site 6 represents little potential risk to ecological receptors due to the lack of potential direct exposure to or leaching of contaminated soil.

### 6.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 6-5.

<b>Table 6-5</b> <b>Site 6 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	<p>Groundwater monitoring criteria are shown in Appendix F. When the most recent version of the Operations and Maintenance Manual (Tetra Tech July 2011) was developed, the selected groundwater monitoring criteria for volatile organic compounds (VOCs) were developed based on Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) 2008 proposed values for Residential and Industrial/Commercial Volatilization Criteria (CTDEEP 2008). CTDEEP RSRs were amended in June 2013 and the Volatilization Criteria for numerous VOCs changed from the 2008 proposed values. The monitoring criteria will require modifications to reflect current CTDEEP Volatilization Criteria; these values should be revised during the next revision of the Operations and Maintenance Manual.</p> <p>The revised RSRs also updated the Residential Direct Exposure Criteria for lead in soil. This change does not affect the protectiveness of the remedy because lead was not identified as a human health contaminant of concern (COC) at Site 6, and the remedial goal for lead based on ecological risk (50 milligrams per kilogram [mg/kg]) is below the updated value.</p>
Changes in Exposure Pathways	Groundwater is not used for drinking water. Volatilization via vapor intrusion (VI) has been reassessed since the last five-year review because of recent changes in guidance. VI is not expected to be an issue at this site; see Table 2-1 for further details.
Changes in Land Use	There have been no changes in land use since the last five-year review. Subase New London Instruction (SUBASENLONINST) 5090.25 prevents land use changes without notification.

<b>Table 6-5</b> <b>Site 6 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins (1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin and octachlorodibenzodioxin) were listed as COCs at Site 6 soil. The Site 6 remedial goal for dioxins (0.00059) is greater than the United States Environmental Protection Agency Regional Screening Level for Industrial Soil direct contact for tetrachlorodibenzo-p-dioxin (0.000022). However, this site is capped and land use controls (LUCs) (e.g., SUBASENLONINST 5090.25) prevent intrusive activities onsite, thus eliminating the pathway. Updates to this class of emerging contaminants would only warrant further investigation if LUCs were removed and land use changes.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 6; however, due to the lack of documentation of materials disposed of at the landfill, it is likely that the basewide perfluorinated compound (PFC) desktop study/preliminary assessment will conclude that additional action is required at Site 6 in regard to PFCs.</p> <p><b>1,4-Dioxane</b> — 1,1-dichloroethane and chloroethane, daughter compounds of 1,1,1-trichloroethane, have been detected in soil and groundwater at Site 6. The stabilizer 1,4-dioxane is commonly associated with that 1,1,1- trichloroethane. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane. The Navy will perform presence/absence sampling for 1,4-dioxane at Site 6 in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for VOCs, which may affect some sites where VOCs are a concern in groundwater. VI information for Site 6 was reviewed as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.
Expected Progress towards Meeting Remedial Action Objectives	The remedial action objectives for Site 6 (Operable Unit 2) were met by maintaining the installed cap system and conducting groundwater monitoring. A LUC RD for Site 6 soil and groundwater is in progress; until implementation, LUCs are implemented via SUBASENLONINST 5090.25.
	Groundwater monitoring for the last two biennial sampling events demonstrate that concentrations of COCs have remained below monitoring criteria, indicating contaminants are not migrating from soil to groundwater.

### 6.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

## 6.6 Issues and Recommendations

Issues and recommendations are identified in Table 6-6.



## **6.7 Protectiveness Statement**

Remedial actions implemented at Site 6 are currently protective of human health and the environment in the short term. Most of the source was removed and the remaining material was contained by a cap system during a TCRA; the cap system minimizes infiltration and subsequent contaminant migration and prevents direct contact with soil. An O&M program has been implemented and results verify that the remedy and cap are performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized. However, to provide long-term protectiveness, it is necessary to ensure proper enforcement of SUBASENLONINST 5090.25 by implementation of a storage permit in the LUC RD, improved onsite signage and markings (i.e., painting a line along with cap boundary), and to assess whether the cap penetrations will affect cap integrity.

Table 6-6 Site 6 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	SUBASENLONINST 5090.25 is not being properly enforced, as indicated by rebar installed through the cap.	Ensure proper enforcement of SUBASENLONINST 5090.25. Consider alternatives to prevent recurrence including implementation of enhanced signage, markings, and a storage permit (similar to the one developed for the Area A Landfill [Site 2A]).	Navy	U.S. EPA, CTDEEP	31 July 2017	N	Y	
2	While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending LUC RD to prevent both potable and industrial/non-potable use. Further clarity is also required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.	SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification. (When the Site 6 LUC RD is finalized, include these provisions as necessary.)	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
3	The ROD required sign-in at a security desk. However, due to changes in site operations, there is no longer a security desk at Site 6.	Document in a Memorandum to the Administrative File that all security actions will be discussed in the pending LUC RD. Review appropriate procedures with the Environmental Restoration Manager, which may include enhanced signage, marking and a storage permit similar to the one developed for the Area A Landfill [Site 2A] (see Issue #1 above).	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
4	During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012 as recommended by the Third Five-Year Review Report.	There is no LUC RD for the landfill; until the LUC RD is finalized, modify procedures to ensure that inspections are performed quarterly and properly documented.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
5	The Site 6 Soil and Groundwater LUC RD has not been finalized.	Finalize and implement the LUC RD. In the interim, continue enforcement of the SUBASENLONINST 5090.25 to ensure remedy protectiveness.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	

<b>Table 6-6</b> <b>Site 6 — Issues and Recommendations/Follow-Up Actions</b>							
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)	
						Current	Future
6	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N
<b>Monitoring</b>							
7	ARARs used to develop monitoring criteria have changed and based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 6 should be reviewed and potentially optimized.	Update the O&M Manual to reflect: <ul style="list-style-type: none"> <li>Changes to monitoring criteria based on ARAR changes</li> <li>Any changes to the monitoring program based on an optimization review</li> </ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N
8	The contaminants 1,1-dichloroethane and chloroethane, daughter compounds of 1,1,1-TCA, were detected in soil and groundwater at Site 6. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations at Site 6 did not include soil or groundwater analysis for 1,4-dioxane.	Perform presence/absence sampling for 1,4-dioxane at Site 6 in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N
9	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 6; however, there is a lack of documentation of materials disposed of at the landfill. A basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N
10	The monitoring criteria were met for all wells during the last two rounds of biennial groundwater monitoring.	Opportunities for optimization (including reduction in groundwater monitoring frequency) should be considered and the results documented, as appropriate.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N
<b>Operations and Maintenance</b>							
11	Rebar penetrated the cap in at least two locations.	Seal the rebar in place, if necessary, then investigate and repair any cap damage identified, as necessary.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	Y
12	Inspections of the culvert discharge in the rip rap along the Thames River are difficult due to site fencing.	Evaluate the need for a man gate in the fencing to facilitate culvert inspections.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N

<b>Table 6-6</b> <b>Site 6 — Issues and Recommendations/Follow-Up Actions</b>							
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)	
						Current	Future
13	Further review of O&M procedures should be performed to clarify and document roles and responsibilities to ensure timely reporting and repair activities.	Revise O&M Manual to clarify roles and responsibilities and other issues identified in this five-year review (i.e., reduction in COCs or monitoring frequency and changes to monitoring criteria).	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N
<b>Other</b>							
14	The Site 6 Soil and Groundwater Remedial Action Completion Report has not been finalized, as recommended by the Third Five-Year Review Report.	Finalize the Remedial Action Completion Report upon completion of the LUC RD.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

SUBASENLONINST	=	Subbase New London Instruction	U.S. EPA	=	United States Environmental Protection Agency
CTDEEP	=	Connecticut Department of Energy and Environmental Protection	LUC RD	=	Land Use Control Remedial Design
ROD	=	Record of Decision	LUC	=	Land Use Controls
VOC	=	Volatile Organic Compound	TCA	=	Trichloroethane
ARAR	=	Applicable or Relevant and Appropriate Requirement	O&M	=	Operations and Maintenance
PFC	=	Perfluorinated Compound	COC	=	Contaminant of Concern

## 7.0 SITE 8 — GOSS COVE LANDFILL, OPERABLE UNIT 5

Site 8, the Goss Cove Landfill, is included in this five year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 7-1 shows the site layout of Site 8, located adjacent to the Thames River in the southwestern section of NSB NLON. The Nautilus Museum and paved parking lot occupies a large portion of Site 8. OU 5 includes soil, sediment, groundwater, and surface water at Site 8.

### Site 8

- Former landfill
  - Accepted NSB NLON wastes including: residues from the former base incinerator, refuse, and debris
- COCs: PAHs, PCBs, metals, and pesticides
- Remedy:
  - Soil and Sediment ROD (September 1999)
    - Containment via engineered control cap
    - LUCs
    - Groundwater monitoring
    - O&M
    - Five-year reviews

## 7.1 Site History and Background

Table A-5 in Appendix A summarizes the chronology of events at Site 8.

## 7.2 Conceptual Site Model

From 1946 to 1957, Site 8 was used as a landfill. Incinerator ash and inert rubble were disposed at the site in what was then the northern portion of Goss Cove. It is not known if any other materials were disposed in the former landfill. The estimated landfill volume is approximately 107,000 cubic yards (NAVFAC September 1999).

### Site 8 Physical Characteristics

- The 6.5-acre site is located in the southwestern corner of NSB NLON, adjacent to the Thames River.
- Site 8 is west of Shark Boulevard and the intersection of Crystal Lake Road and Military Highway, east of the Thames River, and north of Goss Cove.
- The landfill encompasses approximately 3.5 acres of the site.

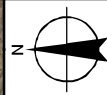
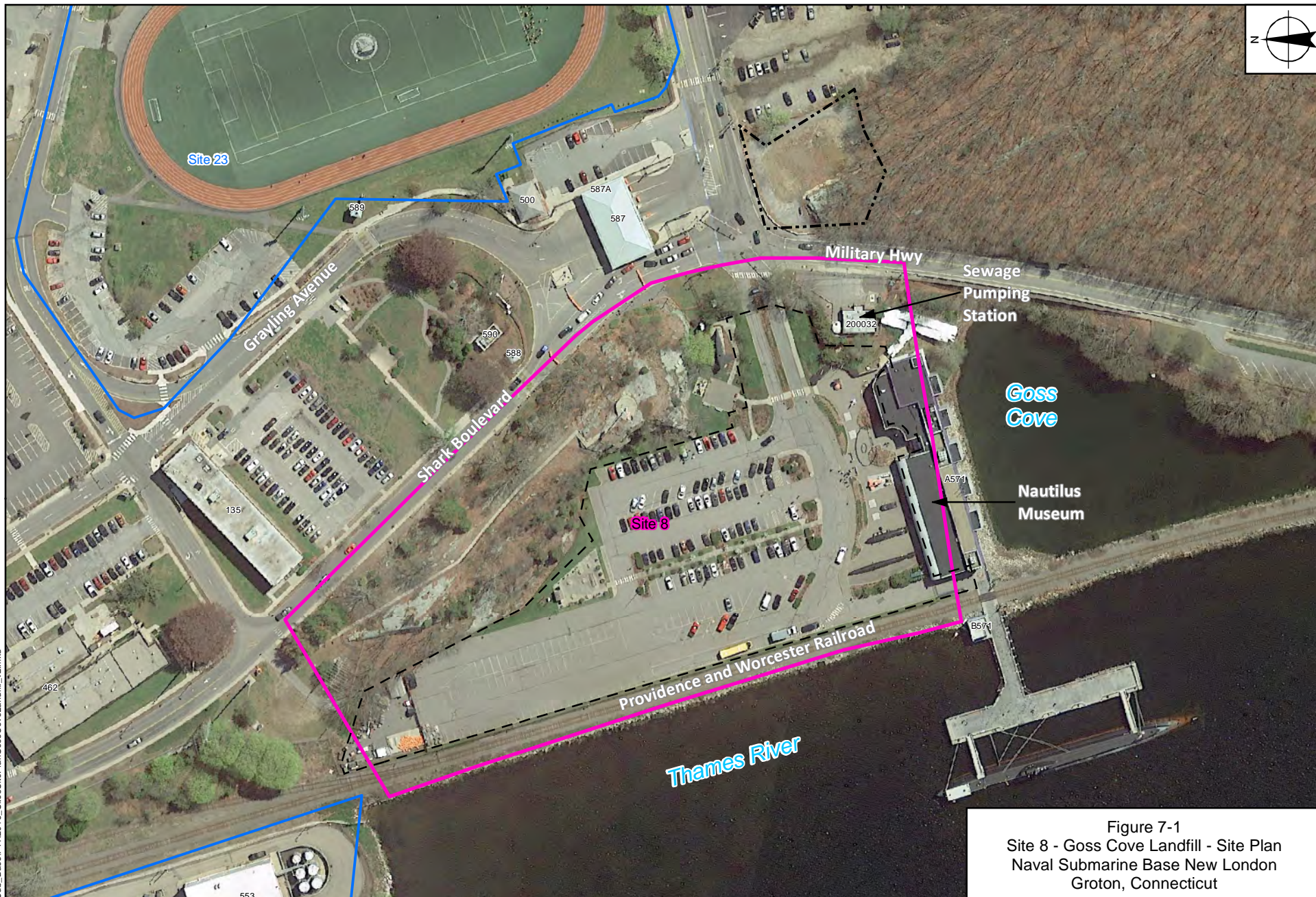
The Submarine Force Library and Museum (constructed in 1985) (herein after referred to as the “Nautilus Museum”) and a paved parking lot were constructed over the site of the former landfill. The Navy-operated museum is open to the public, and has many features and displays throughout, a picnic area in the northeast portion, and an equipment storage area in the northwestern corner. The site is fully fenced and is secure when the museum is not open to the public.

### 7.2.1 Nature and Extent of Contamination

The contamination consists primarily of PAHs (attributed to incomplete combustion) and metals (attributed to incinerator ash) (NAVFAC September 1999). Fate and transport modeling indicated that COCs were not migrating from soil via the groundwater pathway; due to the extensive pavement/foundations onsite, erosion was not a viable migration pathway (NAVFAC September 1999). A DGI concluded that PCE contamination detected in groundwater



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- Approximate Limit of Landfill Cap
  - Former Fusconi Dry Cleaners
  - Site 8 Boundary
- 245 Building Number

0 75 150  
Feet

Note - All site boundaries are approximate.

Figure 7-1  
Site 8 - Goss Cove Landfill - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/17/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



likely originated at the Former Fusconi Cleaners (see Table A-5 in Appendix A) located upgradient of Site 8 (B&RE August 1999).<sup>1</sup>

CTDEEP classified groundwater beneath NSB NLON, including Site 8, as GB because it has been used for long-term intense industrial or commercial development and a public water supply service is available.

### **7.2.2 Basis for Taking Action**

As part the Phase II RI, an HHRA evaluated the following potential human receptors as potentially exposed to media at Site 8: full-time employees exposed to surface soil, fugitive dust, and indoor air at the Nautilus Museum; construction workers exposed to fugitive dust, surface/subsurface soil, and groundwater; older child trespassers exposed to the museum parking lot, grassy areas outside the museum, and in the vicinity of the picnic area or the northern bank of the cove; and future hypothetical residents (although extremely unlikely) exposed to fugitive dust and surface/subsurface soil (B&RE March 1997).<sup>2</sup>

#### **Site 8 Contaminants Evaluated in Phase II RI**

- VOCs (groundwater, surface water, and indoor air)
- SVOCs (soil, groundwater, surface water, sediment)
- Pesticides (soil and surface water)
- PCBs (soil and sediment)
- Dioxins (soil)
- Metals (soil, groundwater, surface water, and sediment)

The Phase II RI HHRA evaluated current and future potential human receptors possibly exposed to media at Site 8. Estimated cumulative ILCRs for the full-time employee (1.1E-04), older child trespasser (5.5E-05), construction worker (4.2E-05), and future hypothetical resident (2.7E-04) scenarios evaluated exceeded CTDEEP-acceptable cumulative risk level (B&RE March 1997). Exposure to concentrations of PAHs and arsenic in soil via incidental ingestion were the carcinogenic risk drivers for most receptor scenarios except the construction worker, where tetrachloroethene (PCE) in groundwater was the primary risk driver via dermal contact.<sup>3</sup> Non-carcinogenic HIs exceeded 1 for the construction worker (8.3) attributed primarily to PCE (which is from an offsite source and is not site-related) in groundwater and the future hypothetical resident (2.6) to PCBs, arsenic, and antimony in soil. The IEUBK model predicted no adverse effects for the hypothetical residential child receptor (B&RE March 1997).

<sup>1</sup> Because the Fusconi Cleaners site is an offsite source unrelated to landfilling operations at Site 8, it is not discussed in detail in this five-year review. Additional details regarding initial identification of the Fusconi Cleaners site are provided in Appendix A, Table A-5; additional details regarding remediation of the Fusconi Cleaners site are provided in Section 7.4.2.

<sup>2</sup> The HHRA did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered for the construction worker scenario.

<sup>3</sup> The PCE originated from the offsite Fusconi Cleaners plume.

Development of the former landfill area at Site 8 into a museum and paved parking lot resulted in poor habitat for most wildlife species so an ERA was not performed at the landfill area. An ERA was performed for the surface water and sediment in the adjacent Goss Cove water body, which estimated HQs greater than 1 for benthic macroinvertebrates exposed to some metals and pesticides present in sediment. After the landfill was capped, NFA was required for the sediments in Goss Cove as documented in the ROD (NAVFAC September 1999).

### **7.3 Remedial Actions**

The ROD (NAVFAC September 1999) was signed by the Navy and U.S. EPA Region 1 on 30 September 1999.

#### **7.3.1 Remedial Action Objectives**

The following RAOs were developed to mitigate existing and future potential threats to public health and the environment (Tetra Tech September 1999):

- Protect potential receptors (i.e., full-time employees, construction workers, older child trespassers, and future residents) from exposure to contaminated soil.
- Prevent unacceptable risk to ecological receptors in the Thames River and Goss Cove from potential migration of contaminants.

#### **7.3.2 Remedial Goals**

Because a presumptive remedy was selected, chemical-specific RGs were not developed for Site 8. However, criteria for the groundwater monitoring program were developed to monitor post-closure contaminant migration from Site 8, as described in Section 7.3.4.2.

#### **7.3.3 Remedy Selection**

The selected presumptive remedy for the soil and waste/fill material included the following components:

- Containment — Engineered control cap to prevent human contact with contaminants in soil within the landfill area of the site and serve as an infiltration barrier to minimize the potential for any long-term vertical contaminant migration from the landfill
- No Action — NFA for sediment within Goss Cove

- Institutional Controls — Future land use would be limited under the deployment of institutional controls to ensure that the site is not used in a manner that would disturb the cap or the soil
- Monitoring — Long-term groundwater monitoring to evaluate the effectiveness of the cap and ensure that contaminants do not migrate to Goss Cove or the Thames River, with routine maintenance and inspection of the cap
- Five-Year Reviews — Because contamination will remain in place above levels that allow for UU/UE

### **7.3.4 Remedy Implementation**

#### **7.3.4.1 Containment via Engineered Control Cap**

Preliminary construction activities began at the site in September 2000 and installation of the new storm sewer system and the engineered cap system was completed in June 2001.<sup>4,5</sup> The cover system in the grass-covered areas included, in ascending order, a gas management layer, LDPE geomembrane, geosynthetic drainage layer, sub-base layer, non-woven geotextile, base course layer, non-woven geotextile, fill material layer, and vegetative material surface layer. The cover system in the asphalt-covered areas included a gas management layer, LDPE geomembrane, geosynthetic drainage layer, sub-base layer, woven geotextile, base course layer, and bituminous concrete surface layer. Details regarding the remedial action are summarized in the Final Remedial Action Report (FWEC September 2002).

#### **7.3.4.2 Groundwater Monitoring**

The Navy implemented a groundwater monitoring program at Site 8 in January 2002 (Tetra Tech March 2001). Since 2002, sampling activities at the site have been completed in accordance with the GMP in Volume II of the O&M Manual; groundwater monitoring is currently performed in accordance with Revision 2 (Tetra Tech July 2011). The results of the program are being used to confirm that contamination is not migrating from the site at concentrations in excess of monitoring criteria.

Background groundwater concentrations, CTDEEP SWPC, site-specific SWPC, and CTDEEP Volatilization Criteria were used to develop the monitoring criteria. The monitoring criteria for the Site 8 groundwater monitoring program are shown in Appendix F (Tetra Tech July 2011).

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<sup>4</sup> The Nautilus Museum was built in 1985, prior to ROD signature and remedy selection.

<sup>5</sup> The remedy also included the replacement of a storm sewer system that served the southern portion of NSB NLON and the Goss Cove Landfill parking lot and surrounding area. The existing storm sewer pipes were under-sized and in a deteriorated condition.

#### **7.3.4.3 Land Use Controls**

SUBASENLONINST 5090.25 (Navy April 2013) defines the Navy's policy regarding ground surface disturbance of soils or any subsurface disturbance of soils and/or groundwater at ER Program sites. Additional information is provided in Section 2.11.1. A draft LUC RD for soil, sediment, and groundwater at Site 8 (OU 5) is in progress. Once finalized, the LUC RD will become the primary LUC document at Site 8 (the LUC RD will also be referenced in SUBASENLONINST 5090.25 and identified on a basewide map) and will continue to protect potential human receptors and ecological receptors from contaminated soil within the landfill and prevent erosion of and infiltration through the landfill soil/contents. Although not explicitly required in the ROD, the LUC RD will prevent disturbance of the Nautilus Museum and associated outbuilding foundations.

Because Site 8 is the Nautilus Museum, the site is open to the public when the museum is open. A visitors log is not maintained, but the area is patrolled.

#### **7.3.4.4 Operations and Maintenance**

Volume V of the O&M Manual details requirements for Site 8 inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech July 2011).<sup>6</sup> Inspection activities for Site 8 include:

- Assessing access controls (e.g., fencing) and compliance with LUCs
- Assessing cap elements
- Inspecting drainage features, including video inspection of the box culvert and catch basins (initially performed annually, currently performed once every five-year review period)
- Inspecting gas vents
- Inspecting monitoring wells

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<sup>6</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are found in Volume I, Section 1.7 (Tetra Tech November 2012).



### **7.3.5 System Operation/Operations and Maintenance**

#### **7.3.5.1 Groundwater Monitoring Program**

Twenty-seven rounds of sampling have been performed over 14 years, and both the number of wells and the analytical suite have been optimized over time. Currently, groundwater monitoring at Site 8 is performed annually, with samples collected from 10 wells analyzed for select VOCs (methylene chloride, PCE, and total xylene), select SVOCs (PAHs), and metals (total and dissolved). Sampling activities performed during this five-year review period are summarized in Section 7.5.1.1.

#### **7.3.5.2 Operations and Maintenance**

Inspections of Site 8 are performed annually in accordance with Volume V of the O&M Manual (Tetra Tech July 2011). In recent years, the inspections were conducted in the spring, and corrective actions completed during the following summer. The partial video inspection of the box culvert and catch basins was performed during this FYR period in 2013. Inspection activities performed during this five-year review period are summarized in Section 7.5.1.3.

### **7.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 8. Table 7-1 provides a list and status of the recommendations that were made for Site 8 in the last five-year review.

<b>Table 7-1 Site 8 — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Investigate potential cap damage caused by installation of aboveground storage tank, pad, and piping, and whether this pad can be enlarged. If the investigation determines that the cap was damaged, remediate the damage to restore remedy functionality.	As discussed in Section 7.4.1 and Table A-5 in Appendix A, the October 2011 investigation determined that the cap was not damaged by installation of the aboveground storage tank.
Continue Operations and Maintenance (O&M) (annual inspection and monitoring) and address O&M deficiencies noted.	Annual inspections and monitoring were conducted and the deficiencies were addressed as described in the Annual Inspection and Repair Reports, except as described in Section 7.5.1.3.
Complete and implement Revision 2 of the O&M Manual.	Revision 2 of the O&M Manual, which includes Site 8, was finalized in 2011 and implemented in 2012.
Complete a Remedial Action Completion Report to document completion of the remedial action.	A Remedial Action Completion Report is in progress.
Investigate warning signs and update, as needed.	Warning signs are maintained and updated, as needed.
Improve internal communication within the Navy by conducting a meeting with Nautilus Museum personnel to communicate Environmental Restoration (ER) Program requirements.	This meeting occurred in June 2011.
Place an ER Program reference document at gate with Nautilus Museum Command Suite and Pier Watch.	This document was placed at the gate in May 2011.

Table 7-1 Site 8 — Status of Recommendations from the Last Five-Year Review	
Recommendation	Action
Implement the following corrective actions for land use control (LUC) compliance: <ul style="list-style-type: none"> <li>• Environmental Division to perform quarterly LUC inspections</li> <li>• Dig permits to require concurrence of Environmental Division</li> <li>• Environmental Division to use Geospatial Information and Services and Naval Installation Restoration Information Solution to identify LUC areas and wells for planners</li> <li>• Revise Mid-Atlantic Regional Instruction (5090.2)</li> </ul>	<ul style="list-style-type: none"> <li>• During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012; they were in 2013, 2014, and 2015.</li> <li>• The Environmental Division reviews and approves all Naval Submarine Base New London dig permits.</li> <li>• LUC areas and wells were documented in Naval Installation Restoration Information Solution on 30 November 2011.</li> <li>• Naval Submarine Base New London does not have jurisdiction to update the Mid-Atlantic Regional Instruction; however, Naval Subbase New London Instruction 5090.25 was updated in April 2013.</li> </ul>

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Annual groundwater monitoring and O&M inspection reports for Site 8 are summarized in Table 7-2; complete document references are in Section 14.

Table 7-2 Site 8 — Summary of Groundwater Monitoring and Operations and Maintenance Inspection Reports		
Year	Groundwater Monitoring	Operations and Maintenance Inspection
2011	Sovereign Consulting (December 2012)	Sovereign Consulting (December 2012)
2012	H&S Environmental [H&S] (December 2013)	H&S (September 2012)
2013	H&S (July 2015)	H&S (April 2014)
2014	H&S (March 2015)	H&S (May 2015)
2015	H&S (March 2016)	H&S (March 2016)

#### 7.4.1 Aboveground Storage Tank Investigation

As documented in the Third Five-Year Review Report (NAVFAC December 2011), the Navy ER Manager became aware that a portion of the Site 8 cap had been excavated and that an aboveground storage tank (AST), its foundation, and associated piping were installed on the cap system without authorization from or coordination with the ER Manager, as required by SOPA (ADMIN) 5090.25. An investigation determined no adverse impact to the cap system from the AST. The AST construction did not penetrate the geosynthetic drainage layer or geomembrane. However, the investigation found that institutional controls were not effectively implemented and the AST installation did not comply with Site 8 action-specific ARARs.

#### 7.4.2 Fusconi Cleaners Remediation

In 2003, CTDEEP implemented permanganate injections to treat the PCE source area in groundwater at the Former Fusconi Cleaners site. In April 2013, the Town of Groton took ownership of the site

(adjacent to Site 8) and the building was subsequently razed (Fuss and O'Neill November 2013). Subsequently, the Town of Groton performed investigations to delineate the extent of PCE contamination at the property. A Remedial Action Plan was developed and the remedy included excavation of PCE-impacted soil and groundwater monitoring (Fuss and O'Neill November 2013); remedial actions were completed in December 2014 (Fuss and O'Neill February 2015). Groundwater monitoring (including impacted wells on Site 8) show that significant improvements have resulted from PCE remedial actions at the Former Fusconi Cleaners site. Groundwater analytical data are discussed in Section 7.5.1.1.

## 7.5 Technical Assessment

The following information supports the determination that the selected remedies for soil, sediment, surface water, and groundwater at Site 8 are functioning as intended, except as noted below. Areas in which remedy performance can be improved are listed in the Issues and Recommendations table referenced in Section 7.6.

### 7.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?

#### 7.5.1.1 Monitoring Data Summary

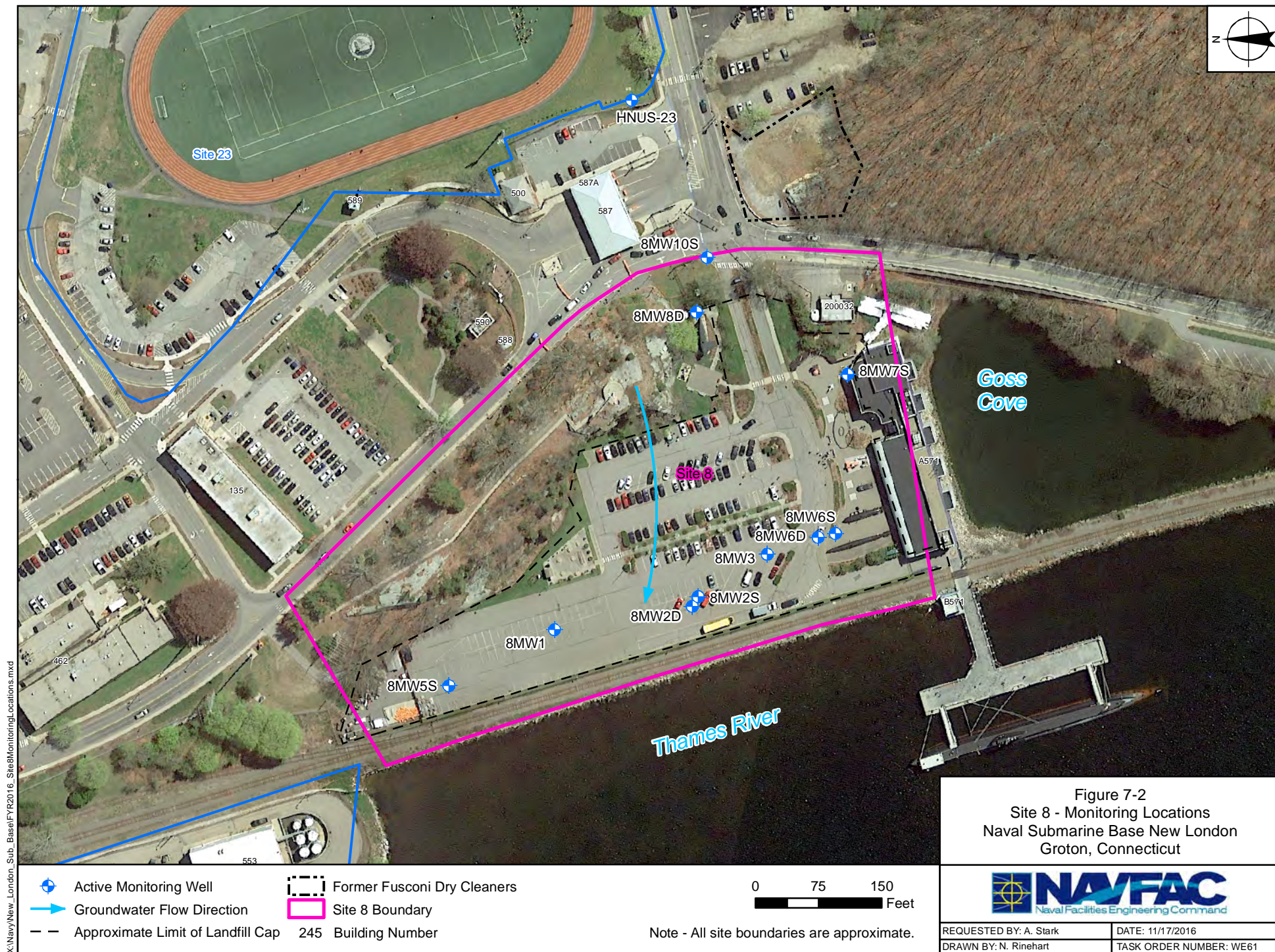
Figure 7-2 shows the location of wells in the active monitoring program. Analytical results for annual groundwater monitoring activities were provided in their respective annual reports, listed in Table 7-2.

During this five-year review period, only PCE, total and dissolved arsenic, total cadmium, and total and dissolved mercury have been detected above monitoring criteria. PCE was released from the upgradient, offsite Former Fusconi Cleaners. PCE concentrations have decreased over this five-year review period, with most of the decrease occurring in 2014 and 2015, likely a result of the removal action performed at the Former Fusconi Cleaners property in 2014 (discussed in Section 7.4.2).

Based on a qualitative review of data, COC concentrations during this five-year review period are consistent with historical data and do not exhibit increasing trends. During the most recent sampling event (2015), concentrations of all COCs were below monitoring criteria.

Location	Frequency	Detections > Monitoring Criteria?
8MW1	annual	none
8MW2S	annual	none
8MW2D	annual	Total/dissolved mercury (2013)
8MW3	annual	none
8MW5S	annual	none
8MW6S	annual	Total/dissolved arsenic (2013, 2014)
8MW6D	Annual	Total/dissolved arsenic (2014) Total cadmium (2011)
8MW7S	Annual	none
8MW8D	Annual	PCE (2011, 2012, 2013, 2014)
8MW10S	Annual	PCE (2011, 2012)
HNUS-23	Annual	none





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These data continue to indicate there is no concern for contaminant migration from Site 8 soil to groundwater or to Goss Cove and the Thames River; monitoring should continue per the decision diagram presented in Volume II of the O&M Manual.

#### **7.5.1.2 Land Use Control Status**

The LUC RD for soil at Site 8 has not been finalized. In the interim, SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at Site 8. While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending LUC RD to prevent both potable and industrial/non-potable use; see Section 2.11.1.

#### **7.5.1.3 Operations and Maintenance Summary**

Inspections have been conducted annually as part of O&M activities associated with Site 8 since 2003; five inspections were performed at Site 8 during this five-year review period. Review of Site 8 O&M inspection checklists and findings for 2011 through 2015 (as provided in their respective annual reports) indicated that communication of maintenance requirements and subsequent repairs and documentation/re-inspection were not performed early in the review period. Further review of O&M procedures should be performed to clarify and document roles and responsibilities, based on lessons learned during the latter part of the five-year review period and to ensure timely submittals/responses. Appropriate revisions should be incorporated into the next O&M Manual update.

The 2013 video inspection of the box culvert and catch basins did not identify any issues requiring corrective action; a complete inspection of the culvert (including the lateral lines) as requested, was not performed. Steps are being taken to perform a video inspection of the lateral lines before finalization of this FYR. The May 2015 inspection concluded that the cap is functioning as designed; however, several O&M issues were noted: damage to fencing, tank footing, and monitoring wells, and gun display settling. The gun display settlement is the only O&M issue identified that hasn't been addressed; the display was assessed further during the five-year review site visit, as discussed in Section 7.5.1.4.

#### **7.5.1.4 Five-Year Review Site Visit Findings**

The site visit included visual observations of several Site 8 features (i.e., cap surface, gas vents, and monitoring wells). The land use of Site 8 had not changed since the remedy was implemented and



the Third Five-Year Review was completed; the area remains the Nautilus Museum and associated parking lot.

During the site visit, the landfill cap and associated remedy components (e.g., storm sewer repair, fencing, and signs) appeared to be in good condition and functioning as intended (see photos #8-1 and #8-3 in Appendix B). The settlement previously identified near the gun display was observed and appeared to be superficial settling of the pavers on which the display is mounted, not of the actual display (see photos #8-4 through #8-7 in Appendix B). The Site 8 landfill cap included installation of engineered concrete foundations for this display; therefore, no impacts to the underlying cap are anticipated due to superficial settling of pavers. The NSB NLON ER Manager indicated that maintenance requests have been initiated. These activities will not be conducted as part of CERCLA O&M, but will be addressed during routine NSB NLON maintenance.

#### 7.5.1.5 Technical Evaluation

Table 7-3 summarizes the technical evaluation for Question A.

<b>Table 7-3</b> <b>Site 8 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	The engineered landfill cap system installed is currently effective in limiting direct exposure to contaminated soil and minimizing infiltration and contaminant migration from the site.
	While exceedances of monitoring criteria have occurred during this five-year review period, no exceedances occurred during the most recent sampling event in 2015. Results from the groundwater monitoring program indicate there are no contaminant migration concerns (from soil to groundwater, and to Goss Cove and the Thames River).
	Over the past five years, tetrachloroethene concentrations at Site 8 due to the Former Fusconi Cleaners (an upgradient, off-base source) dropped significantly in the deep upgradient well (8MW8D) and the shallow upgradient well (8MW10S) to below monitoring criteria; these reductions occurred after the 2014 Connecticut Department of Energy and Environmental Protection remedial action.
Systems Operation/ Operations and Maintenance (O&M)	Annual O&M inspections and the five-year review inspection verify that the landfill cap is in good condition.
	Corrective actions to improve communication of maintenance requirements and subsequent repairs and documentation/re-inspection have been implemented, but need to be reviewed and documented in the next revision of the O&M Manual; however, all issues identified in 2011 through 2015 inspections have been addressed. Repairs to the display will be conducted under routine Naval Submarine Base New London maintenance and not by the Environmental Restoration program.

<b>Table 7-3</b> <b>Site 8 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Implementation of Land Use Controls and Institutional/Engineering Controls	Institutional controls associated with Site 8 soil and sediment are in Subbase New London Instruction (SUBASENLONINST) 5090.25. Site 8 is fenced and access is restricted when the Nautilus Museum is closed. The Land Use Control Remedial Design for Site 8 is in progress.
	While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending Land Use Control Remedial Design to prevent both potable and industrial/non-potable use. Further clarity is also required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.
Opportunities for Optimization	Based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 8 should be reviewed and potentially optimized.
Early Indicators of Potential Remedy Problems	None identified.

## **7.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

### **7.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Site 8 was summarized in Section 7.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Risks to potential receptors from landfill contents were prevented by the installation of a landfill cap and LUCs. The O&M program ensures that the cap system does not have deficiencies or other issues that could negatively affect long-term performance. Site 8 currently serves as a museum with public parking, and the current land use is expected to remain unchanged; SUBASENLONINST 5090.25 prohibits disturbance of soil and groundwater, as discussed in Section 7.5.1.2.

As discussed in Section 7.5.1.1, groundwater monitoring has verified that no significant contaminant migration from soil to groundwater has occurred. While groundwater concentrations of several analytes (PCE, arsenic, cadmium, and mercury) had exceeded monitoring criteria earlier in the five-year review period, during the most recent sampling event (2015) all COCs were below relevant screening levels.

Because the Nautilus Museum at Site 8 could potentially be affected by VOCs in groundwater, a VISL comparison was performed during this five-year review. PCE is present at concentrations above the industrial groundwater VISL criterion (65 µg/L) in one shallow well (68 µg/L in 8MW10S) located

more than 100 feet from any inhabitable structure at Site 8, hydraulically side-gradient from the museum building. Groundwater flow is to the west/northwest, away from the museum building, beneath the parking lot, and into the Thames River. Therefore, 8MW10S was not considered during VI screening. PCE concentrations in shallow wells adjacent to the museum building (8MW6S, 8MW7S, and 8MW8S) were all below groundwater VISL screening levels. The VI evaluation for Site 8 (discussed in Section 2.9 and Table 2-1) concluded that no further evaluation of the VI pathway is necessary.

### 7.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 7-4.

<b>Table 7-4</b> <b>Site 8 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	<p>Groundwater monitoring criteria are shown in Appendix F. When the most recent version of the Operations and Maintenance Manual (Tetra Tech July 2011) was developed, the selected groundwater monitoring criteria for volatile organic compounds (VOCs) were based on Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) 2008 proposed values for Residential and Industrial/Commercial Volatilization Criteria (CTDEEP 2008). CTDEEP RSRs were amended in June 2013 and the Volatilization Criteria changed from the 2008 proposed values for numerous VOCs. The monitoring criteria will require modifications to reflect current CTDEEP Volatilization Criteria; these values should be revised during the next revision of the Operations and Maintenance Manual.</p> <p>The revised RSRs also updated the Residential Direct Exposure Criteria for lead in soil. This change does not affect the protectiveness of the remedy because land use controls prevent future residential development of Site 8.</p>
Changes in Exposure Pathways	Groundwater is not used for drinking water. Volatilization via vapor intrusion (VI) has been reassessed since the last five-year review because of recent changes in guidance. Based on the VI screening evaluation presented in Table 2-1, it is recommended that Subase New London Instruction (SUBASENLONINST) 5090.25 be reviewed to determine whether construction provisions require VI assessment and mitigation (if required) at Site 8. Protectiveness of the site remedy is not affected.
Changes in Land Use	There have been no changes in land use since the Record of Decision was finalized. SUBASENLONINST 5090.25 prevents land use changes without notification.

<b>Table 7-4 Site 8 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dibenzofuran was listed as a COC in Site 8 soil. The Feasibility Study detected dibenzofuran in 8 of 12 surface soil locations at concentrations ranging from 0.075 to 5.2 milligrams per kilogram (mg/kg) and in 9 of 12 subsurface soil locations at concentrations ranging from 0.1 to 2.4 mg/kg (Tetra Tech September 1999). Those concentrations are below the CTDEEP GB Mobility Criteria (5.6 mg/kg) and the United States Environmental Protection Agency Industrial Soil Regional Screening Level (100 mg/kg), so the updates to this class of emerging contaminants do not affect the protectiveness of the remedy. Land use at Site 8 is restricted, as discussed in Section 2.11.1 and Section 7.3.4.3.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 8; however, due to the lack of documentation of materials disposed of at the landfill, it is likely that the basewide perfluorinated compound (PFC) desktop study/preliminary assessment will conclude that additional action is required at Site 8 in regard to PFCs.</p> <p><b>1,4-Dioxane</b> — 1,1,1-trichloroethane and its daughter compounds 1,1-dichloroethane and chloroethane have been detected in groundwater at Site 8. The stabilizer 1,4-dioxane is commonly associated with 1,1,1- trichloroethane. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane. The Navy will perform presence/absence sampling for 1,4-dioxane at Site 8 in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	<p>No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for VOCs, which may affect some sites where VOCs are a concern in groundwater if groundwater could be used as a potable source in the future. VI information for Site 8 was reviewed as discussed above and as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.</p>
Expected Progress towards Meeting Remedial Action Objectives	<p>The remedial action objectives for the soil at Operable Unit 5 have been met by conducting the remedial action that included installation and maintenance of an engineered cap and groundwater monitoring. A Land Use Control Remedial Design for Site 8 soil, sediment, and groundwater is currently under development; until implementation, land use controls are implemented via SUBASENLONINST 5090.25.</p> <p>While exceedances of monitoring criteria have occurred during this five-year review period, no exceedances occurred during the most recent sampling event in 2015. Groundwater monitoring for the last five annual sampling events demonstrate that contaminants are not migrating from soil to groundwater.</p>

### 7.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

## **7.6 Issues and Recommendations**

Issues and recommendations are identified in Table 7-5.

## **7.7 Protectiveness Statement**

Remedial actions implemented at Site 8 are protective of human health and the environment. Remedial actions (installation of the engineered cap system) minimize infiltration and subsequent contaminant migration, and prevent direct contact with soil. An O&M program has been implemented and results verify that the cap is performing as designed. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.



Table 7-5 Site 8 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	SUBASENLONINST 5090.25 language does not consider the potential for vapor intrusion during the event of future construction scenarios at Site 8.	Review SUBASENLONINST 5090.25 to determine whether modifications are required. (When the Site 8 LUC RD is finalized, include these provisions as necessary.)	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
2	During this five-year review period, quarterly site inspections to document compliance with LUCs were not documented in 2011 and 2012 as recommended by the Third Five-Year Review Report.	There is no LUC RD for the landfill; until the LUC RD is finalized, modify procedures to ensure that inspections are performed quarterly and properly documented.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
3	The Site 8 Soil LUC RD has not been finalized. The ROD does not explicitly require LUCs to prevent disturbance of the Nautilus Museum and associated outbuilding foundations.	Finalize and implement the LUC RD. In the interim, continue enforcement of SUBASENLONINST 5090.25 to ensure remedy protectiveness. The Site 8 LUC RD should prohibit disturbance of the Nautilus Museum and associated outbuilding foundations.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
4	While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending LUC RD to prevent both potable and industrial/non-potable use. Further clarity is also required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.	SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification. (When the Site 8 LUC RD is finalized, include these provisions as necessary.)	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
5	ARARs used to develop monitoring criteria have changed and based on the decision diagram in Volume II of the O&M Manual and groundwater monitoring results during this five-year review period, the analytical suite for Site 8 should be reviewed and potentially optimized.	Update the O&M Manual to reflect: <ul style="list-style-type: none"><li>Changes to monitoring criteria based on ARAR changes</li><li>Any changes to the monitoring program based on an optimization review</li></ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	

Table 7-5 Site 8 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
6	The contaminants 1,1,1-TCA and its daughter compounds 1,1-dichloroethane and chloroethane were detected in groundwater at Site 8. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations at Site 8 did not include soil or groundwater analysis for 1,4-dioxane.	Perform presence/absence sampling for 1,4-dioxane at Site 8 in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	
7	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 8; however, there is a lack of documentation of materials disposed of at the landfill. A basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	
<b>Operations and Maintenance</b>								
8	Further review of O&M procedures should be performed to clarify and document roles and responsibilities to ensure timely reporting and repair activities.	Revise O&M Manual to clarify roles and responsibilities and other issues identified in this five-year review (i.e., reduction in COCs and changes to monitoring criteria).	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
<b>Other</b>								
9	The Site 8 Soil Remedial Action Completion Report has not been finalized, as recommended by the Third Five-Year Review Report.	Finalize the Remedial Action Completion Report upon completion of the LUC RD.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

<sup>[2]</sup> Well abandonment activities are dependent on results of the emerging contaminant assessments/investigations and long-term monitoring program; a date for well abandonment cannot be estimated at this time.

SUBASENLONINST	=	Subbase New London Instruction	LUC RD	=	Land Use Control Remedial Design
U.S. EPA	=	United States Environmental Protection Agency	CTDEEP	=	Connecticut Department of Energy and Environmental Protection
LUC	=	Land Use Control	ROD	=	Record of Decision
VOC	=	Volatile Organic Compound	ARAR	=	Applicable or Relevant and Appropriate Requirement
O&M	=	Operations and Maintenance	TCA	=	Trichloroethane
PF	=	Perfluorinated Compound	COC	=	Contaminant of Concern

## **8.0 SITE 23 — FORMER FUEL FARM, OPERABLE UNIT 9**

Site 23, the Former Fuel Farm, is included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 8-1 shows the layout of the Former Fuel Farm, which was a large tank farm in the southern portion of NSB NLON. Site 23 includes existing ASTs and former underground storage tanks (USTs) including former OT-5, which is addressed under CERCLA as Site 9 (see Section 9 for further detail).

### **Site 23**

- Source of contamination: former use as a petroleum tank farm; soil was investigated and remediated under RCRA Subtitle I
- Groundwater COCs: PCE, naphthalene, lead, total arsenic, PAHs, and hexachlorobenzene
- Groundwater Remedy:
  - OU 9 ROD (September 2008)
    - o Institutional controls

At Site 23, groundwater is managed under OU 9 (Basewide Groundwater). Due to the physical location of Site 9 (within Site 23), groundwater is collectively referred to as Sites 9 and 23. This section contains a complete discussion of groundwater at Sites 9 and 23.

The Navy submitted a Draft SASE which determined there are no remaining CERCLA issues at Site 23 soil, particularly in the vicinity of Oily Tank (OT)-4 and OT-10 (Resolution Consultants March 2016). However, non-CERCLA soil was not fully delineated beneath the groundwater table and non-CERCLA LUCs may be required. U.S. EPA is reviewing this document.

Groundwater at Sites 9 and 23 was investigated under CERCLA in the BGOURI (Tetra Tech December 2001) with a one-year monitoring program (Tetra Tech September 2008), and is addressed in the OU 9 ROD (NAVFAC September 2008).

## **8.1 Site History and Background**

Table A-6 in Appendix A summarizes the chronology of events at Site 23, including non-CERCLA investigations referenced above.

## **8.2 Conceptual Site Model**

In the early 1940s, Crystal Lake was drained and dredged to allow for construction of nine concrete USTs labeled OT-1 through OT-9. When UST construction was complete, the former lake bed was reportedly filled and graded to create a level surface for development (B&RE September 1997).

### **Underground Storage Tank Contents**

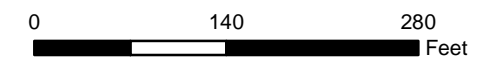
- OT-1 through OT-3 — No. 6 fuel oil
- OT-4 — tank bottom wastes from OT-1
- OT-5 — waste oil (see Site 9, Section 9)
- OT-6 through OT-9 — diesel fuel
- OT-10 Complex — wastewater management system
- OT-12 and OT-13 — diesel fuel





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- Fuel Lines
  - Former Tanks
  - SVE System
  - Site 23 Boundary
- 245 Building Number



Note - All site boundaries are approximate.

Figure 8-1  
Site 23 - Former Fuel Farm - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/17/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



Product (No. 6 fuel oil or diesel fuel) was historically delivered via barge to a pier, from which it was pumped via pipelines to the Former Fuel Farm USTs through a valve house. The No. 6 fuel oil transfer lines were situated within concrete-lined trenches; the transfer lines were removed because No. 6 fuel oil is no longer used at NSB NLON; the diesel transfer lines have no trenches and were abandoned and decommissioned in 2011.

Former tanks OT-1 through OT-9 and the OT-10 complex were closed in place under CTDEEP's Underground Storage Tank Program by emptying and cleaning the tanks, partially demolishing the tank roof supports, filling the voids with gravel and other fill, and restoring the surface. Site 23 also includes two active 150,000-gallon ASTs (OT-12 and OT-13) for diesel oil.

An air sparging/soil vapor extraction (AS/SVE) system was installed outside and upgradient of Site 23 at the adjacent Naval Exchange Service Station in 1991 due to petroleum contamination (BTEX and other petroleum related COCs such as 2-methylnaphthalene) in groundwater. The system is no longer operational; these actions are discussed further in Appendix A, Table A-6; however, because they are not associated with the CERCLA remedy at Site 23, they are not discussed further in this five-year review.

### **8.2.1 Nature and Extent of Contamination**

Investigations of the Former Fuel Farm conducted from 1989 through 1999 detected evidence of releases of petroleum products from Tanks OT-1 through OT-9. Both soil contamination and free-product were identified at Site 23 during those investigations. Petroleum hydrocarbons have been detected periodically at the outfall of the Former Fuel Farm storm sewer system adjacent to the Thames River (B&RE September 1997); the most recent documented observation was in 2011.

#### **Site 23 Current Physical Characteristics**

- Nine abandoned-in-place USTs (OT-1 through OT-9) (see Site 9, Section 9 for OT-5)
- OT-10 Complex (decommissioned in 2006)
- Tanker truck dumping pad and trough
- Two active 150,000-gallon ASTs (OT-12 and OT-13)
- A fuel oil loading area adjacent to Building 482
- Associated UST piping systems
- Buildings 445 (Restrooms), 461 (The MWR Recreation Center), 482, 515, 549, and 550
- One Guard Tower
- Six baseball fields
- Running track

CTDEEP classified groundwater beneath NSB NLON, including Site 23, as GB because it has been used for long-term intense industrial or commercial development and a public water supply service is available.



### **8.2.2 Basis for Taking Action**

As a conservative measure, the risk assessments presented in the OU 9 (Basewide Groundwater) ROD evaluated a hypothetical future human residential exposure scenario under which the base was closed and redeveloped for residential use, and assumed groundwater would be used as a drinking water source. Groundwater at Sites 9 and 23 does not result in unacceptable risk to human health or the environment under current or expected future land use, however cancer risks exceeded U.S. EPA's acceptable risk range for the hypothetical future resident ( $2.6E-04$ ) under a direct exposure scenario; potable consumption was not evaluated. VI risks were within both U.S. EPA and CTDEEP acceptable risk ranges (NAVFAC September 2008).

Human health and ecological risks due to site soil were re-evaluated in the SASE, currently under regulatory review. The Draft SASE determined there were no CERCLA soil issues at Site 23.

## **8.3 Remedial Actions**

The OU 9 ROD, which included groundwater at Sites 9 and 23, was signed by the Navy on 24 September 2008 and by U.S. EPA Region 1 on 30 September 2008.

### **8.3.1 Remedial Action Objectives**

The following RAOs were developed for groundwater at Sites 9 and 23 (NAVFAC September 2008):

- Protect potential future receptors from exposure to contaminated groundwater via ingestion (potable water supply).
- Protect aquatic ecological receptors.

### **8.3.2 Remedial Goals**

Chemical-specific RGs were not developed for groundwater at Sites 9 and 23.

### **8.3.3 Remedy Selection**

The selected remedy was institutional controls, including preventing withdrawal and/or use of groundwater from Sites 9 and 23 for potable water purposes or any other purposes that may result in unacceptable risks to human health or the environment and ensuring that groundwater extracted from Sites 9 and 23 during construction dewatering activities is handled, stored, and disposed in accordance with applicable state and federal regulatory requirements, and five-year reviews until contaminant concentrations are shown to be protective of human health and the environment.

#### **8.3.4 Remedy Implementation**

Groundwater at Sites 9 and 23 was included in the OU 9 (Basewide Groundwater) ROD (NAVFAC September 2008). The LUC RD for OU 9 identified LUCs at Sites 9 and 23 to prevent the withdrawal and/or use of groundwater for potable water purposes and ensure that groundwater extracted during construction dewatering activities is properly handled, stored, and disposed (Tetra Tech November 2009). The RACR for OU 9 was prepared to document the completion of site remedies and ongoing activities at Sites 9 and 23 (Tetra Tech June 2010). Additional information regarding the OU 9 LUC RD can be found in Section 2.11.2.

Volume VIII of the O&M Manual details requirements for Sites 9 and 23 inspections and includes site-specific instructions for O&M activities and an inspection checklist (Tetra Tech November 2012).<sup>1</sup>

Inspection activities for Sites 9 and 23 include:

- Assessing compliance with the OU 9 LUC RD
- Inspecting monitoring wells until the soil remedy is finalized

SUBASENLONINST 5090.25 (Navy April 2013) defines the Navy policy regarding any subsurface disturbance of soil and/or groundwater at all ER Program sites; however, there are no specific inspection activities mandated for Sites 9 and 23 soil as the soil remedy has not been finalized. SUBASENLONINST 5090.25 indicates that future LUCs for soil have yet to be determined.

#### **8.3.5 System Operation/Operations and Maintenance**

Inspections of Sites 9 and 23 are to be conducted annually, in accordance with Volume VIII of the O&M Manual (Tetra Tech November 2012), to maintain monitoring wells within Sites 9 and 23 and ensure compliance with institutional controls. The first O&M inspection, performed in November 2015, determined that monitoring wells are in good condition. The O&M inspection checklist is provided in the 2015 Annual Inspection Report (H&S March 2016).

### **8.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 23. Table 8-1 provides a list and status of the recommendations that were made for Site 23 in the last five-year review.

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<sup>1</sup> General O&M procedures regarding inspections, repairs and maintenance, reporting, and documentation are in Volume I, Section 1.7 (Tetra Tech November 2012).

<b>Table 8-1 Site 23 — Status of Recommendations from the Last Five-Year Review</b>	
<b>Recommendation</b>	<b>Action</b>
Develop and implement a Site Assessment Screening Evaluation for the soil to determine if there are any remaining Comprehensive Environmental Response, Compensation, and Liability Act issues.	The Draft Site 23 Site Assessment Screening Evaluation was submitted in March 2016.
Continue to manage soil at the site under Standard Operating Procedure — Administrative New London Instruction 5090.25 until it is determined if a soil Land Use Control Remedial Design (LUC RD) is necessary and prepared.	Subase New London Instruction 5090.25 (cancelled Standard Operating Procedure — Administrative New London Instruction 5090.25) is being enforced at Sites 9 and 23 until it is determined if a soil LUC RD is necessary and is prepared.
Continue enforcement of the OU 9 LUC RD for groundwater at the site.	The OU 9 LUC RD is being enforced but land use control inspections were not performed except for 2015.
Initiate annual compliance inspections for groundwater land use controls and incorporate inspection reports into future five-year reviews.	Volume VIII of the Operations and Maintenance Manual was written in November 2012 (Tetra Tech November 2012) and annual inspections began in 2015.
Ensure that current rework of the athletic fields at Site 23 does not change land use in any way that is inconsistent with the OU 9 LUC RD or SOPA (ADMIN) NLONINST 5090.25.	The rework of the athletic fields did not alter land use in any way. The current site conditions are consistent with previous land use.

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25 and Volume VIII of the O&M Manual (Tetra Tech November 2012) and the Draft SASE (Resolution Consultants March 2016) were completed, as summarized in Table A-6 in Appendix A. Complete document references are in Section 14.

SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils at ER Program sites; see Section 2.11.1. However, specific restrictions for soil at Sites 9 and 23 are not identified in SUBASENLONINST 5090.25. SUBASENLONINST 5090.25 indicates that future LUCs for soil have yet to be determined; as discussed above, non-CERCLA LUCs may be required.

## **8.5 Technical Assessment**

The following information supports the determination that the selected remedy for groundwater at Sites 9 and 23 is functioning as intended.

### **8.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

#### **8.5.1.1 Land Use Control Status**

The LUC RD that included groundwater at Sites 9 and 23 was finalized in 2009. The LUC RD requires that inspections and certifications be performed annually. During this five-year review period, annual LUC inspections and certifications (as required by the OU 9 LUC RD) were not performed or

documented, except for 2015. NSB NLON is currently modifying its procedures to ensure compliance with the LUC RD.

During this five-year review, a comparison of LUC language for sites in OU 9 indicated that groundwater use restrictions are inconsistent from site to site; language at Sites 9 and 23 needs further review to prevent groundwater use under non-potable scenarios.

#### **8.5.1.2 Operations and Maintenance Summary**

O&M inspections are to be conducted annually, in accordance with Volume VIII of the OM Manual (Tetra Tech November 2012) to maintain monitoring wells. The first O&M inspection, performed in November 2015, noted damage to some wells. However, since there is no active groundwater monitoring program at Sites 9 and 23, the monitoring wells should be evaluated for abandonment. The O&M inspection checklist is provided in the 2015 Operations and Maintenance Inspections Technical Memorandum (Resolution Consultants July 2016).

#### **8.5.1.3 Five-Year Review Site Visit Findings**

The site visit included visual observations of site features. The land use had not changed since the remedy was implemented and the Third Five-Year Review was completed; Site 23 remains a partially fenced area used for recreation with paved roadways. In accordance with the land use restriction, groundwater at Sites 9 and 23 is not used for human consumption. There are no short-term or long-term plans to convert this area to any other use.

#### **8.5.1.4 Technical Evaluation**

Table 8-2 summarizes the technical evaluation for Question A.

Table 8-2 Sites 9 and 23 — Technical Evaluation — Question A	
Question	Summary
Remedial Action Performance	The Operable Unit (OU) 9 Land Use Control Remedial Design (LUC RD) is in place for groundwater at Sites 9 and 23.
Systems Operation/ Operations and Maintenance	Operations and maintenance inspections are performed annually to verify the condition of monitoring wells. There is no active groundwater monitoring program at Sites 9 and 23.



Table 8-2 Sites 9 and 23 — Technical Evaluation — Question A	
Question	Summary
Implementation of Land Use Controls and Institutional/Engineering Controls	Specific restrictions for soil at Sites 9 and 23 are not identified in Subase New London Instruction 5090.25. Subase New London Instruction 5090.25 indicates that future land use controls (LUCs) for soil have yet to be determined. Upon finalization of the Site Assessment Screening Evaluation, the need for LUCs for soil at Sites 9 and 23 should be properly documented.
	The LUC RD for OU 9 Basewide Groundwater, which includes Sites 9 and 23 groundwater, was completed and the controls have been implemented. However, during this five-year review period, inspections and certifications were only performed in 2015 which is not in accordance with the OU 9 LUC RD (annual certifications). Naval Submarine Base New London is currently modifying its procedures to ensure that OU 9 LUC inspections and certifications are performed.
	During this five-year review, a comparison of LUC language for sites in OU 9 indicated that groundwater use restrictions are inconsistent from site to site; language at Sites 9 and 23 needs further review to prevent groundwater use under non-potable scenarios.
Opportunities for Optimization	There is no groundwater monitoring program at Sites 9 and 23; monitoring wells should be evaluated for abandonment following the completion of emerging contaminant assessments and investigations.
Early Indicators of Potential Remedy Problems	None identified.

## 8.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?

### 8.5.2.1 Risk Assessment Review: Current Conditions

The basis for action at Sites 9 and 23 was summarized in Section 8.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Groundwater risks due to hypothetical residential land use are addressed by the OU 9 LUC RD, which prevents withdrawal or use of groundwater for potable purposes and ensures that groundwater extracted during construction activities is managed appropriately (Tetra Tech November 2009).

A conservative evaluation of VI into indoor air performed in 2013 as part of the Site 23 SASE (Resolution Consultants March 2016). An HHRA included in the SASE, originally performed in 2013 and updated in 2016, evaluated the indoor air (via VI) exposure pathway for groundwater contaminants below Site 23 (but outside of the former AS/SVE system). Receptors evaluated include a current/future site worker (in existing onsite buildings) and a hypothetical future resident. The risks and hazards for exposures to indoor air were determined to be at or below the U.S. EPA cancer risk range and a target organ HI of 1. A VI evaluation for Site 9 conducted as part of this five-year review (shown in Table 2-1) concluded that no further evaluation of the VI pathway is necessary.<sup>2</sup> The VI evaluation for Sites 9 and 23 (shown in Section 2.9 and Table 2-1) concluded that the OU 9 LUC RD

<sup>2</sup> Bromodichloromethane and chloroform present in groundwater at Site 9, which do exceed VISLs, may be associated with numerous potable water lines which are located near Site 9, and not associated with waste handling/disposal activities. They are not considered in this VI screening evaluation.

should be edited to require VI assessment and mitigation as necessary for any new building construction at these sites.

### 8.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 8-3.

<b>Table 8-3</b> <b>Sites 9 and 23 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	There have been no applicable or relevant and appropriate requirement changes that affect the remedy at Sites 9 and 23.
Changes in Exposure Pathways	While groundwater is not used for drinking water, volatilization via vapor intrusion (VI) has been reassessed since the last five-year review pending recent changes in guidance. Based on the VI screening evaluation presented in Table 2-1, it is recommended that the Operable Unit (OU) 9 Land Use Control Remedial Design (LUC RD) be reviewed to determine whether construction provisions require VI assessment and mitigation (if required) at Sites 9 and 23. Protectiveness of the site remedy is not affected.
Changes in Land Use	There have been no changes in land use since the Record of Decision was finalized. The OU 9 LUC RD prevents land use changes without notification.
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins are not probable contaminants at Sites 9 and 23 due to its site history, and samples have not been collected for dioxin analysis.</p> <p><b>PFCs</b> — Based on a preliminary review of site drawings, perfluorooctanoic acids/perfluorooctanesulfonic acids are potentially present at Sites 9 and 23 as indicated by piping diagrams and associated notations indicating firefighting foams. A basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> — 1,1,1-trichloroethane and its daughter compound 1,1-dichloroethane have been detected in groundwater at Sites 9 and 23. The stabilizer 1,4-dioxane is commonly associated with 1,1,1- trichloroethane. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane. The Navy will perform presence/absence sampling for 1,4-dioxane at Sites 9 and 23 in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs, dioxins, or 1,4-dioxane, as the OU 9 LUC RD prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect the protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for volatile organic compounds, which may affect some sites where volatile organic compounds are a concern in groundwater. VI information for Sites 9 and 23 was reviewed as shown in Table 2-1, which concluded that due to naphthalene vapor intrusion screening level exceedances the OU 9 LUC RD should be reviewed.
Expected Progress towards Meeting Remedial Action Objectives	A LUC RD was prepared for OU 9 groundwater, which includes Sites 9 and 23.

**8.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No other information has come to light that could call into question the protectiveness of the remedy.

**8.6 Issues and Recommendations**

Issues and recommendations are identified in Table 8-4.

**8.7 Protectiveness Statement**

The groundwater remedy for Sites 9 and 23 is protective of human health and the environment; LUCs minimize exposure to groundwater at Sites 9 and 23.

Table 8-4								
Sites 9 and 23 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	Annual groundwater LUC inspections and certifications were not performed in accordance with the OU 9 LUC RD at Sites 9 and 23 during this five-year review period, except for 2015.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 9 LUC RD at Sites 9 and 23.	Navy	U.S. EPA, CTDEEP	31 December 2016	N	N	
2	Review of the OU 9 LUC RD identified the following: <ul style="list-style-type: none"><li>A comparison of LUC language for sites in OU 9 indicated that groundwater use restrictions are inconsistent from site to site; language at Sites 9 and 23 needs further review to prevent non-potable groundwater use.</li><li>The OU 9 LUC RD language does not consider the potential for vapor intrusion during the event of future construction scenarios at Sites 9 and 23.</li></ul>	Edit the OU 9 LUC RD to include the following: <ul style="list-style-type: none"><li>Prohibit non-potable groundwater use.</li><li>Require VI assessment and mitigation as necessary for any new building construction at Sites 9 and 23.</li></ul>	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
3	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
4	The contaminants 1,1,1-TCA and its daughter compound 1,1-dichloroethane were detected in groundwater and soil at Sites 9 and 23. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations at Sites 9 and 23 did not include soil or groundwater analysis for 1,4-dioxane.	Perform presence/absence sampling for 1,4-dioxane at Sites 9 and 23 in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	
5	Perfluorooctanoic acids/perfluorooctanesulfonic acids are potentially present at Sites 9 and 23 as indicated by piping diagrams and associated notations indicating firefighting foams; a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	



Table 8-4 Sites 9 and 23 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
6	There is no groundwater monitoring program at Sites 9 and 23.	Following the completion of emerging contaminant assessments and investigations, evaluate and abandon wells, and document the decision as necessary.	Navy	U.S. EPA, CTDEEP	To Be Determined <sup>[2]</sup>	N	N	
<b>Other</b>								
7	The SASEs for Site 9 and Site 23 determined there were no remaining CERCLA soil issues at Site 9 and Site 23; non-CERCLA soil was not fully delineated beneath the groundwater table at Sites 9 and 23.	Evaluate the need for non-CERCLA LUCs at Sites 9 and 23.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

<sup>[2]</sup> Well abandonment activities are dependent on results of the emerging contaminant assessments/investigations; a date for well abandonment cannot be estimated at this time.

LUC	=	Land Use Control	OU	=	Operable Unit
CTDEEP	=	Connecticut Department of Energy and Environmental Protection	U.S. EPA	=	United States Environmental Protection Agency
LUC RD	=	Land Use Control Remedial Design	SUBASENLONINST	=	Subbase New London Instruction
VOC	=	Volatile Organic Compound	TCA	=	Trichloroethane
PFC	=	Perfluorinated Compounds	SASE	=	Site Assessment Screening Evaluation
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act			

## **9.0 SITE 9 — FORMER WASTEWATER OILY TANK OT-5, OPERABLE UNIT 9**

Site 9, the Former Wastewater Oily Tank OT-5 (Former OT-5), is included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 9-1 shows the site layout of Former OT-5, which was a 750,000-gallon concrete UST located between Sculpin Avenue and Tang Avenue in the southern portion of NSB NLON.

### **Site 9**

- Source of Contamination: OT-5 - Initially used to store No. 6 fuel oil, but converted and stored bilge water and other waste solutions
- Groundwater COCs: PCE, naphthalene, lead, total arsenic, PAHs, and hexachlorobenzene
- Groundwater Remedy:
  - OU 9 ROD (September 2008)
    - Institutional controls

At Site 9, groundwater is managed under OU 9 (Basewide Groundwater). Due to the physical location of Site 9 (within Site 23), groundwater is collectively referred to as Sites 9 and 23. See Section 8 for a complete discussion of groundwater at Sites 9 and 23.

The Navy developed and implemented an SASE for Site 9 soil and determined that there are no remaining CERCLA issues, but it did not fully delineate non-CERCLA soil beneath the groundwater table, as discussed in Section 9.4 and non-CERCLA LUCs may be required.

## **9.1 Site History and Background**

Table A-7 in Appendix A summarizes the chronology of events at Site 9, including non-CERCLA investigations referenced above.

## **9.2 Conceptual Site Model**

Site 9 (OT-5) is part of the larger Former Fuel Farm (Site 23), described in Section 8.2. OT-5 was initially used to store No. 6 fuel oil and, in the late 1970s, was converted to a storage tank for bilge water and other waste solutions (Goldberg-Zoino Associates December 1991). In addition, detergents used to clean ship's bilges may have been mixed with the waste materials stored in the UST (Goldberg-Zoino Associates December 1991). Use of OT-5 ceased in 1989. During tank abandonment activities (circa 1990), debris was observed in the bottom of OT-5, including leaves, rags, cans, wood, and a 55-gallon drum. Upon completion of a series of subsurface investigation activities, OT-5 was abandoned in-place (backfilled) in 1995. The Site 9 area is now used as a military dog training facility.

### **Site 9 Physical Characteristics**

- The tank OT-5 had a diameter of approximately 112 feet, with tank walls 11 feet tall.
- The top of the tank was approximately 4 feet bgs
- The tank had a capacity of approximately 750,000 gallons.
- The 1-foot thick cover slab was supported by 37 columns, each 16 inches in diameter and spaced approximately 16 feet apart.



- OT-10 Complex    245    Building Number
- Fuel Lines
- Site 9 Boundary

0      20      40  
 Feet

Note - All site boundaries are approximate.

Figure 9-1  
 Site 9 - Former Oily Tank 5 - Site Plan  
 Naval Submarine Base New London  
 Groton, Connecticut



REQUESTED BY: A. Stark	DATE: 11/17/2016
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: WE61

Data Sources: ArcGIS Online Imagery Basemap



### 9.2.1 Nature and Extent of Contamination

Investigations of the Former Fuel Farm (including Site 9) conducted from 1989 through 1999 detected evidence of releases of petroleum products from Tanks OT-1 through OT-9. Petroleum hydrocarbons have been detected periodically at the outfall of the Former Fuel Farm storm sewer system adjacent to the Thames River (B&RE September 1997); the most recent documented observation was in 2011.

CTDEEP classified groundwater beneath NSB NLON, including Site 9, as GB because it has been used for long-term intense industrial or commercial development and a public water supply service is available.

### 9.2.2 Basis for Taking Action

Health risks associated with groundwater at Sites 9 and 23 are discussed in Section 8.2.2. Human health and ecological risks due to site soil were re-evaluated in the SASE discussed in Section 9.4.

### 9.3 Remedial Actions

The OU 9 ROD, which included groundwater at Sites 9 and 23, was signed by the Navy on 24 September 2008 and by U.S. EPA Region 1 on 30 September 2008. Information about remedial actions for groundwater at Sites 9 and 23 (i.e., RAOs, remedy selection, and implementation) are discussed in Section 8.3.

### 9.4 Progress Since the Last Five-Year Review

This is the fourth five-year review of Site 9. Table 9-1 provides a list and status of the recommendations that were made for Site 9 in the last five-year review.

Table 9-1 Site 9 — Status of Recommendations from the Last Five-Year Review	
Recommendation	Action
Develop and implement a Site Assessment Screening Evaluation for the soil to determine if there are any remaining Comprehensive Environmental Response, Compensation, and Liability Act issues.	The Site 9 Site Assessment Screening Evaluation (Resolution Consultants February 2013) was completed in 2013; the result was no further action for soil under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, non-CERCLA soil was not fully delineated beneath the groundwater table, therefore, non-CERCLA LUCs may be required.
Continue to manage soil at the site under Standard Operating Procedure — Administrative New London Instruction 5090.25 until it is determined if a soil Land Use Control Remedial Design (LUC RD) is necessary and prepared.	Subbase New London Instruction 5090.25 (cancelled Standard Operating Procedure — Administrative New London Instruction 5090.25) will be enforced at Site 9 until it is determined if a soil LUC RD is necessary and prepared.



Table 9-1 Site 9 — Status of Recommendations from the Last Five-Year Review	
Recommendation	Action
Continue enforcement of the OU 9 LUC RD for groundwater at the site.	The OU 9 LUC RD is being enforced but land use control inspections were not performed except for in 2015.
Initiate annual compliance inspections for groundwater land use controls and incorporate inspection reports into future five-year reviews.	Volume VIII of the Operations and Maintenance Manual was written in November 2012 (Tetra Tech November 2012) and annual inspections began in 2015.

Since the last five-year review, SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25, and Volume VIII of the O&M Manual (Tetra Tech November 2012) and the SASE (Resolution Consultants February 2013) were completed, as summarized in Table A-7 in Appendix A. Complete document references are in Section 14.

The SASE recommended NFA for soil but did not fully delineate non-CERCLA soil beneath the groundwater table; therefore, non-CERCLA LUCs may be required. SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils at ER Program sites; see Section 2.11.1. However, specific restrictions for soil at Sites 9 and 23 are not identified in SUBASENLONINST 5090.25. SUBASENLONINST 5090.25 indicates that future LUCs for soil have yet to be determined.

## 9.5 Technical Assessment

The technical assessment for the Sites 9 and 23 groundwater remedy is in Section 8.5.

## 9.6 Issues and Recommendations

Issues and recommendations for the Sites 9 and 23 groundwater remedy is in Section 8.6.

## 9.7 Protectiveness Statement

The protectiveness statement for the Sites 9 and 23 groundwater remedy is in Section 8.7.

## 10.0 SITES 10 AND 11 — ZONE 1, OPERABLE UNIT 4

OU 4, known as Lower Subbase, is a heavy industrial area of NSB NLON in which submarine docking, maintenance, repair, and overhaul are conducted. As shown on Figures 1-2 and 1-3 in Section 1, OU 4 consists of approximately 33 acres on the eastern bank of the Thames River that roughly extends from Pier 2 to Pier 33. This Five-Year Review includes four Lower Subbase zones (1, 3, 4, and 7) which were addressed under one ROD (NAVFAC August 2012).

OU 4 Zone 1 encompasses Site 10 (Fuel Storage Tanks and Tank 54-H) and Site 11 (Building 29 Power Plant Oil Tanks), which are included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Zone 1 is bound on the north by Building 89 and on the west by Albacore Road, beyond which is the Thames River. Figure 1-3 shows the location and layout of OU 4, Zone 1 and Figure 10-1 shows the site plan for Zone (Sites 10 and 11).

### 10.1 Site History and Background

Table A-8 in Appendix A summarizes the chronology of events at Zone 1.

### 10.2 Conceptual Site Model

Sources of COCs (CPAHs and metals) in soil include USTs and former fuel distribution lines, with utility lines acting as conduits for transport. Existing development (i.e., buildings, foundations, and pavement) prevent, limit, or minimize human and ecological exposures.

#### Zone 1 (Sites 10 and 11)

- Suspected sources of contamination:
  - Leaks of petroleum products from USTs and subsurface fuel oil distribution lines.

#### Site 10 (Fuel Storage Tanks and 54-H)

- Three 125,000-gallon USTs (E, F, and G) stored diesel fuel (1942-1987)
- Two 25,000-gallon USTs (K and L) stored lubrication and hydraulic oil (1954-1989)
- Reclamation Tank 54-H for USTs

#### Site 11 (Power Plant Oil Tanks)

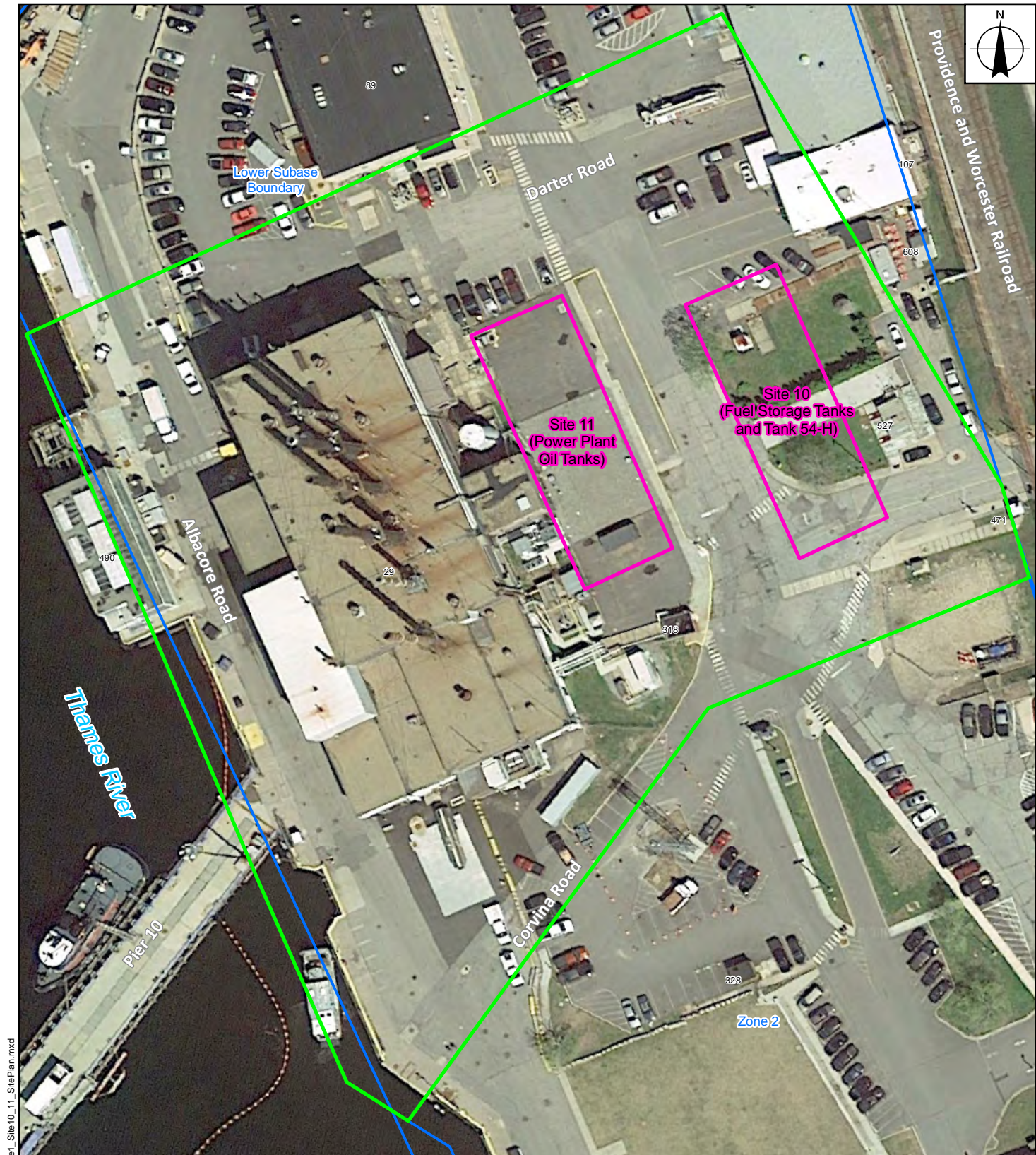
- Four 170,000-gallon USTs that stored No. 6 fuel oil (A and B), diesel oil (C), and bilge-water oil recovery system waste oil (D) from World War II to the mid-1980s.
- Waste oil Tank J (removed in 1943)
- Building 89 UST Z01 stored No. 2 fuel oil (1982-1994)
- Steam, condensate, and electrical lines which may have acted as conduits to transport chemicals.

- COCs: CPAHs and metals
- TPH above CTDEEP RSRs in soil and groundwater and a thin layer of light non-aqueous phase liquid is being addressed under a separate CTDEEP regulatory program because TPH is not regulated under CERCLA
- Remedy (OU 4 ROD signed August 2012)
  - NFA for sediment, groundwater, and surface water
  - LUCs for soil and LTM
    - LUC RD for soil (Draft Final)
    - GMP and O&M Manual (Pending)

#### Carcinogenic PAHs

- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- dibenzo(a,h)anthracene
- indeno(1,2,3-cd)pyrene





- Site Boundary
- Zone Boundary
- 245 Building Number

0 25 50 75 100 Feet

Note - All site boundaries are approximate.

Figure 10-1  
Zone 1, Sites 10 and 11 - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/17/2016

DRAWN BY: N. Rinehart

TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



## **10.2.1 Nature and Extent of Contamination**

### **10.2.1.1 Soil**

Leaks of petroleum products from USTs and fuel distribution lines resulted in release(s) of PAHs to soil. The area of highest PAH concentrations (defined as >1,000 micrograms per kilogram [µg/kg] benzo[a]pyrene equivalent [BaPEQ] concentrations) extends from east of Site 11 to the Thames River in the north half of Zone 1; the maximum BaPEQ concentrations in surface and subsurface soil were 7,955 µg/kg and 27,220 µg/kg, respectively. Lead was detected below the CTDEEP RSR Residential DEC and U.S. EPA Residential RSL (400 mg/kg). Mercury was detected in subsurface soil samples at a maximum of 83.4 mg/kg (NAVFAC August 2012).

#### **Zone 1 Physical Characteristics**

- The Thames River is the only potential ecological habitat because approximately 90 to 95 percent of Zone 1 is paved or covered by buildings; ecological receptors are limited to benthic invertebrates, fish, and other aquatic organisms, and piscivorous birds.
- The Lower Subbase is a high-security industrial area and the Navy has no plans to change the current land use of Zone 1.
- The Thames River near the Lower Subbase is restricted by physical boundaries installed by the Navy.
- CTDEEP has an existing ban on recreational shellfish harvesting from the Thames River near the Lower Subbase.
- All surface runoff within Zone 1 is captured by catch basins and directed to the Thames River by three storm sewer conveyance system outfalls.
- Depth to sediment in the Thames River adjacent to Lower Subbase is 16 to 40 feet.

Maximum concentrations of PAHs and lead in subsurface soil exceeded CTDEEP RSR PMC, suggesting the potential for migration from soil to groundwater. PAH concentrations that exceeded PMC ranged from 2,600 µg/kg to 40,000 µg/kg, depending on the specific PAH. Low concentrations of lead were detected in leachate analyzed using both toxicity characteristic leachate procedure (TCLP) and synthetic precipitation leaching procedure (SPLP) analyses.

### **10.2.1.2 Groundwater**

Groundwater sampling indicated that PAHs and lead had not migrated from soil to groundwater at significant concentrations, even though soil concentrations exceeded PMC. VOCs and SVOCs were detected infrequently and at trace to low concentrations in Zone 1 groundwater. Concentrations of arsenic, copper, and lead in Zone 1 groundwater were similar to NSB NLON background concentrations (NAVFAC August 2012).

The CTDEEP classified groundwater beneath the Lower Subbase as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is utilized.



### **10.2.2 Basis for Taking Action**

A response action was necessary because HHRAs (Tetra Tech January 1999, January 2012) identified unacceptable risks under hypothetical future land-use scenario for human receptors potentially exposed to PAHs and mercury in soil (NAVFAC August 2012). The HHRAs evaluated the following potential human receptors plausibly exposed to media at Zone 1: construction workers, full-time employees, and hypothetical residents (adults and children) (NAVFAC August 2012).<sup>1</sup>

ILCRs for exposure to soil by current and potential future industrial/commercial (I/C) receptors (construction workers and full-time employees) were within the U.S. EPA target risk range. The ILCR for hypothetical adult residents ( $1.0\text{E-}04$ ) was equal to the upper bound of the U.S. EPA target risk range. ILCRs for hypothetical child residents ( $7.0\text{E-}04$ ) and hypothetical lifetime residents ( $8.0\text{E-}04$ ) exceeded the U.S. EPA target risk range, and was due primarily to carcinogenic PAHs in surface/subsurface soil (NAVFAC August 2012). HIs for I/C receptors and hypothetical adult residents were less than or equal to 1; the calculated HI of 4 for hypothetical child residents exposed to surface/subsurface soil was primarily due to mercury.

Risks for hypothetical residents exposed to chemicals (benzene and ethylbenzene) that have volatilized from groundwater and migrated through building foundations into the indoor air of a structure were evaluated using U.S. EPA Johnson and Ettinger VI model. For hypothetical residents, the cumulative HI was less than 1 and the ILCR was within the U.S. EPA target risk range. HIs and ILCRs for industrial workers would also be expected to be within acceptable levels because these receptors would be exposed to VOCs in indoor air on a less frequent basis than residential receptors (NAVFAC August 2012).<sup>2</sup>

The ERA for Zone 1 surface water and sediment was conducted as part of the Phase II RI (B&RE March 1997) and was updated during the Lower Subbase RI (Tetra Tech January 1999) to further evaluate risks to benthic invertebrates exposed to Zone 1 sediment. Surface water and sediment in Zone 1 did not pose unacceptable risk to ecological receptors; soil was not a medium of concern for ecological receptors (NAVFAC August 2012).

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<sup>1</sup> The HHRA did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered.

<sup>2</sup> Only benzene and ethylbenzene were evaluated using the Johnson and Ettinger VI model; naphthalene is also present above screening criteria but was not modeled in the HHRA. See Section 2, Table 2-1 for additional details on supplemental VI evaluations.

### 10.3 Remedial Actions

The OU 4 ROD that included Zone 1 (Sites 10 and 11) was signed by the Navy on 16 August 2012 and by U.S. EPA Region 1 on 23 August 2012. Some components of the remedial action, such as LTM and LUCs, at OU 4 will be managed comprehensively with zone-specific plans and remedial design documents as discussed herein.

#### 10.3.1 Remedial Action Objectives

The RAOs for Sites 10 and 11 considering hypothetical future land use at NSB NLON are as follows:

- Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential preliminary RGs.<sup>3</sup>
- Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than preliminary RGs.
- Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.

#### 10.3.2 Remedial Goals

##### 10.3.2.1 Soil

To achieve the RAOs, human health cleanup goals were developed for each COC. COCs were identified based on CTDEEP Residential DEC (PAHs and mercury) and PMC (PAHs and lead). The FS Addendum established preliminary RGs under a residential scenario for those soil contaminants identified as CERCLA direct-exposure risk-based COCs through the quantitative HHRA. Table 10-1 summarizes RGs for Zone 1 COCs in soil.

Table 10-1 Remedial Goals — Residential Site Use — Zone 1 Contaminants of Concern				
Contaminant of Concern	Direct Exposure	Basis	Pollutant Mobility	Basis <sup>[1]</sup>
Benzo(a)anthracene	1 mg/kg	CTDEEP DEC RSR	4 mg/kg	Alternative PMC <sup>[2]</sup>
Benzo(a)pyrene	1 mg/kg	CTDEEP DEC RSR	6 mg/kg	Alternative PMC <sup>[2]</sup>
Benzo(b)fluoranthene	1 mg/kg	CTDEEP DEC RSR	2.6 mg/kg	Alternative PMC <sup>[2]</sup>
Benzo(k)fluoranthene	Not a COC	Not Applicable	6.5 mg/kg	Alternative PMC <sup>[2]</sup>
Chrysene	Not a COC	Not Applicable	6.8 mg/kg	Alternative PMC <sup>[2]</sup>
Dibenzo(a,h)anthracene	1 mg/kg	CTDEEP DEC RSR	5.1 mg/kg	Alternative PMC <sup>[2]</sup>
Indeno(1,2,3-cd)pyrene	1 mg/kg	CTDEEP DEC RSR	6 mg/kg	Alternative PMC <sup>[2]</sup>
Phenanthrene	Not a COC	Not Applicable	40 mg/kg	CTDEEP PMC RSR

<sup>3</sup> The term "preliminary RG" was established in the FS Addendum (Tetra Tech January 2012) and retained in the RAOs in the ROD (NAVFAC August 2012).

Table 10-1 Remedial Goals — Residential Site Use — Zone 1 Contaminants of Concern				
Contaminant of Concern	Direct Exposure	Basis	Pollutant Mobility	Basis <sup>[1]</sup>
Mercury	24 mg/kg	Hazard Index = 1 <sup>[3]</sup>	Not a COC	Not Applicable
Lead	Not a COC	Not Applicable	0.15 mg/L	CTDEEP PMC RSR

**Notes:**

- mg/kg = milligrams per kilogram  
 CTDEEP = Connecticut Department of Energy and Environmental Protection  
 DEC = Direct Exposure Criterion  
 RSR = Remediation Standard Regulation  
 PMC = Pollutant Mobility Criteria  
 COC = Contaminant of Concern  
 mg/L = milligrams per liter

<sup>[1]</sup> The higher of the CTDEEP PMC RSR and calculated Alternative PMC was used as the RG (NAVFAC August 2012)

<sup>[2]</sup> In areas with GB groundwater, and where no non-aqueous phase liquid is present, CTDEEP allows for calculation of site-specific Alternative PMC, which was determined assuming no pavement would be present to reduce infiltration (NAVFAC August 2012).

<sup>[3]</sup> Risk values based on Human Health Risk Assessment for future residents.

The FS Addendum estimated approximately 27,167 cubic yards of contaminated soil needs to be addressed to eliminate potentially unacceptable risk to residential receptors; Zone 1 does not contain any soil with concentrations of COCs that pose unacceptable human health risk under an I/C land-use scenario (NAVFAC August 2012).

### 10.3.2.2 Groundwater

No groundwater COCs were identified for Zone 1; therefore, no RGs were established (NAVFAC August 2012).

### 10.3.3 Remedy Selection

The remedy selected in the ROD includes the following components.

#### 10.3.3.1 Land Use Controls

- Institutional controls (creating an implementable 65,300-square-foot LUC boundary, encompassing the soil where Residential RGs were exceeded) through a LUC RD, with:
  - CERCLA risk-based engineering controls (building foundations and 48,000 square feet of pavement)<sup>4</sup>
  - Regular inspections and maintenance of building foundations and pavement

<sup>4</sup> CTDEEP RSRs require CERCLA risk-based engineering controls to be comprised of a minimum of 3 inches of bituminous concrete or concrete, or be an existing building or another existing permanent structure.

- The controls restricting residential use of Zone 1 will be maintained until the concentrations of contaminants in soil are less than or equal to levels that allow for UU/UE

#### **10.3.3.2 Long-Term Monitoring**

- Groundwater monitoring for all soil COCs that exceed Residential RGs to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater
- Includes regular inspections to ensure monitoring wells are maintained

#### **10.3.3.3 Five-Year Reviews**

- Performing five-year reviews because contamination will remain in place above levels that allow for UU/UE

### **10.3.4 Remedy Implementation**

#### **10.3.4.1 Land Use Controls**

SUBASENLONINST 5090.25 is the current instruction that restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without LUC RDs throughout NSB NLON (Navy April 2013). The OU 4 Soil LUC RD will be finalized and implemented after the remedial actions are completed at Zone 4.<sup>5</sup> Once finalized, the OU 4 Soil LUC RD will become the primary LUC document at Zone 1 (information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25).

The OU 4 Soil LUC RD at Zone 1 will establish specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy:

- Restricting residential land use and development
- Restricting disturbance of contaminated soil
- Maintaining a protective cover layer to provide CERCLA risk-based engineering controls (including features such as existing building foundations and pavement that already cover inaccessible or environmentally isolated soil)

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<sup>5</sup> A Draft Final OU 4 Soil LUC RD (Resolution Consultants February 2013) updated a Draft OU 4 Soil LUC RD (Resolution Consultants November 2012) issued within 90 days of ROD signature.



#### **10.3.4.2 Long-Term Monitoring**

A GMP will be developed after remedial actions are completed at Zone 4 and incorporated into the O&M Manual. The post-remedial action GMP and O&M Manual will document inspection and maintenance protocols for institutional and engineering controls (e.g., pavement and building structures), as required by LUCs. The LTM component of the selected remedy will also include annual confirmation of compliance with LUCs (e.g., preventing intrusive activities, changes in land use). Results of LTM (including groundwater monitoring for soil COCs) and annual LUC inspections will be provided to U.S. EPA Region 1 and CTDEEP.

### **10.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Sites 10 and 11.<sup>6</sup> The last five-year review recommended completion of the OU 4 (Lower Subbase) ROD to select a remedial action for Zone 1 (Sites 10 and 11) protective of human health and the environment, and continued enforcement of SOPA (ADMIN) NLONINST 5090.25 until selection and implementation of a final remedy (NAVFAC December 2011).

Since the last five-year review, the ROD was signed (August 2012) and SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Table A-8 in Appendix A summarizes information from documents generated that include Zone 1 (Sites 10 and 11), since the last five-year review and reviewed for this five-year review: Lower Subbase Soil and Groundwater Pre-Design Investigation (PDI) Completion Report and FS Addendum (Tetra Tech January 2012), Proposed Plan (NAVFAC March 2012), OU 4 ROD (NAVFAC August 2012), OU 4 Soil LUC RD (Resolution Consultants Draft November 2012, Draft Final February 2013), and SUBASENLONINST 5090.25 (Navy April 2013). Complete document references are in Section 14.

### **10.5 Technical Assessment**

#### **10.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

##### **10.5.1.1 Data Summary**

Monitoring data has not been generated at Zone 1 (Sites 10 and 11) since the ROD was signed. GMPs will be developed comprehensively for OU 4; the GMP for Zone 1 will be prepared after remedial actions at Zone 4 are complete.

##### **10.5.1.2 Land Use Control Status**

The OU 4 Soil LUC RD is pending finalization following completion of the remedial actions at Zone 4. In the interim, SUBASENLONINST 5090.25 (Navy April 2013) restricts ground surface disturbance of

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<sup>6</sup> Previous five-year reviews included OU 4 (Lower Subbase) sites for informational purposes only, as the ROD had not been signed.

soils and any subsurface disturbance of soils and groundwater at ER Program Sites without finalized LUC RDs throughout NSB NLON. As noted in Section 2.11.1, while SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.

#### **10.5.1.3 Operations and Maintenance Summary**

SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (e.g., existing building foundations and pavement). U.S. EPA's *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"* (OSWER Directive 9355.7-18) (U.S. EPA September 2011) identifies the need for clarity in long-term stewardship of LUCs (e.g., implementing, maintaining, and enforcing). Review of SUBASENLONINST 5090.25 indicated that no clear instructions for implementing, maintaining, or enforcing LUCs (e.g., inspection of pavement and building foundations) have been provided in the interim period until the final OU 4 Soil LUC RD is implemented. While informal inspections may be performed by NSB NLON personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed.

#### **10.5.1.4 Five-Year Review Site Visit Findings**

Building foundations and pavement that covered most of Zone 1 identified in the ROD remain in place. There has been no demolition or removal of buildings or pavement that act as CERCLA risk-based engineering controls to prevent exposure to underlying contaminated soil. Land use has not changed since the last five-year review.

#### **10.5.1.5 Technical Evaluation**

Table 10-2 summarizes the technical evaluation for Question A.

<b>Table 10-2</b> <b>Zone 1 (Sites 10 and 11) — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	<p>The Operable Unit (OU) 4 remedy is in progress, as follows.</p> <ul style="list-style-type: none"> <li>• Building foundations and approximately 48,000 square feet of pavement designated as Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls to meet residential remedial goals are in place.</li> <li>• Land Use Controls (LUCs) — The OU 4 Soil Land Use Control Remedial Design (LUC RD) will be finalized after remedial actions are completed at Zone 4. Until that time, Subase New London Instruction (SUBASENLONINST) 5090.25 is the functional LUC document for Zone 1. SUBASENLONINST 5090.25 has procedures to prevent unauthorized ground-disturbing activity and monitoring well abandonment.</li> <li>• Long-Term Monitoring — A Groundwater Monitoring Plan will be developed to ensure soil contaminants of concern do not migrate to groundwater after remedial actions are completed at Zone 4 and incorporated into the Operations and Maintenance Manual.</li> </ul>
Systems Operation/ Operations and Maintenance	<p>SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subase engineering controls (existing building foundations and pavement). While informal inspections may be performed by Naval Submarine Base New London personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed. As noted in Section 10.5.1.3, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.</p>
Opportunities for Optimization	<p>The long-term groundwater monitoring portion of the selected remedy at OU 4 has not been implemented so there have been no opportunities for optimization.</p>
Implementation of LUCs and Institutional/Engineering Controls	<p>SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at Environmental Restoration Program Sites without finalized LUC RDs throughout Naval Submarine Base New London. Engineering controls at Zone 1 (Sites 10 and 11) are existing building foundations and pavement present at the time of remedy selection. As noted in Section 10.5.1.3, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.</p> <p>While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.</p>
Early Indicators of Potential Remedy Problems	None

## **10.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

### **10.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Zone 1 (Sites 10 and 11) was summarized in Section 10.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect the protectiveness of the remedy are discussed below.

Unacceptable risks were identified in soil for human receptors under a hypothetical future residential land-use scenario. No unacceptable human health risks were identified for the current or reasonably anticipated future Residential or I/C scenarios for groundwater, surface water, or sediment (NAVFAC August 2012). Remedial actions in Zone 1 were due primarily to CPAHs in surface/subsurface soil; RGs were not identified for groundwater, which is classified GB (non-potable). Concern regarding migration of contaminants from soil to groundwater will be addressed via a GMP that will be developed and implemented to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater. No unacceptable ecological risks have been identified for Zone 1.

The VI evaluation for Zone 1 (Sites 10 and 11) (shown in Section 2.9 and Table 2-1) concluded that Draft Final OU 4 Soil LUC RD should be should be edited to require VI assessment and mitigation as necessary for any new building construction at these sites.

### 10.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 10-3.

<b>Table 10-3</b> <b>Zone 1 (Sites 10 and 11) — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	In June 2013, the Connecticut Department of Energy and Environmental Protection updated the 1996 Residential Direct Exposure Criteria Remediation Standard Regulation for lead in soil. Lead was not identified as a residential direct exposure contaminant of concern at Zone 1, and the Pollutant Mobility Criteria for lead has not changed. Therefore, this change does not affect cleanup goals or the protectiveness of the remedy.
Changes in Exposure Pathways	Although groundwater is not used for drinking water, volatilization via vapor intrusion (VI) was reassessed during this five-year review because of recent changes in guidance. See Table 2-1 for further details. VI is not expected to be an issue at this site; however, given naphthalene exceedances of industrial Vapor Intrusion Screening Levels, review of Subase New London Instruction (SUBASENLONINST) 5090.25 may be warranted to determine whether existing language is sufficient to require additional VI assessment and/or mitigation, prior to any future construction activities.
Changes in Land Use	There have been no changes in land use since the Operable Unit (OU) 4 Record of Decision (ROD) was signed. There are no plans to close the base or transfer ownership outside the Navy. Building foundations and pavement that cover Zone 1 and act as engineering controls to prevent exposure to contaminated soil have been maintained to ensure continued protection. SUBASENLONINST 5090.25 prevents land use changes without notification.
	During this five-year review, it was noted that although the human health risk assessment did not consider an unlimited use/unrestricted exposure scenario (e.g., potable use of groundwater), land use controls prohibiting groundwater use were not required in the OU 4 ROD. The need for future institutional controls to protect against the unlimited use/unrestricted exposure scenario should be evaluated further.



<b>Table 10-3</b> <b>Zone 1 (Sites 10 and 11) — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins are not probable constituents at Zone 1 based on site history and samples have not been collected for dioxin analysis.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Zone 1; however, a basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> — The contaminant 1,1,1-trichloroethane was detected in groundwater at Site 10, and its daughter compound 1,1-dichloroethane was detected in groundwater at Site 11. The stabilizer 1,4-dioxane is commonly associated with 1,1,1- trichloroethane. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane. The Navy will perform presence/absence sampling for 1,4-dioxane at Zone 1 (Sites 10 and 11) in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to dioxins, PFCs, or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	<p>No changes in toxicity values were found that would affect protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for volatile organic compounds, which may affect some sites where volatile organic compounds are a concern in groundwater if groundwater could be used as a potable source in the future. VI information was reviewed for Sites 10 and 11 as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.</p>
Expected Progress towards Meeting Remedial Action Objectives	<p>Certain components of the selected remedies for OU 4 zones and sites are being managed comprehensively. The Draft OU 4 Soil Land Use Control Remedial Design (LUC RD) was prepared in November 2012 in accordance with the ROD, which required development of a LUC RD within 90 days of ROD signature. The OU 4 Soil LUC RD (currently Draft Final) and Groundwater Monitoring Plan for Zone 1 will be finalized following completion of remedial actions at Zone 4.</p>

### 10.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

## 10.6 Issues and Recommendations

Issues and recommendations for Zone 1 (Sites 10 and 11) are identified in Table 10-4.

## 10.7 Protectiveness Statement

Remedial actions at OU 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at OU 4 Zone 1 (Sites 10 and 11) will be protective of human health and the environment upon completion. CERCLA risk-based engineering controls (existing building foundations and pavement) are in place, and LUCs and LTM



will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

Table 10-4								
Zone 1 (Sites 10 and 11) — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	Annual LUC inspections and certifications were not performed in accordance with the Draft Final OU 4 Soil LUC RD at Sites 10 and 11 in 2013, 2014, and 2015. SUBASENLONINST 5090.25 does not clearly define implementation, maintenance, and enforcement requirements for OU 4 engineering controls during the interim period prior to finalization of the OU 4 Soil LUC RD.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 4 Soil LUC RD at Site 10 and 11.	Navy	U.S. EPA, CTDEEP	31 March 2017	N	N	
2	Review of SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD identified the following: <ul style="list-style-type: none"><li>Additional clarity is required in the pending OU 4 Soil LUC RD to prevent potable use of groundwater.</li><li>SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD language do not consider the potential for vapor intrusion during the event of future construction scenarios at Zone 1.</li></ul>	Edit the pending OU 4 Soil LUC RD to include the following: <ul style="list-style-type: none"><li>Prohibit potable groundwater use.</li><li>Require VI assessment and mitigation as necessary for any new building construction at Zone 1.</li></ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
3	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
4	The contaminant 1,1,1-TCA was detected in groundwater at Site 10, and its daughter compound 1,1-dichloroethane was detected in groundwater at Site 11. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations at Zone 1 (Sites 10 and 11) did not include soil or groundwater analysis for 1,4-dioxane.	Perform presence/absence sampling for 1,4-dioxane at Zone 1 (Sites 10 and 11) in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	
5	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Sites 10 and 11; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	



**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

LUC	=	Land Use Control	LUC RD	=	Land Use Control Remedial Design
OU	=	Operable Unit	SUBASENLONINST	=	Subase New London Instruction
U.S. EPA	=	United States Environmental Protection Agency	CTDEEP	=	Connecticut Department of Energy and Environmental Protection
VOC	=	Volatile Organic Compound	TCA	=	Trichloroethane
PFC	=	Perfluorinated Compound			



## **11.0 SITE 17 — ZONE 3, OPERABLE UNIT 4**

OU 4, known as Lower Subbase, is a heavy industrial area of NSB NLON in which submarine docking, maintenance, repair, and overhaul are conducted. As shown on Figures 1-2 and 1-3 in Section 1, OU 4 consists of approximately 33 acres on the eastern bank of the Thames River that roughly extends from Pier 2 to Pier 33. This Five-Year Review includes four Lower Subbase zones (1, 3, 4, and 7) which were addressed under one ROD (NAVFAC August 2012).

OU 4 Zone 3 encompasses Site 17 (Former Building 31) and is included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Zone 3 is bound on the north by OU 4 Zone 2 and on the west by the Thames River. Figure 1-3 shows the location and layout of OU 4, Zone 3 and Figure 11-1 shows the site plan for Zone 3 (Site 17).

### **Zone 3 (Site 17) — Former Building 31**

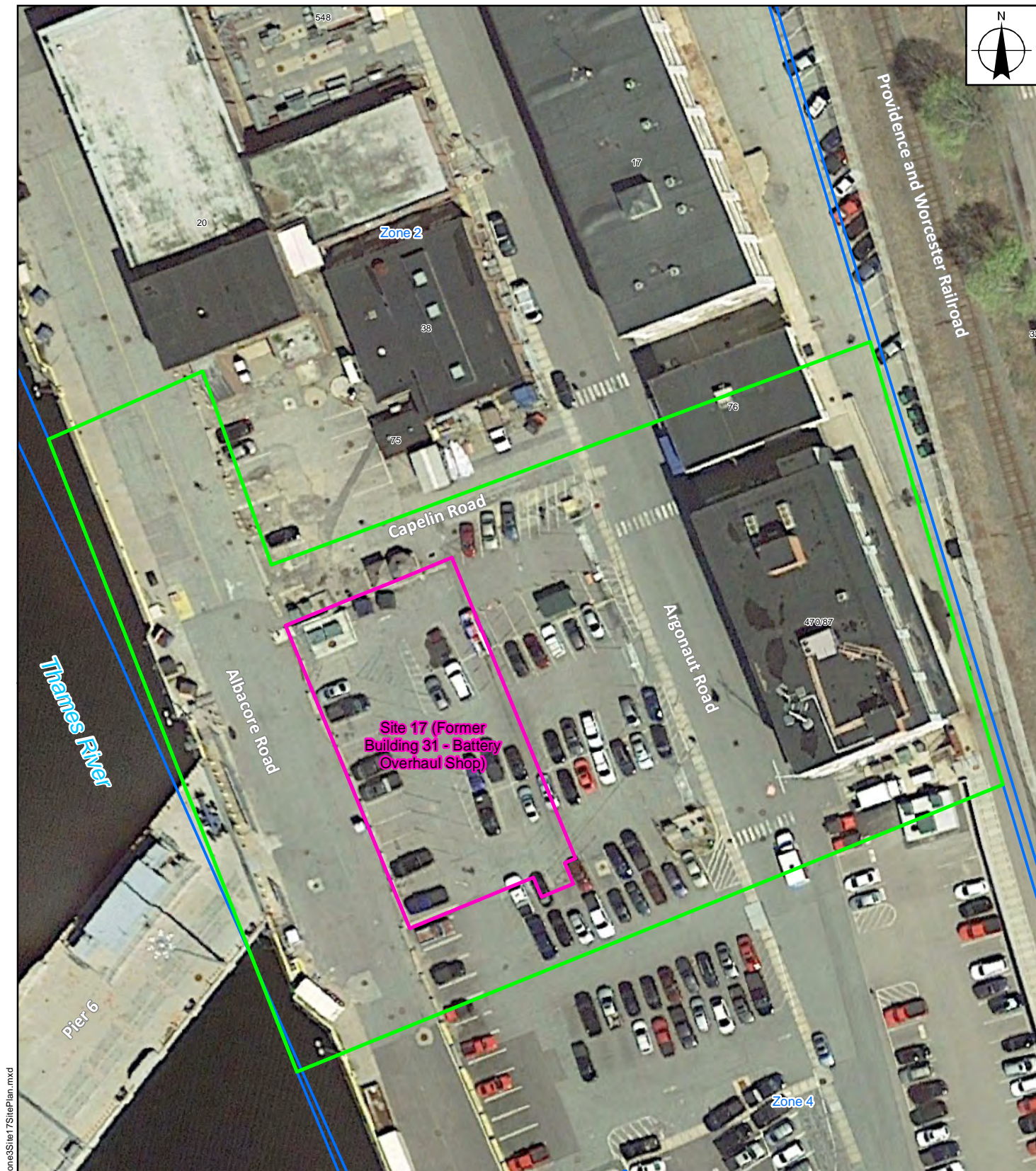
- Suspected sources of contamination:
  - Releases of lead from Former Battery Overhaul Shop
  - Leaks of petroleum products from USTs and fuel distribution lines
  - Steam, condensate, and electrical lines which may have acted as conduits to transport chemicals.
- COCs:
  - benzo(a)anthracene and lead
- Remedy (OU 4 ROD signed August 2012)
  - NFA for sediment, groundwater, and surface water
  - LUCs for soil and LTM
    - LUC RD (Draft Final)
    - GMP and O&M Manual (Pending)

## **11.1 Site History and Background**

Table A-9 in Appendix A summarizes the chronology of events at Zone 3 (Site 17).

## **11.2 Conceptual Site Model**

The Former Battery Overhaul Shop (Former Building 31) was constructed in 1917 and used as a battery shop (until the mid-1950s) and the main hazardous/flammable materials warehouse (1970s to late 1990s). Building 31 was demolished after a removal action in 1995; circa 1999 after the RI was completed. Battery overhaul was one of the largest operations conducted at NSB NLON prior to the advent of nuclear-powered submarines. Sources of COCs (benzo[a]anthracene and lead) include releases from the former battery overhaul shop operations and leaks of petroleum products from USTs and distribution lines, with utility lines acting as conduits for transport. Existing development (i.e., pavement, buildings, and foundations) prevent, limit, or minimize human and ecological exposures.



X:\Navy\New\_London\_Sub\_Base\FY2016\_Zone3Site17SitePlan.mxd

- Site Boundary
- Zone Boundary
- 245 Building Address Number

0 30 60  
Feet

Note - All site boundaries are approximate.

Figure 11-1  
Zone 3, Site 17 - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/17/2016

DRAWN BY: N. Rinehart

TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



## **11.2.1 Nature and Extent of Contamination**

### **11.2.1.1 Soil**

The area of highest PAH concentrations in soil (defined as >1,000 µg/kg BaPEQ concentrations) was in the western portion of Zone 3; the maximum BaPEQ concentrations in surface and subsurface soil were 1,776 µg/kg and 1,714 µg/kg, respectively (NAVFAC August 2012). Maximum concentrations of PAHs in subsurface soil (ranging from 2,600 µg/kg to 40,000 µg/kg depending on the specific PAH) exceeded CTDEEP RSR PMC, suggesting the potential for migration from soil to groundwater.

Lead is present at concentrations exceeding U.S. EPA and OSWER screening levels and the CTDEEP RSR for I/C DEC in both surface and subsurface soil in the southwestern portion of Zone 3 (NAVFAC August 2012).

#### **Zone 3 Physical Characteristics**

- The Thames River is the only potential ecological habitat because approximately 90 to 95 percent of Zone 3 is paved or covered by buildings; ecological receptors are limited to benthic invertebrates, fish, and other aquatic organisms, and piscivorous birds.
- The Lower Subase is a high-security industrial area and the Navy has no plans to change the current land use of Zone 3.
- The Thames River near the Lower Subase is restricted by physical boundaries installed by the Navy.
- CTDEEP has an existing ban on recreational shellfish harvesting from the Thames River near the Lower Subase.
- Groundwater flow is generally west toward the Thames River during low and high tides; tidal influence is restricted to monitoring wells along the Thames River (MW1-3RI and MW2-3RI).
- All surface runoff within Zone 3 is captured by catch basins and directed to the Thames River by two storm sewers along Capelin Road.
- Depth to sediment in the Thames River adjacent to Lower Subase is 16 to 40 feet.

A TCRA conducted in 1995 involved soil excavation and (1) stabilization and replacement or (2) offsite disposal. The remedial action thresholds were 500 mg/kg of total lead (the CTDEEP RSR for Residential DEC at that time) and/or 5.0 mg/L TCLP extracted lead.

Soil beneath most of former Building 31 was excavated, stabilized by solidification, and replaced. This portion of the TCRA reduced the leachability of lead in treated soil; residual lead remains onsite, encapsulated within the stabilized soil (NAVFAC August 2012). During the TCRA, soil was also excavated from three areas adjacent to Building 31 above the mean high water table and replaced with clean backfill. Residual soil contamination above remedial action thresholds remains below the water table in one of the three removal areas (NAVFAC August 2012).

Soil contributing to the soil-to-groundwater migration pathway included: soil not included in the TCRA in the vicinity of former Building 31, which contains elevated concentrations of total and leachable lead; some Zone 3 soil not included in the TCRA is leachable; and maximum concentrations of lead in subsurface soil that exceeds CTDEEP RSR PMC.

#### **11.2.1.2 Groundwater**

Although TCLP and SPLP analysis and total contaminant concentrations in soil exceed CTDEEP RSR PMC, groundwater sampling indicated that PAHs and lead have not migrated at concentrations that exceed direct contact, risk-based preliminary RGs (NAVFAC 2012). The CTDEEP classified groundwater beneath the Lower Subbase as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is utilized.

#### **11.2.2 Basis for Taking Action**

A response action was necessary because HHRAs (Tetra Tech January 1999, January 2012) identified unacceptable acute toxicity risks under current and hypothetical future land use scenarios for human receptors potentially exposed to lead in soil (NAVFAC August 2012). No unacceptable human health risks were identified for the current or reasonably anticipated future Residential or I/C scenarios for groundwater, surface water, or sediment.

The HHRAs evaluated the following potential human receptors plausibly exposed to media at Zone 3: current and future construction workers and full-time employees, and hypothetical residents (adults and children). No cancer risks or noncarcinogenic hazards were identified for current or potential future human receptors; HIs were less than or equal to 1 and ILCRs were less than or within the U.S. EPA target risk range and less than CTDEEP acceptable cumulative exposure levels (NAVFAC August 2012).

Lead was identified as a contaminant of potential concern (COPC) in surface and subsurface soil at Zone 3. Potential exposure risks by current and future full-time employees and construction workers, and hypothetical future residents were evaluated using lead models. Exposures to the hypothetical child, construction workers, and full-time employee (with the fetus of a pregnant worker as the receptor of concern) were performed using either the IEUBK or the U.S. EPA Adult Lead Model. Both analyses indicated risks were less than U.S. EPA blood lead goals. However, although both lead models showed that predicted concentrations of lead were within U.S. EPA acceptable levels, lead concentrations in localized areas of Zone 3 surface soil (0 to 2 feet below paved areas) and subsurface soil (2 to 10 feet bgs) exceeded the CTDEEP I/C and Residential DEC RSRs and OSWER screening level. The acute toxicity risks associated with lead prompted selection of a remedial action.



Concentrations of benzo(a)anthracene, benzo(b)fluoranthene, chrysene, and TPH in subsurface soil exceeded the CTDEEP RSR PMC; however, the HHRA determined there were no groundwater volatilization COPCs and identified no groundwater COCs for Zone 3.<sup>1</sup>

The ERA for Zone 3 surface water and sediment was conducted as part of the Phase II RI (B&RE March 1997) and was updated during the Lower Subbase RI (Tetra Tech January 1999) to further evaluate risks to benthic invertebrates exposed to Zone 3 sediment. Surface water and sediment in Zone 3 did not pose unacceptable risks to ecological receptors; soil was not a medium of concern for ecological receptors (NAVFAC August 2012).

### **11.3 Remedial Actions**

The OU 4 ROD that included Zone 3 (Site 17) was signed by the Navy on 16 August 2012 and by U.S. EPA Region 1 on 23 August 2012. Some components of the remedial action, such as LTM and LUCs, at OU 4 will be managed comprehensively with zone-specific plans and remedial design documents as discussed herein.

#### **11.3.1 Remedial Action Objectives**

Table 11-1 lists the RAOs developed for Zone 3 (Site 17) under the land use scenarios with unacceptable risks in soil for human receptors identified in the ROD.

<b>Table 11-1 Remedial Action Objectives — Zone 3 (Site 17)</b>	
<b>Current Land Use</b>	<b>Hypothetical Future Land Use</b>
Prevent exposure of current and future full-time employees and construction workers to surface/subsurface soil containing concentrations of contaminants of concern (COCs) greater than Industrial/Commercial remedial goals (RGs).	Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than Residential RGs.
Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than RGs.	Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than RGs.
Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.	Prevent migration of surface subsurface soil COCs as a result of erosion and sedimentation.

<sup>1</sup> The HHRA did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered.

## 11.3.2 Remedial Goals

### 11.3.2.1 Soil

To achieve the RAOs, human health RGs were developed for each COC. COCs were identified based on Residential DEC (benzo[a]anthracene and lead) and PMC (lead). Table 11-2 summarizes RGs established for Zone 3 COCs in soil.

Table 11-2 Remedial Goals — Zone 3 Contaminants of Concern — Soil				
Contaminant of Concern	Selected RG — Human Health (mg/kg)	Basis	Selected RG — PMC (mg/L)	Basis
<b>Residential Scenario</b>				
Benzo(a)anthracene	1	CTDEEP DEC RSR	Not Applicable	Not Applicable
Lead	400	CTDEEP DEC RSR	0.15	CTDEEP PMC RSR
<b>Industrial/Commercial Scenario</b>				
Lead	1,090 <sup>[1]</sup>	Target Action Level	0.47 <sup>[2]</sup>	Alternative PMC

**Notes:**

- RG = remedial goal
- mg/kg = milligrams per kilogram
- mg/L = milligrams per liter
- CTDEEP = Connecticut Department of Energy and Environmental Protection
- DEC = Direct Exposure Criterion
- RSR = Remediation Standard Regulations
- PMC = Pollutant Mobility Criteria

<sup>[1]</sup> OSWER Target Action Level calculated based on the estimated concentration of lead in the blood of a worker.

<sup>[2]</sup> Alternative PMC calculated based on the presence of pavement to reduce infiltration, as allowed by CTDEEP for areas with GB groundwater where no non-aqueous phase liquid is present (NAVFAC August 2012).

Concentrations of lead in some areas of Zone 3 are an order of magnitude higher than the U.S. EPA RSL and CTDEEP RSR for Residential DEC (400 mg/kg) and several times higher than the preliminary RG (1,090 mg/kg).<sup>2</sup> The FS Addendum estimated 8,304 and 750 cubic yards of soil would need to be addressed to eliminate potentially unacceptable risk to Residential and I/C receptors, respectively (NAVFAC August 2012). The volume of contaminated soil with lead exceeding I/C DEC or PMC RGs consist of 610 cubic yards (240 cubic yards of which are surface soil and 370 cubic yards are subsurface soil), and the estimated mass of lead that exceeds I/C RGs is 5,120 pounds (Tetra Tech January 2012).

### 11.3.2.2 Groundwater

No groundwater COCs were identified for Zone 3; therefore, no RGs were established (NAVFAC August 2012).

<sup>2</sup> The term "preliminary RG" was established in the FS Addendum (Tetra Tech January 2012) and retained in the RAOs in the ROD (NAVFAC August 2012).

### **11.3.3 Remedy Selection**

The remedy selected in the ROD includes the following components.

#### **11.3.3.1 Land Use Controls**

- Institutional controls (creating an implementable 60,900-square-foot LUC boundary, encompassing soil where Residential RGs were exceeded) through a LUC RD with:
  - CTDEEP RSR engineered controls (6,200 square feet of pavement) to meet I/C RGs<sup>3,4</sup>
  - CERCLA risk-based engineering controls (existing building foundations and 46,600 square feet of pavement) to meet Residential RGs<sup>5</sup>
  - Regular inspections and maintenance of building foundations and pavement
- The controls restricting residential use of Zone 3 will be maintained until the concentrations of contaminants in soil are less than or equal to levels that allow for UU/UE

#### **11.3.3.2 Long-Term Monitoring**

- Groundwater monitoring for all soil COCs that exceed Residential RGs to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater
- Includes regular inspections to ensure monitoring wells are maintained

#### **11.3.3.3 Five-Year Reviews**

- Performing five-year reviews because contamination will remain in place above levels that allow for UU/UE

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<sup>3</sup> Under I/C site use, CTDEEP RSRs allow low permeability pavement to be a CTDEEP RSR engineered control, which is required in an area classified as I/C site use when concentrations of COCs are greater than the I/C DEC in the top 2 feet of soil beneath paved areas and/or where COCs are greater than the Alternative GB PMC RGs for I/C site use in soil above the water table.

<sup>4</sup> CTDEEP RSRs require CERCLA risk-based engineering controls to be comprised of a minimum of 3 inches of bituminous concrete or concrete, or be an existing building or another existing permanent structure.

<sup>5</sup> Soil beneath former Building 31 contains concentrations of COCs that exceed I/C RGs; however, this soil is considered inaccessible under CTDEEP RSRs (NAVFAC August 2012). Under the I/C site use, CTDEEP RSR standards classify contaminated soil as inaccessible if it is unpaved and more than 4 feet bgs, more than 2 feet below a paved surface comprising a minimum of 3 inches of bituminous concrete or concrete, or beneath an existing building or another existing permanent structure (NAVFAC August 2012).

### **11.3.4 Remedy Implementation**

#### **11.3.4.1 Land Use Controls**

SUBASENLONINST 5090.25 is the current instruction that restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without LUC RDs throughout NSB NLON (Navy April 2013). The OU 4 Soil LUC RD will be finalized and implemented after the remedial actions are completed at Zone 4.<sup>6</sup> Once finalized, the OU 4 Soil LUC RD will become the primary LUC document at Zone 3 (information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25).

The OU 4 Soil LUC RD at Zone 3 will establish specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy:

- Restricting residential land use and development
- Restricting disturbance of contaminated soil
- Maintaining a protective cover layer to provide CERCLA risk-based engineering controls (including features such as existing building foundations and pavement that already cover inaccessible or environmentally isolated soil) and CTDEEP engineered controls (including pavement that already covers soil with concentrations of COCs greater than CTDEEP I/C DEC and PMC RGs)

#### **11.3.4.2 Long-Term Monitoring**

A GMP will be developed after remedial actions are completed at Zone 4 and incorporated into the O&M Manual (Resolution Consultants October 2013). The post-remedial action GMP and O&M Manual will document inspection and maintenance protocols for institutional and engineering controls (e.g., pavement and building structures), as required by LUCs. The LTM component of the selected remedy will also include annual confirmation of compliance with LUCs (e.g., preventing intrusive activities, changes in land use). Results of LTM (including groundwater monitoring for soil COCs) and annual LUC inspections will be provided to U.S. EPA Region 1 and CTDEEP.

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<sup>6</sup> A Draft Final OU 4 Soil LUC RD (Resolution Consultants February 2013) updated a Draft OU 4 Soil LUC RD (Resolution Consultants November 2012) issued within 90 days of ROD signature.



## **11.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Site 17.<sup>7</sup> The last five-year review recommended completion of the OU 4 (Lower Subbase) ROD to select a remedial action for Site 17 (Zone 3) protective of human health and the environment, and continued enforcement of SOPA (ADMIN) NLONINST 5090.25 until selection and implementation of a final remedy (NAVFAC December 2011).

Since the last five-year review, the ROD was signed (August 2012) and SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Table A-9 in Appendix A summarizes information from documents generated that include Zone 3 (Site 17) since the last five-year review and reviewed for this five-year review: Lower Subbase Soil and Groundwater PDI Completion Report and FS Addendum (Tetra Tech January 2012), Proposed Plan (NAVFAC March 2012), OU 4 ROD (NAVFAC August 2012), OU 4 Soil LUC RD (Resolution Consultants Draft November 2012, Draft Final February 2013), and SUBASENLONINST 5090.25 (Navy April 2013). Complete document references are in Section 14.

## **11.5 Technical Assessment**

### **11.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

#### **11.5.1.1 Data Summary**

Monitoring data has not been generated at Zone 3 (Site 17) since the ROD was signed. GMPs will be developed comprehensively for OU 4; the GMP for Zone 3 will be prepared after remedial actions at Zone 4 are complete.

#### **11.5.1.2 Land Use Control Status**

The OU 4 Soil LUC RD is pending finalization following completion of the remedial actions at Zone 4. In the interim, SUBASENLONINST 5090.25 (Navy April 2013) restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without finalized LUC RDs throughout NSB NLON. As noted in Section 2.11.1, while SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.

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<sup>7</sup> Previous five-year reviews included OU 4 (Lower Subbase) for informational purposes only, as the ROD had not been signed.

### 11.5.1.3 Operations and Maintenance Summary

SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (e.g., existing building foundations and pavement). U.S. EPA's *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"* (OSWER Directive 9355.7-18) (U.S. EPA September 2011) identifies the need for clarity in long-term stewardship of LUCs (e.g., implementing, maintaining, and enforcing). Review of SUBASENLONINST 5090.25 indicated that no clear instructions for implementing, maintaining, or enforcing LUCs (e.g., inspection of pavement and building foundations) have been provided in the interim period until the final OU 4 Soil LUC RD is implemented. While informal inspections may be performed by NSB NLON personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed.

### 11.5.1.4 Five-Year Review Site Visit Findings

Building foundations and pavement that covered most of Zone 3 identified in the ROD remain in place. There has been no demolition or removal of buildings or pavement that act as CERCLA risk-based engineering controls or CTDEEP RSR engineered controls to prevent exposure to underlying contaminated soil. Land use has not changed since the last five-year review.

### 11.5.1.5 Technical Evaluation

Table 11-3 summarizes the technical evaluation for Question A.

Table 11-3 Zone 3 (Site 17) — Technical Evaluation — Question A	
Question	Summary
Remedial Action Performance	<p>The Operable Unit (OU) 4 remedy is in progress, as follows.</p> <ul style="list-style-type: none"> <li>• Building foundations and approximately 46,600 square feet of pavement designated as Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls to meet Residential remedial goals are in place.</li> <li>• 6,200 square feet of pavement designated as Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations engineered controls to meet Industrial/Commercial remedial goals are in place.</li> <li>• Land Use Controls (LUCs) — The OU 4 Soil Land Use Control Remedial Design (LUC RD) will be finalized after remedial actions are completed at Zone 4. Until that time, Subbase New London Instruction (SUBASENLONINST) 5090.25 is the functional LUC document for Zone 3. SUBASENLONINST 5090.25 has procedures to prevent unauthorized ground-disturbing activity and monitoring well abandonment.</li> <li>• Long-Term Monitoring — A Groundwater Monitoring Plan will be developed after remedial actions are completed at Zone 4 and incorporated into the Operations and Maintenance Manual.</li> </ul>

<b>Table 11-3</b> <b>Zone 3 (Site 17) — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Systems Operation/ Operations and Maintenance	SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (existing building foundations and pavement). While informal inspections may be performed by Naval Submarine Base New London personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed. As noted in Section 11.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement, etc.) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.
Opportunities for Optimization	The long-term groundwater monitoring portion of the selected remedy at OU 4 has not been implemented so there have been no opportunities for optimization.
Implementation of LUCs and Institutional/Engineering Controls	<p>SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at Environmental Restoration Program sites without finalized LUC RDs throughout Naval Submarine Base New London. Engineering and engineered controls at Zone 3 (Site 17) are existing building foundations and pavement present at the time of remedy selection. As noted in Section 11.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement, etc.) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.</p> <p>While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.</p>
Early Indicators of Potential Remedy Problems	None

## **11.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

### **11.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Zone 3 (Site 17) was summarized in Section 11.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect protectiveness of the remedy are discussed below.

Unacceptable risks were identified in soil for human receptors under current and hypothetical future residential land-use scenarios. No unacceptable human health risks were identified for the current or reasonably anticipated future Residential or I/C scenarios for groundwater, surface water, or sediment (NAVFAC August 2012). Remedial actions in Zone 3 were primarily due to lead in surface/subsurface soil; RGs were not identified for groundwater, which is classified GB (non-potable). Concern regarding migration of contaminants from soil to groundwater will be addressed via a GMP that will be developed and implemented to confirm that the remedy remains

protective and that soil contaminants are not migrating to groundwater. No unacceptable ecological risks have been identified for Zone 3.

### 11.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 11-4.

<b>Table 11-4</b> <b>Zone 3 (Site 17) — Technical Evaluation, Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	In June 2013, the Connecticut Department of Energy and Environmental Protection updated the 1996 Residential Direct Exposure Criteria Remediation Standard Regulation for lead in soil. The updated Direct Exposure Criteria Remediation Standard Regulation for lead is the same as the Remedial Goal for lead in the Record of Decision (ROD), so this change does not affect the cleanup goals or the protectiveness of the remedy.
Changes in Exposure Pathways	Lead and benzo(a)pyrene were the primary contaminants of concern at this site; therefore, vapor intrusion is not a pathway of concern.
Changes in Land Use	<p>There have been no changes in land use since the Operable Unit (OU) 4 ROD was signed. There are no plans to close the base or transfer ownership outside the Navy. Subase New London Instruction (SUBASENLONINST) 5090.25 prevents land use changes without notification. The Building 31 foundation and pavement that cover Zone 3 and act as engineering controls to prevent exposure to contaminated soil have been maintained to ensure continued protection.</p> <p>During this five-year review, it was noted that although the human health risk assessment did not consider an unlimited use/unrestricted exposure scenario (e.g., potable use of groundwater), land use controls prohibiting groundwater use were not required in the OU 4 ROD. The need for future institutional controls to protect against the unlimited use/unrestricted exposure scenario should be evaluated further.</p>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> – Dioxins are not probable constituents at Zone 3 based on site history and samples have not been collected for dioxin analysis.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Zone 3; however, a basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> – The contaminant 1,1,1-trichloroethane or its daughter products were not detected in soil or groundwater at Site 17 and previous investigations did not include soil or groundwater analysis for 1,4-dioxane.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. No volatile compounds are present in Zone 3.
Expected Progress towards Meeting Remedial Action Objectives	Some components of the selected remedies for OU 4 zones and sites are being managed comprehensively. The Draft OU 4 Soil Land Use Control Remedial Design (LUC RD) for soil was prepared in November 2012 in accordance with the ROD, which required development of a LUC RD within 90 days of ROD signature. The Soil LUC RD (currently Draft Final) and Groundwater Monitoring Plan for Zone 3 will be finalized following completion of remedial actions at Zone 4.



**11.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No other information has come to light that could call into question the protectiveness of the remedy.

**11.6 Issues and Recommendations**

Issues and recommendations for Zone 3 (Site 17) are identified in Table 11-5.

**11.7 Protectiveness Statement**

Remedial actions at OU 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at OU 4, Zone 3 (Site 17) will be protective of human health and the environment upon completion. CERCLA risk-based engineering controls (existing building foundations and pavement) and CTDEEP RSR engineered controls (pavement installed as a component of the remedy) are in place, and LUCs and LTM will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

Table 11-5								
Zone 3 (Site 17) — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	Annual LUC inspections and certifications were not performed in accordance with the Draft Final OU 4 Soil LUC RD at Site 17 in 2013, 2014, and 2015. SUBASENLONINST 5090.25 does not clearly define implementation, maintenance, and enforcement requirements for OU 4 engineering controls during the interim period prior to finalization of the OU 4 Soil LUC RD.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 4 Soil LUC RD at Site 17.	Navy	U.S. EPA, CTDEEP	31 March 2017	N	N	
2	Review of the Draft Final OU 4 Soil LUC RD identified that additional clarity is required to prevent potable use of groundwater.	When the OU 4 Soil LUC RD is finalized, include language that explicitly prohibits potable use of groundwater.	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
3	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
4	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 17; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

LUC = Land Use Control

OU = Operable Unit

U.S. EPA = United States Environmental Protection Agency

VOC = Volatile Organic Compound

LUC RD = Land Use Control Remedial Design

SUBASENLONINST = Subbase New London Instruction

CTDEEP = Connecticut Department of Energy and Environmental Protection

PFC = Perfluorinated Compound

## **12.0 SITES 13 AND 19 — ZONE 4 AND OUTER PIER 1, OPERABLE UNIT 4**

OU 4, known as Lower Subase, is a heavy industrial area of NSB NLON in which submarine docking, maintenance, repair, and overhaul are conducted. As shown on Figures 1-2 and 1-3 in Section 1, OU 4 consists of approximately 33 acres on the eastern bank of the Thames River that roughly extends from Pier 2 to Pier 33. This Five-Year Review includes four Lower Subase zones (1, 3, 4, and 7) which were addressed under one ROD (NAVFAC August 2012).

OU 4 Zone 4 includes Sites 13 and 19, the Thames River between Piers 2 and 6, and the Quay Wall Study Area. Zone 4 is bordered on the north by OU 4 Zone 3 and on the west by the Thames River. Outer Pier 1 is at the south end of Lower Subase, and includes the middle and south end of former Pier 1 and the adjoining Thames River sediment; former Pier 1 was subdivided into two subareas (Inner and Outer) based on contaminant distribution. Zone 4 and Outer Pier 1 are separated by Building 110, Building 564, and the remnants of Inner Pier 1.

Zone 4 and Outer Pier 1 are included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 1-3 shows the location and layout of OU 4, Zone 4 and Figure 12-1 shows the site plan for Zone 4 (Sites 13 and 19) and Outer Pier 1.

### **Zone 4 Soil**

- Suspected sources of contamination:
  - Releases of petroleum, waste oil, and solvents from the former waste oil pit at former Building 79 (Site 13)
  - Releases of lead from the Former Battery Overhaul Shop (Zone 3)
  - Releases of solvents stored in former Building 316 (Site 19)
  - Leaks of petroleum products from USTs and fuel distribution lines
  - Steam, condensate, and electrical lines which may have acted as conduits to transport chemicals.
- COCs:
  - PAHs and lead
- Soil Remedy (OU 4 ROD signed August 2012)
  - Excavation (Ongoing)
  - CERCLA Risk-Based Engineering Controls (In place)
  - LUCs and LTM
    - LUC RD (Draft Final)
    - GMP and O&M Manual (Pending)

### **Zone 4 (Thames River) and Outer Pier 1 Sediment**

- Suspected Sources:
  - Releases from Zone 4 and Lower Subase
  - Former Pier 1 marine railway activities (sandblasting, paint scraping, and ship maintenance)
  - Releases from Building 79 waste pit discharge
- COCs: metals, PAHs, pesticides, and PCBs
- Sediment Remedy (OU 4 ROD signed August 2012)
  - Zone 4 Dredging (Pending)
  - Outer Pier 1 Engineering Controls (Pending)
  - LUCs and LTM
    - LUC RD (Draft Final)
    - O&M Manual (Pending)

## **12.1 Site History and Background**

Table A-10 in Appendix A summarizes the chronology of events at Zone 4 and Outer Pier 1.





# LEGEND

- SITE BOUNDARY
- ZONE BOUNDARY
- 245 BUILDING NUMBER

0 100 200  
Feet

Note - All site boundaries are approximate.

Figure 12-1  
Zone 4, Site 13, Site 19, and  
Outer Pier 1 - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark

DATE: 11/17/2016

DRAWN BY: B. Austin

TASK ORDER NUMBER: WE61

Data Sources: ArcGIS Online Imagery Basemap



## **12.2 Conceptual Site Model**

PAHs and lead were detected in soil and sediment at concentrations exceeding Residential and I/C RSRs, as described below. Existing development (i.e., buildings, foundations, and pavement) prevent, limit, or minimize human and ecological exposures.

### **12.2.1 Soil**

The sources of contamination in Zone 4 soil were:

- Releases of petroleum, waste oil, and solvents from Site 13 (former Building 79 waste oil pit into which waste oil and solvents from diesel engine repair were drained) and Site 19 (Building 316 in which various equipment-cleaning solvents were stored).<sup>1</sup>
- Releases of lead from the Former Battery Overhaul Shop (Zone 3).
- Layers of petroleum contamination in soil above a wooden platform (pier) and Quay Wall constructed in 1940 and underlie Albacore Road in the west part of Zone 4.<sup>2</sup>
- Leaks of petroleum products from fuel distribution lines, with possible secondary transport by steam, condensate, and electrical utility lines throughout Zone 4.

### **12.2.2 Sediment**

Storm sewer outfalls discharge runoff from industrial areas within Lower Subase to the Thames River. Ship maintenance activities (e.g., sandblasting, paint scraping, and ship maintenance) at the former Pier 1 marine railway also caused releases of metals, PAHs, and PCBs to sediment in the Thames River at former Pier 1. Releases from these sources and other sources throughout Lower Subase, including releases from the Building 79 waste pit discharge, may have contributed to contamination in Thames River sediment in Zone 4 and Outer Pier 1 (NAVFAC August 2012). Phase 1 of a NTCRA completed in March 2010 removed most of the contaminated sediment at Inner Pier 1 through mechanical dredging; the remaining contamination was removed using hydraulic dredging in spring 2012 during Phase 2.<sup>3</sup>

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<sup>1</sup> The pit was filled with concrete by 1987 and Building 79 was demolished between 2011 and 2012. The building foundation remains and the surrounding area was paved for parking.

<sup>2</sup> A two-phase removal action was completed to address petroleum contamination, and a storm water pipe leading to the outfall was abandoned and plugged in December 1994. Free product recovery wells installed at the same time ultimately recovered 18,300 gallons of oily wastewater.

<sup>3</sup> A small area of contaminated sediment that comprises the Outer Pier 1 portion included with Zone 4 not included in the NTCRA was subsequently evaluated in the Lower Subase FS and FS Addendum.

### **12.2.3 Nature and Extent of Contamination**

#### **12.2.3.1 Soil**

PAHs were detected in surface and subsurface (to 15 feet bgs) soil below CTDEEP RSRs across most of Zone 4, except for a small area outside the southwest corner of Building 85, where concentrations exceeded the 1,000 µg/kg BaPEQ. The maximum concentration of PAHs (BaPEQ) in soil was 7,120 µg/kg.

Lead was detected in surface and subsurface soil (to 15 feet bgs) above the CTDEEP Residential DEC RSR in the central and northwest portions of Zone 4, including soil along the Thames River.

Within that footprint are areas of lead concentrations that also exceed the CTDEEP I/C DEC RSR (surface soil maximum 10,600 mg/kg; subsurface soil maximum 8,240 mg/kg). Lead leachate tests results were high, which suggested the potential for migration from soil to groundwater, but lead detections in Zone 4 groundwater during the PDI/FS Addendum indicated lead has not migrated to groundwater above regulatory criteria (NAVFAC August 2012).

A small area in the northwest portion of Zone 4 with lead contamination commingled with high concentrations (defined as greater than 500 mg/kg) of TPH will be addressed under CERCLA; areas where TPH is elevated but lead is absent, TPH will be addressed under CTDEEP petroleum regulations (NAVFAC August 2012).

#### **Physical Characteristics**

##### **Zone 4**

- The Zone 4 ground surface is entirely paved or covered by buildings.
- Groundwater flow is generally west towards the Thames River during low tide; monitoring wells along Albacore Road are influenced by diurnal tides.
- Surface runoff within Zone 4 and portions of Zone 3 is collected in catch basins and directed to the Thames River by storm sewers. These storm sewers discharge directly to the Thames River from Zone 4 via catch basins and outfalls.
- The Lower Subase is a high-security industrial area and the Navy has no plans to change the current use of the site.

##### **Outer Pier 1**

- Outer Pier 1 has a natural bedrock shoreline on the east side and open water of the Thames River on the west side.
- Sediment thickness, as well as water depth, increases with distance from the shoreline and Inner Pier 1.
- The Thames River adjacent to Lower Subase is owned by the State of Connecticut but access is controlled by the Navy.

#### **12.2.3.2 Sediment**

Metals, PAHs, pesticides, and PCBs were detected at elevated concentrations in Zone 4 sediment. Ecological effects of those contaminants were calculated using Total Effects Range Median-Quotient (ERM-Q); total PCBs were also evaluated separately. Sediment preliminary RGs and COPCs identified through the Baseline ERA include an ERM-Q of 1.17 and PCB congener of 1 mg/kg (Tetra Tech January 2012); details of the Baseline ERA are in Section 12.2.2.

- Eight surface and 10 subsurface samples had ERM-Qs above 1.17, with maximum sediment ERM-Qs of 2.7 (surface) and 2.8 (subsurface). One sediment sample location in the area of Outer Pier 1 (which was not included in the NTCRA) had elevated concentrations of PCBs, pesticides, metals, and PAHs, and a subsurface sediment ERM-Q of 1.43.
- For total PCBs, the maximum surface sediment concentration was 1 mg/kg with three subsurface sediment locations exceeding 1 mg/kg; the maximum subsurface concentration of total PCBs was 1.4 mg/kg. Total PCB concentrations generally decreased with distance from the Quay Wall Study Area.
- For all contaminants, concentrations were generally lower in surface sediment (0 to 1 foot below sediment surface [bss]) compared to subsurface samples (greater than 2 feet bss).

#### **12.2.3.3 Groundwater**

Groundwater sampling indicated that PAHs had not migrated from soil to groundwater at significant concentrations, even though soil concentrations exceeded PMC. VOCs and SVOCs were detected infrequently and at low concentrations in Zone 4 groundwater (Tetra Tech January 2012). Additional groundwater sampling conducted as part of the PDI, which focused on arsenic, copper, and lead, detected concentrations of those inorganics significantly (generally an order of magnitude) less than previous investigations and did not warrant further investigation (Tetra Tech January 2012).

The CTDEEP classified groundwater beneath the Lower Subbase as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is utilized.

#### **12.2.4 Basis for Taking Action**

A response action was necessary because HHRAs (Tetra Tech January 1999, January 2012) and ERAs (Battelle March 2008 and Tetra Tech December 2010) identified:

- Unacceptable human health risks for hypothetical future residential exposure to Zone 4 soil due to PAHs and lead.
- Unacceptable human health risks for current and future construction workers and full-time exposure to lead in Zone 4 soil.

- Unacceptable ecological risks for benthic invertebrates and piscivorous birds exposed to metals, PAHs, pesticides, and PCBs in Zone 4 and Outer Pier 1 sediment.

#### **12.2.4.1 Human Health Risk Assessment**

The HHRAs evaluated the following potential human receptors plausibly exposed to media at Zone 4: current and future construction workers and full-time employees, and hypothetical residents (adults and children).<sup>4</sup> No unacceptable noncarcinogenic hazards were identified for any receptors under the RME scenario (NAVFAC August 2012).

ILCRs for exposure to soil by current and potential future I/C receptors (construction workers and full-time employees) were within the U.S. EPA target risk range. The ILCRs for hypothetical child residents and hypothetical lifetime residents (both 3E-04) exceeded the U.S. EPA target risk range, and was due primarily to PAHs and arsenic in surface/subsurface soil (NAVFAC August 2012).

Lead was identified as a COPC in surface and subsurface soil at Zone 4. Potential exposure risks by current and future full-time employees and construction workers, and hypothetical future residents were evaluated using lead models. Exposures to the hypothetical child, construction workers, and full-time employee (with the fetus of a pregnant worker as the receptor of concern) were performed using either the IEUBK or the U.S. EPA Adult Lead Model. The analyses indicated risks for hypothetical future child residents exceeded U.S. EPA's goal, but construction workers and full-time employees did not exceed the U.S. EPA goal. Although lead models showed that average concentrations of lead would not pose a hazard to workers, lead concentrations (above the CTDEEP I/C DEC RSR) in localized areas of Zone 4 presented acute risk to current and future workers.<sup>5</sup>

Risks for hypothetical residents exposed to VOCs (ethylbenzene and vinyl chloride) that have volatilized from groundwater and migrated through building foundations into the indoor air of a structure were evaluated using U.S. EPA's Johnson and Ettinger VI model. For hypothetical residents, the HI was less than 1 and ILCR was 4E-05 (within the U.S. EPA target risk range). HIs and ILCRs for industrial workers would also be expected to be within acceptable levels because these receptors would be exposed to volatile compounds in indoor air on a less frequent basis than residential receptors (Tetra Tech January 2012).<sup>6</sup>

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<sup>4</sup> The HHRAs did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered.

<sup>5</sup> The acute toxicity risks associated with lead prompted the decision to address lead contamination in Zone 4 soil under the current industrial scenario as well as hypothetical future residential scenario (NAVFAC August 2012).

<sup>6</sup> Only ethylbenzene and vinyl chloride were evaluated using the Johnson and Ettinger VI model; 1,1-DCA is also present above screening criteria but was not modeled.



#### **12.2.4.2 Ecological Risk Assessment**

Several metals, PAHs, pesticides, and PCBs were identified as COPCs that cause potential risk to benthic organisms in Zone 4 and Outer Pier 1 sediment, and four metals were identified as COPCs for potential risk to upper-trophic-level piscivorous birds in the screening level ERA (NAVFAC August 2012). These COPCs were included in the Baseline ERA, which was conducted as part of the Thames River Validation Study (Battelle March 2008) to further evaluate risks to benthic invertebrates and piscivorous birds.

The Baseline ERA developed preliminary RGs including an ERM-Q of 1.17 and a total PCB congener of 208 µg/kg, both of which correspond to a 50 percent reduction in benthic invertebrate (represented by amphipods) reproduction in offspring. Subsequently, a consensus that the ERM-Q of 1.17 was the predominant sediment preliminary RG, and that the total PCB congener preliminary RG could be set at 1 mg/kg was reached (Tetra Tech December 2010).<sup>7</sup>

Food-chain modeling calculated site-specific bioaccumulation factors using chemical concentrations in whole-body fish tissue samples collected from former Pier 1 and an upstream reference area. No high magnitude risk to piscivorous birds was identified; low magnitude risk to piscivorous birds was shown for lead and zinc in Zone 4 and for mercury in Outer Pier 1. Further evaluation of the dose modeling suggested that lead and mercury did not pose unacceptable risk to piscivorous birds; modeling was used to establish the No-Observed-Adverse-Effect Level and Lowest-Observed-Adverse-Effect Level for zinc as 560 mg/kg and 5,040 mg/kg, respectively.

Historical investigations concluded that soil is not a medium of concern for ecological receptors and surface water in Zone 4 does not pose unacceptable risk to ecological receptors (NAVFAC August 2012).

### **12.3 Remedial Actions**

The OU 4 ROD that included Zone 4 (Sites 13 and 19) and Outer Pier 1 was signed by the Navy on 16 August 2012 and by U.S. EPA Region 1 on 23 August 2012. Some components of the remedial action, such as LTM and LUCs, at OU 4 will be managed comprehensively with zone-specific plans and remedial design documents as discussed herein.

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<sup>7</sup> The decision to use 1 mg/kg was based on CERCLA risk-based standards for PCBs in sediment, which does not pose an unreasonable risk of injury to human health or the environment under the Toxic Substances Control Act (NAVFAC August 2012).

### **12.3.1 Remedial Action Objectives**

#### **12.3.1.1 Zone 4 Soil**

Table 12-1 lists the RAOs for Zone 4 soil under applicable land use scenarios at NSB NLON.

<b>Table 12-1 Remedial Action Objectives — Zone 4 Soil</b>	
<b>Current Land Use</b>	<b>Hypothetical Future Land Use</b>
Prevent exposure of current and future full-time employees (FTEs) and construction workers to surface/subsurface soil containing concentrations of contaminants of concern (COCs) greater than Industrial/Commercial remedial goals (RGs).	Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than Residential RGs.
Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than RGs.	Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than RGs.
Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.	Prevent migration of surface subsurface soil COCs as a result of erosion and sedimentation.

#### **12.3.1.2 Zone 4 and Outer Pier 1 Sediment**

The following are RAOs for Zone 4 and Outer Pier 1 sediment under current I/C land use along the NSB NLON waterfront and surrounding area.

- Reduce risks to benthic aquatic organisms from exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- Reduce risks to piscivorous birds from food-chain exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- Mitigate the potential for bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to migrate to less impacted areas of the Thames River and cause adverse effects to receptors.

### **12.3.2 Remedial Goals**

#### **12.3.2.1 Soil**

To achieve the RAOs, human health cleanup goals were developed for each COC. COCs were identified based on CTDEEP Residential DEC and PMC (carcinogenic PAHs and lead) and I/C DEC and PMC (lead). Table 12-2 summarizes RGs for Zone 4 COCs in soil.

Table 12-2 Remedial Goals — Zone 4 Contaminants of Concern — Soil				
Contaminant of Concern	Selected Remedial Goals			
	Direct Exposure	Basis	Pollutant Mobility	Basis
<b>Residential Scenario</b>				
Benzo(a)anthracene	1 mg/kg	CTDEEP DEC RSR	3.4 mg/kg	Alternative PMC <sup>[1]</sup>
Benzo(a)pyrene	1 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Benzo(b)fluoranthene	1 mg/kg	CTDEEP DEC RSR	2.2 mg/kg	Alternative PMC <sup>[1]</sup>
Dibenzo(a,h)anthracene	1 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Indeno(1,2,3-cd)pyrene	1 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Lead	400 mg/kg	CTDEEP DEC RSR	0.15 mg/L	CTDEEP PMC RSR <sup>[3]</sup>
<b>Industrial/Commercial Scenario</b>				
Lead	1,090 mg/kg <sup>[3]</sup>	Target Action Level <sup>[4]</sup>	0.24 mg/L <sup>[5]</sup>	Alternative PMC <sup>[2]</sup>

**Notes:**

- mg/kg = milligrams per kilogram  
 CTDEEP = Connecticut Department of Energy and Environmental Protection  
 DEC = Direct Exposure Criterion  
 RSR = Remediation Standard Regulations  
 PMC = Pollutant Mobility Criteria  
 COC = Contaminant of Concern  
 mg/L = milligrams per liter

<sup>[1]</sup> In areas with GB groundwater where no non-aqueous phase liquid is present, CTDEEP allows for calculation of site-specific Alternative PMC. The Alternative PMC for residential site use was determined assuming no pavement would be present to reduce infiltration.

<sup>[2]</sup> The higher of the calculated Alternative PMC and CTDEEP PMC RSR was used as the RG.

<sup>[3]</sup> Site-specific preliminary Remedial Goal for an industrial worker was derived using U.S. EPA's Adult Lead Model. Lead was evaluated separately from other chemicals and was not included in risk totals.

<sup>[4]</sup> Cumulative risk in Zone 4 meets U.S. EPA requirement of less than 1.0E-04.

<sup>[5]</sup> In areas with GB groundwater where no non-aqueous phase liquid is present, CTDEEP allows for calculation of site-specific Alternative PMC. The Alternative PMC for I/C site use was determined assuming pavement would be present to reduce infiltration.

The FS Addendum estimated approximately 11,480 and 1,780 cubic yards of lead-contaminated soil would need to be addressed to eliminate potentially unacceptable risk to residential and industrial receptors, respectively.

### 12.3.2.2 Sediment

The preliminary RGs established in the FS — ERM-Q (1.17) and Total PCBs (1 mg/kg) — were selected as the RGs for Zone 4 sediment.<sup>8</sup> The FS Addendum estimated the volume of contaminated sediment in Zone 4 and Outer Pier 1 that would need to be addressed to eliminate ecological risk is approximately 23,160 cubic yards (NAVFAC August 2012). A PDI was conducted prior to remedy implementation to further refine the extent of sediment contamination and calculate the actual volume of contaminated sediment, as discussed in Section 12.3.4.2.

<sup>8</sup> The term "Preliminary RG" was established in the FS Addendum (Tetra Tech January 2012) and retained in portions of the ROD and subsequent documents (NAVFAC August 2012).

### **12.3.2.3 Groundwater**

No groundwater COCs were identified for Zone 4; therefore, no RGs were established (NAVFAC August 2012).

### **12.3.3 Remedy Selection**

#### **12.3.3.1 Zone 4 Soil**

The remedy selected in the ROD for Zone 4 soil consists of the following components.

#### **Excavation and Offsite Disposal**

- Excavate across a 13,100-square-foot area to meet CTDEEP I/C DEC and PMC RSRs
  - To 2 feet bgs where soil exceeds CTDEEP I/C DEC
  - To the depth of the mean high water where soil exceeds CTDEEP I/C PMC
  - Do not extend below the wooden platform to prevent damage to Quay Wall
- Analyze excavated soil to determine offsite disposal options for an estimated 1,780 cubic yards of soil and 240 cubic yards of asphalt
- Backfill with clean soil and repave

#### **Land Use Controls**

- Institutional controls (creating an implementable 61,100-square-foot LUC boundary) through a LUC RD, with:
  - CERCLA risk-based engineering controls (buildings, foundations, and 36,000 square feet of pavement) to meet Residential RGs <sup>9,10</sup>
  - Regular inspections and maintenance of buildings, foundations, and pavement
- The controls restricting residential use of Zone 4 will be maintained until the concentrations of contaminants in soil are less than or equal to levels that allow for UU/UE

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<sup>9</sup> CTDEEP RSRs require CERCLA risk-based engineering controls to be comprised of a minimum of 3 inches of bituminous concrete or concrete, or be an existing building or another existing permanent structure.

<sup>10</sup> Soil beneath existing buildings and 36,000 square feet of pavement that cover inaccessible and/or environmentally isolated soil. Under the I/C site use, CTDEEP RSR standards classify contaminated soil as inaccessible if it is unpaved and more than 4 feet bgs, more than 2 feet below a paved surface comprising a minimum of 3 inches of bituminous concrete or concrete, or beneath an existing building or another existing permanent structure (NAVFAC August 2012).



### **Long-Term Monitoring**

- Groundwater monitoring for all soil COCs that exceed Residential RGs to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater
- Regular inspections to ensure monitoring wells are maintained

### **Five-Year Reviews**

- Performing five-year reviews because contamination will remain in place above levels that allow for UU/UE

#### **12.3.3.2 Zone 4 and Outer Pier 1 Sediment**

The remedy selected in the ROD for Zone 4 and Outer Pier 1 sediment includes the following components.

#### **Dredging, Dewatering, and Offsite Disposal**

- Dredge approximately 19,700 cubic yards of contaminated sediment including approximately 97,300 square feet in Zone 4 with confirmation samples to verify contaminated sediment has been adequately removed
- Dewater dredged sediment to its original in-situ volume by using barges fitted with permeable liners to operate as passive drainage beds
  - Stabilize dewatered sediment by blending with 8 percent (by weight) of fly ash
  - Sample dewatering fluid prior to offsite disposal
- Offsite disposal of dewatered sediment and dewatering fluid
  - Dispose of approximately 21,660 cubic yards of stabilized sediment at an offsite landfill
  - Ship approximately 398,000 gallons of dewatering fluid to an offsite treatment and disposal facility
- Backfill with approximately 10,250 cubic yards to maintain the stability of the slope in the area along the Quay Wall

- Monitoring prior to, during, and after construction to verify COCs did not migrate

### **Land Use Controls**

LUCs are required because contaminants in remaining Zone 4 and Outer Pier 1 sediment are at concentrations that could result in unacceptable risks to ecological receptors if disturbance of sediment is not restricted.

- Implement LUCs over 13,500 square feet of contaminated sediment to prevent disturbance of the maintained cover/cap (existing uncontaminated sediment) at Outer Pier 1
- Implement LUCs over the area adjacent to the Quay Wall and beneath the existing pier structure in Zone 4 because of the potential for contaminated sediment that may remain beneath the existing Quay Wall and pier structure to re-contaminate clean sediment in the dredged area of Zone 4
- Conduct yearly site inspections to verify continued implementation of LUCs
- LUCs will remain in place until potentially contaminated sediment no longer presents a risk to the environment (i.e., concentrations of contaminants in sediment are less than levels that allow for UU/UE).

While access to the Zone 4 and Outer Pier 1 areas is controlled by the Navy, coordination of LUCs will be with U.S. EPA and the State of Connecticut, which owns the subtidal area (NAVFAC August 2012).

### **Long-Term Monitoring**

- Conduct surface water and sediment monitoring to verify that the remedy remains protective and contaminants are not migrating to surface water or to areas of sediment that are currently uncontaminated.

### **Five-Year Reviews**

- Conduct five-year reviews because contamination will remain in excess of levels that allow for UU/UE.

## **12.3.4 Remedy Implementation**

### **12.3.4.1 Zone 4 Soil**

#### **Excavation and Offsite Disposal**

Soil excavation activities within Zone 4 were performed between May and December 2014, with the excavated area backfilled and repaved, in accordance with the ROD. Although the soil excavation encompassed the physical extents estimated in the ROD, the remedial action did not achieve the established RGs outlined in Section 12.3.3.1. Data from the remedial action are currently being reviewed to determine the scope of additional remedial action.

#### **Land Use Controls**

SUBASENLONINST 5090.25 is the current instruction that restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without LUC RDs throughout NSB NLON (Navy April 2013). The OU 4 Soil LUC RD will be finalized and implemented after the remedial action is completed at Zone 4.<sup>11</sup> Once finalized, the OU 4 Soil LUC RD will become the primary LUC document for soil at Zone 4 (information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25).

The OU 4 Soil LUC RD at Zone 4 will establish specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy:

- Restricting residential land use and development
- Restricting disturbance of contaminated soil
- Maintaining a protective cover layer to provide CERCLA risk-based engineering controls (including features such as existing buildings and pavement that already cover inaccessible and/or environmentally isolated soil)

#### **Long-Term Monitoring**

A GMP will be developed after remedial actions are completed at Zone 4 and incorporated into the O&M Manual (Resolution Consultants October 2013). The post-remedial action GMP and O&M Manual will document inspection and maintenance protocols for engineering controls (e.g., pavement and building structures), as required by LUCs. The selected remedy will also include annual confirmation

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<sup>11</sup> A Draft Final OU 4 Soil LUC RD (Resolution Consultants February 2013) updated a Draft OU 4 Soil LUC RD (Resolution Consultants November 2012) issued within 90 days of ROD signature.

of compliance with LUCs (e.g., preventing intrusive activities, changes in land use). Results of long term groundwater, surface water, and sediment monitoring and annual LUC inspections will be provided to U.S. EPA Region 1 and CTDEEP.

#### **12.3.4.2 Zone 4 and Outer Pier 1 Sediment**

##### **Dredging, Dewatering, and Offsite Disposal**

Sediment dredging activities are scheduled to begin in fiscal year 2017. In accordance with the ROD, a PDI Completion Report for Sediment at Zone 4 and Outer Pier 1 has been completed and presents the results of sediment sampling and dewatering tests conducted in support of RD (Tetra Tech February 2013). Nine sediment samples within Zone 4 exceeded the 1.17 ERM-Q RG but none exceeded the 1 mg/kg Total PCB RG. None of the PCB concentrations or ERM-Qs detected within Outer Pier 1 exceeded RGs. The horizontal and vertical extent of sediment contamination at Zone 4 and Outer Pier 1 and corresponding volumes calculated in the Lower Subase FS Addendum were updated using the results from the PDI Completion Report.

The revised contaminated sediment volume and mass (7,616 cubic yards/8,835 tons) are less than those calculated in the FS Addendum. The position of the contaminated sediment has changed, with a decrease in the total volume of contaminated sediment along the Quay Wall and an increase along the north side of and near Pier 2. The PDI Completion Report also revised the volume and mass of sediment to be dredged from Zone 4 upwards to 23,662 cubic yards/27,448 tons owing to the discovery of additional contaminated areas and because some contamination is in subsurface sediment that requires dredging of surface sediment together with the contaminated sediment.

##### **Land Use Controls**

SUBASENLONINST 5090.25 is the current instruction that restricts disturbance of Thames River Sediment at ER Program Sites without LUC RDs throughout NSB NLON (Navy April 2013). The OU 4 Sediment LUC RD will be finalized and implemented after remedial actions are completed at Zone 4.<sup>12</sup> Once finalized, the OU 4 Sediment LUC RD will become the primary LUC document for sediment at Zone 4 (information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25).

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<sup>12</sup> A Draft Final OU 4 Sediment LUC RD (Resolution Consultants January 2013) updated a Draft OU 4 Sediment LUC RD (Resolution Consultants October 2012) issued within 90 days of ROD signature.



The OU 4 Sediment LUC RD will establish specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy:

- Prohibiting disturbance of sediment over 1,930-square-foot area in Outer Pier 1 and adjacent to the Quay Wall and beneath the existing pier structure in Zone 4<sup>13</sup>
- Control remaining contaminated sediment under the Quay Wall and beneath the existing pier structure
- Establish a “Safety Zone” or “No Anchor Zone” around the Outer Pier 1 capped area to avoid damage as a result of maintenance dredging activities and to repair such damage if it occurs

### **Long-Term Monitoring**

A long-term surface water and sediment monitoring program will be developed after remedial actions are completed at Zone 4 and incorporated into the O&M Manual. The post-remedial action LTM will document inspection and maintenance protocols for institutional and engineering controls, as required by LUCs. The LTM component of the selected remedy will also include annual confirmation of compliance with LUCs (e.g., preventing damage as a result of maintenance dredging activities). Results of the LTM and annual LUC inspections will be provided to U.S. EPA Region 1 and CTDEEP.

## **12.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Zone 4.<sup>14,15</sup> The last five-year review recommended completion of the Lower Subbase ROD to select remedial actions for Zone 4 (Sites 13 and 19) and Outer Pier 1 protective of human health and the environment, and continued enforcement of the SOPA (ADMIN) NLONINST 5090.25 until selection and implementation of the final remedy.<sup>16</sup>

Since the Third Five-Year Review, the ROD was signed (August 2012) and SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Table A-10 in Appendix A summarizes information from documents generated that include Zone 4 (Sites 13 and 19) and Outer Pier 1 since the last five-year review and reviewed for this five-year review: Lower Subbase Soil and Groundwater PDI Completion Report and FS Addendum (Tetra Tech January 2012), Proposed Plan

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<sup>13</sup> The revised contaminated sediment volume, mass, and area (143 cubic yards/166 tons/1,930 square feet) are less than those calculated in the FS Addendum (1,001 cubic yards/1,192 tons/13,500 square feet), primarily due to refinement of the extent of sediment with exceedances of RGs at the 4- to 6-foot depth interval.

<sup>14</sup> The Third Five-Year Review was the first to include Pier 1 (NAVFAC December 2011).

<sup>15</sup> Previous five-year reviews included OU 4 (Lower Subbase) for informational purposes only, as the ROD had not been signed.

<sup>16</sup> The First, Second, and Third Five-Year Review reports discussed Sites 13 and 19 in separate sections.

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(NAVFAC March 2012), OU 4 ROD (NAVFAC August 2012), SUBASENLONINST 5090.25 (Navy April 2013), OU 4 Soil LUC RD (Resolution Consultants Draft November 2012, Draft Final February 2013), OU 4 Sediment LUC RD (Resolution Consultants Draft October 2012, Draft Final January 2013), PDI Completion Report for Sediment at Zone 4 and Outer Pier 1 (Tetra Tech February 2013), Final RACR Pier 1 Inner Area Sediment Removal Action Phase 2 (AGVIQ-CH2M HILL Constructors, Inc. Joint Venture III [AGVIQ] June 2014), 60 Percent Design Report for CERCLA Sediment, Lower Subase, OU 4 (Resolution Consultants November 2014), and Quay Wall Geotechnical Report, CERCLA Sites OU 4 Sediment (Resolution Consultants 18 November 2015, 26 October 2016).<sup>17</sup> Complete document references are in Section 14.

## **12.5 Technical Assessment**

### **12.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

#### **12.5.1.1 Data Summary**

The remedies for Zone 4 soil and sediment and Outer Pier 1 sediment have not been completed, as discussed below. Long-term groundwater and surface water monitoring data has not been generated at Zone 4 since the ROD was signed. GMPs will be developed comprehensively for OU 4 and a site-specific sediment and surface water monitoring plan will be developed for Zone 4 and Outer Pier 1. Both monitoring plans will be prepared after remedial actions at Zone 4 are complete.

#### **Zone 4 Soil**

A comparison of adjacent Zone 3 RAOs and RGs with Zone 4 indicates that objectives and goals established for Zone 4 are more stringent.<sup>18</sup> Excavation actions conducted to date within Zone 4 extended to the shared boundary with Zone 3 but have ceased pending determination of further action; initially because of the onset of winter; however, further review of data and site conditions is underway. Documentation of excavation, paving/capping, and offsite disposal is pending completion of the Zone 4 remedial actions.

#### **Zone 4 and Outer Pier 1 Sediment**

The PDI Completion Report delineated the horizontal and vertical extent of sediment contamination and updated corresponding volumes requiring remedial action (dredging, dewatering, and offsite disposal) from those estimated in the FS Addendum (Tetra Tech February 2013). Sediment dredging activities were scheduled to begin in the summer of 2016, pending finalization of

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<sup>17</sup> The Final RACR (AGVIQ June 2014) documents activities at Inner Pier 1 that occurred as part of the NTCRA from October 2012 through February 2013; those activities were not conducted as part of the remedy selected in the ROD, which addresses Outer Pier 1.

<sup>18</sup> The Zone 3 RG is based on Alternative PMC of 0.47 mg/L and assumes that a CTDEEP RSR engineered low-permeability cap is emplaced to reduce infiltration (NAVFAC August 2012); the Zone 3 RG is approximately twice the Zone 4 PMC RG (0.24 mg/L).

the RD. However, due to structural integrity concerns for the Quay Wall identified during Navy's review of the geotechnical evaluation in the RD, re-evaluation of the geotechnical report recommendations are ongoing and have impacted the dredging schedule. The study determined remedy implementation requirements (e.g., backfill materials, material storage, etc.) and also recommended limited excavation in the passive wedge area and structural monitoring (Resolution Consultants 18 November 2015, 26 October 2016); U.S. EPA is currently reviewing this study.

#### **12.5.1.2 Land Use Control Status**

The OU 4 Soil and Sediment LUC RDs are pending finalization following completion of the remedial actions at Zone 4. In the interim, SUBASENLONINST 5090.25 (Navy April 2013) restricts ground surface disturbance of soils and any subsurface disturbance of soils, sediment, and groundwater at ER Program Sites without finalized LUC RDs throughout NSB NLON. As noted in Section 2.11.1, while SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.

#### **12.5.1.3 Operations and Maintenance Summary**

SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (existing buildings, foundations, and pavement). U.S. EPA's *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"* (OSWER Directive 9355.7-18) (U.S. EPA September 2011) identifies the need for clarity in long-term stewardship of LUCs (e.g., implementing, maintaining, and enforcing). Review of SUBASENLONINST 5090.25 indicated that no clear instructions for implementing, maintaining, or enforcing LUCs (e.g., inspection of pavement and buildings, and restricting disturbance of clean sediment covers) have been provided in the interim period until the final OU 4 Soil and Sediment LUC RDs are implemented. While informal inspections may be performed by NSB NLON personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed.

#### **12.5.1.4 Five-Year Review Site Visit Findings**

Building foundations and pavement that covered most of Zone 4 remain as identified in the ROD. There has been no demolition or removal of pavement that act as CERCLA risk-based engineering

controls to prevent exposure to underlying contaminated soil; all soil excavations conducted as part of the selected remedy have been backfilled and repaved in accordance with approved work plans. Land use at Zone 4 has not changed since the last five-year review or the OU 4 ROD was signed.

#### 12.5.1.5 Technical Evaluation

Table 12-3 summarizes the technical evaluation for Question A.

<b>Table 12-3</b> <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	<p>The Operable Unit (OU) 4 remedy is in progress, as follows.</p> <p><b>Soil</b></p> <ul style="list-style-type: none"> <li>Buildings and approximately 36,000 square feet of pavement were designated as Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls to meet Residential remedial goals (RGs).</li> <li>The soil excavation and offsite disposal components of the selected remedy are in progress. Soil was excavated in the areas and to the depths identified in the Record of Decision and Remedial Action Work Plan but the RGs were not met in select areas; a decision for the scope of additional remedial action has not been documented. All soil excavated to date was disposed of offsite, and the excavations were backfilled with clean soil and repaved.</li> <li>A Groundwater Monitoring Plan will be developed after remedial actions are completed at Zone 4 and incorporated into the Operations and Maintenance Manual.</li> </ul> <p><b>Sediment</b></p> <ul style="list-style-type: none"> <li>A Pre-Design Investigation redefined the extent of sediment that exceeded the RGs and the volume of sediment to be dredged at Zone 4 and Outer Pier 1. Sediment dredging is tentatively scheduled to begin in fiscal year 2017.</li> <li>Clean sediment that acts as a cover to contaminated sediment within Outer Pier 1 has not been dredged or otherwise disturbed since the Record of Decision. A long-term surface water and sediment monitoring program will be developed after remedial action is completed at Zone 4 and Outer Pier 1 sediment.</li> <li>Due to structural integrity concerns of the Quay Wall, a geotechnical investigation and evaluation was performed to evaluate the proposed dredge activities and their effect on the Quay Wall. The study determined remedy implementation requirements (e.g., backfill materials, material storage, etc.) and also recommended limited excavation in the passive wedge area and structural monitoring (Resolution Consultants 18 November 2015, 26 October 2016). The Navy's subsequent review of the findings of this study raised questions that will require resolution; U.S. EPA is currently reviewing this study.</li> </ul> <p><b>Land Use Controls</b></p> <p>The OU 4 Soil and Sediment Land Use Control Remedial Designs (LUC RDs) will be finalized after remedial actions are completed at Zone 4. Until that time, Subase New London Instruction (SUBASENLONINST) 5090.25 is the functional LUC document for Zone 4 soil, sediment, and surface water. SUBASENLONINST 5090.25 has procedures to prevent unauthorized ground- and sediment-disturbing activity.</p>

Table 12-3 Zone 4 (Sites 13 and 19) and Outer Pier 1 — Technical Evaluation — Question A	
Question	Summary
Systems Operation/ Operations and Maintenance	SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (existing buildings, foundations, pavement, or sediment). While informal inspections may be performed by Naval Submarine Base New London personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed. As noted in Section 12.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of land use controls (LUCs) (e.g., inspection of pavement and sediment) occurs in the interim period prior to finalization the OU 4 Soil and Sediment LUC RDs.
Opportunities for Optimization	Neither the long-term groundwater monitoring nor surface water/sediment monitoring portions of the selected remedy at OU 4 has been implemented so there have been no opportunities for optimization.
Implementation of LUCs and Institutional/Engineering Controls	SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils, sediment, and groundwater at Environmental Restoration Sites without finalized LUC RDs throughout Naval Submarine Base New London. Engineering controls present at the time of remedy selection are existing buildings, foundations, and pavement at Zone 4 (Sites 13 and 19) and existing clean sediment within Outer Pier 1. As noted in Section 12.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement, sediment cover, etc.) occurs in the interim period prior to finalization of the OU 4 Soil and Sediment LUC RDs.
	While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.
Early Indicators of Potential Remedy Problems	None

## 12.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?

### 12.5.2.1 Risk Assessment Review: Current Conditions

The basis for action at Zone 4 and Outer Pier 1 was summarized in Section 12.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect protectiveness of the remedy are discussed below.

Remedial actions were necessary to protect human health due to PAHs and lead in surface/subsurface soil in Zone 4 and protect benthic invertebrates and piscivorous birds exposed to metals, PAHs, pesticides, and PCBs in Zone 4 and Outer Pier 1 sediment. RGs were not identified for groundwater, which is classified GB (non-potable). Concern regarding migration of contaminants from soil to groundwater will be addressed via a GMP that will be developed and implemented to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater. Concern



regarding contaminants migrating to surface water or areas of uncontaminated sediment will be addressed in a long-term surface water and sediment monitoring program.

The VI evaluation for Zone 4 (shown in Section 2.9 and Table 2-1) concluded that Draft Final OU 4 Soil LUC RD should be edited to require VI assessment and mitigation as necessary for any new building construction at these sites.

### 12.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 12-4.

<b>Table 12-4</b> <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	In June 2013, the Connecticut Department of Energy and Environmental Protection updated the 1996 Residential Direct Exposure Criteria Remediation Standard Regulation for lead in soil. The updated Direct Exposure Criteria Remediation Standard Regulation for lead is the same as the Remedial Goal (RG) for lead in the Record of Decision (ROD), so these changes do not affect the cleanup goals or the protectiveness of the remedy.
Changes in Exposure Pathways	Lead and polynuclear aromatic hydrocarbons were the primary contaminants of concern in soil within Zone 4. Volatilization via vapor intrusion (VI) was reassessed during this five-year review because of recent changes in guidance. VI is not expected to be an issue at this site; see Table 2-1 for further details.
Changes in Land Use	<p>There have been no changes in land use since the Operable Unit (OU) 4 ROD was signed. There are no plans to close the base or transfer ownership outside the Navy. Subase New London Instruction (SUBASENLONINST) 5090.25 prevents land use changes without notification. Buildings, foundations, and pavement that cover Zone 4 that act as engineering controls to prevent exposure to contaminated soil have been maintained to ensure continued protection. There were no construction or dredging projects or intrusive work in the area of Outer Pier 1.</p> <p>During this five-year review, it was noted that although the human health risk assessment did not consider an unlimited use/unrestricted exposure scenario (e.g., potable use of groundwater), land use controls prohibiting groundwater use were not required in the OU 4 ROD. The need for future institutional controls to protect against the unlimited use/unrestricted exposure scenario should be evaluated further.</p>

<p style="text-align: center;"><b>Table 12-4</b> <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Technical Evaluation — Question B</b></p>	
<b>Question</b>	<b>Summary</b>
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — Dioxins are not probable constituents at Zone 4 based on site history and samples have not been collected for dioxin analysis.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Zone 4; however, a basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> — The contaminants 1,1,1-trichloroethane (TCA) and its daughter compound 1,1-dichloroethane were detected in Site 13 soil and groundwater and chloroethane was detected in Site 13 soil. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane; samples were not collected from any Site 19 or Outer Pier 1 media for 1,1,1-TCA, 1,1-dichloroethane, or chloroethane analysis. The Navy will perform presence/absence sampling for 1,4-dioxane at Zone 4 (Sites 13 and 19) and Outer Pier 1 in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to PFCs or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	<p>No changes in toxicity values were found that would affect protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for volatile organic compounds, which may affect some sites where volatile organic compounds are a concern in groundwater if groundwater could be used as a potable source in the future. VI information was reviewed for Zone 4 (Sites 13 and 19) and Outer Pier 1, as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary; however, given vinyl chloride exceedances of Industrial Vapor Intrusion Screening Levels, review of SUBASENLONINST 5090.25 may be warranted to determine whether existing language is sufficient to require additional VI assessment and/or mitigation, prior to any future construction activities.</p>
Expected Progress towards Meeting Remedial Action Objectives	<p>Initial soil excavation activities within Zone 4 were performed between May and December 2014 with all excavated soil disposed of offsite, and the excavations backfilled with clean soil and repaved in accordance with the ROD. Although the soil excavation encompassed the physical extents estimated in the ROD and Remedial Action Work Plan, the remedial action did not achieve the established RGs outlined in Section 12.3.3.1. A decision for further remedial action has not been documented.</p> <p>In accordance with the ROD, a Pre-Design Investigation redefined the extent of sediment that exceeded the RGs and the volume of sediment to be dredged at Zone 4 and Outer Pier 1. Sediment dredging is tentatively scheduled to begin in fiscal year 2017; findings from the Quay Wall investigation are being reviewed by the Navy which has raised questions that will require resolution; U.S. EPA is currently reviewing this study.</p> <p>Some components of the selected remedies for OU 4 zones and sites are being managed comprehensively; therefore, a Remedial Action Completion Report for OU 4 will be issued following completion of all soil and sediment remedial actions at Zone 4. In addition, Draft OU 4 Soil and Sediment Land Use Control Remedial Designs (LUC RDs) were prepared in November and October 2012, respectively, in accordance with the ROD, which required development of LUC RDs within 90 days of ROD signature. The OU 4 Soil and Sediment LUC RDs (both currently Draft Final), Groundwater Monitoring Plan for Zone 4, and long-term surface water and sediment monitoring plan for Zone 4 and Outer Pier 1 will be finalized following completion of remedial actions at Zone 4.</p>

**12.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No other information has come to light that could call into question the protectiveness of the remedy.

**12.6 Issues and Recommendations**

Issues and recommendations for Zone 4 (Sites 13 and 19), and Outer Pier 1 are in Table 12-5.

**12.7 Protectiveness Statement**

Remedial actions at OU 4 are still ongoing. Currently, human, but not ecological exposures are under control. No human health risks are occurring but ecological risks are still present. The remedy at OU 4, Zone 4 (Sites 13 and 19) and Outer Pier 1, will be protective of human health and the environment upon completion. Soil and sediment removal actions will have been completed, CERCLA risk-based engineering controls (existing building foundations and pavement) are in place, and LUCs and LTM will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.

Table 12-5 Zone 4 (Sites 13 and 19) and Outer Pier 1 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Remedy Performance								
1	At this time, the soil excavation has not achieved remedial goals and a decision for the scope of additional remedial action has not been documented.	Determine the scope of the additional remedial action necessary to achieve the remedial goals and modify the decision documents as appropriate.	Navy	U.S. EPA, CTDEEP	31 December 2018	N	Y	
Institutional Controls								
2	Annual LUC inspections and certifications were not performed in accordance with the Draft Final OU 4 Soil LUC RD at Sites 13 and 19 in 2013, 2014, and 2015. SUBASENLONINST 5090.25 does not clearly define implementation, maintenance, and enforcement requirements for OU 4 engineering controls during the interim period prior to finalization of the OU 4 Soil LUC RD.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 4 Soil LUC RD at Site 13 and 19.	Navy	U.S. EPA, CTDEEP	31 March 2017	N	N	
3	Review of SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD identified the following: <ul style="list-style-type: none"><li>Additional clarity is required in the pending OU 4 Soil LUC RD to prevent potable use of groundwater.</li><li>SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD language do not consider the potential for vapor intrusion during the event of future construction scenarios at Zone 4.</li></ul>	Edit the pending OU 4 Soil LUC RD to include the following: <ul style="list-style-type: none"><li>Prohibit potable groundwater use.</li><li>Require VI assessment and mitigation as necessary for any new building construction at Zone 4.</li></ul>	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
4	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	

Table 12-5 Zone 4 (Sites 13 and 19) and Outer Pier 1 — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Monitoring								
5	The contaminants 1,1,1-TCA and its daughter compound 1,1-DCA were detected in Site 13 soil and groundwater and chloroethane was detected in Site 13 soil. The stabilizer 1,4-dioxane is commonly associated with 1,1,1-TCA. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane; samples were not collected from any Site 19 or Outer Pier 1 media for 1,1,1-TCA, 1,1-DCA, or chloroethane analysis.	Perform presence/absence sampling for 1,4-dioxane at Zone 4 (Sites 13 and 19) and Outer Pier 1 in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	
6	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Sites 13 and 19; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	

**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

LUC = Land Use Control

OU = Operable Unit

U.S. EPA = United States Environmental Protection Agency

VOC = Volatile Organic Compound

DCA = Dichloroethane

LUC RD = Land Use Control Remedial Design

SUBASENLONINST = Subase New London Instruction

CTDEEP = Connecticut Department of Energy and Environmental Protection

TCA = Trichloroethane

PFC = Perfluorinated Compound



### **13.0 SITES 21 AND 25 — ZONE 7, OPERABLE UNIT 4**

OU 4, known as Lower Subbase, is a heavy industrial area of NSB NLON in which submarine docking, maintenance, repair, and overhaul are conducted. As shown on Figures 1-2 and 1-3 in Section 1, OU 4 consists of approximately 33 acres on the eastern bank of the Thames River that roughly extends from Pier 2 to Pier 33. This Five-Year Review includes four Lower Subbase zones (1, 3, 4, and 7) which were addressed under one ROD (NAVFAC August 2012).

OU 4 Zone 7 includes Site 21 (Berth 16) and Site 25 (Former Classified Materials Incinerator). Zone 7 is included in this five-year review because contaminants remain at concentrations that do not allow for UU/UE. Figure 1-3 shows the location of and layout of OU 4 Zone 7 and Figure 13-1 shows the site plan for Zone 7 (Sites 21 and 25).

#### **Zone 7 (Sites 21 and 25)**

- Suspected sources of contamination:
  - Former incinerator at Site 25 (demolished in 1979)
  - Former PCB-containing transformers at Vault 31 (Building 157)
  - Leaks of petroleum products from diesel fuel UST and fuel distribution lines associated with Berth 16
  - Historical uses (including submarine battery maintenance), construction debris, and incinerator ash and cinders
  - Former Dumpster Washing Area (in present-day location of Building 456)
  - Steam, condensate, and electrical lines which may have acted as conduits to transport chemicals.
- COCs:
  - PAHs and metals
- Remedy (ROD signed August 2012)
  - NFA for sediment, groundwater, and surface water
  - LUCs for soil and LTM
    - Installation of CTDEEP RSR Engineered Controls (completed)
    - Storm Sewer Upgrades (completed)
    - LUC RD (Draft Final)
    - GMP and O&M Manual (Pending)

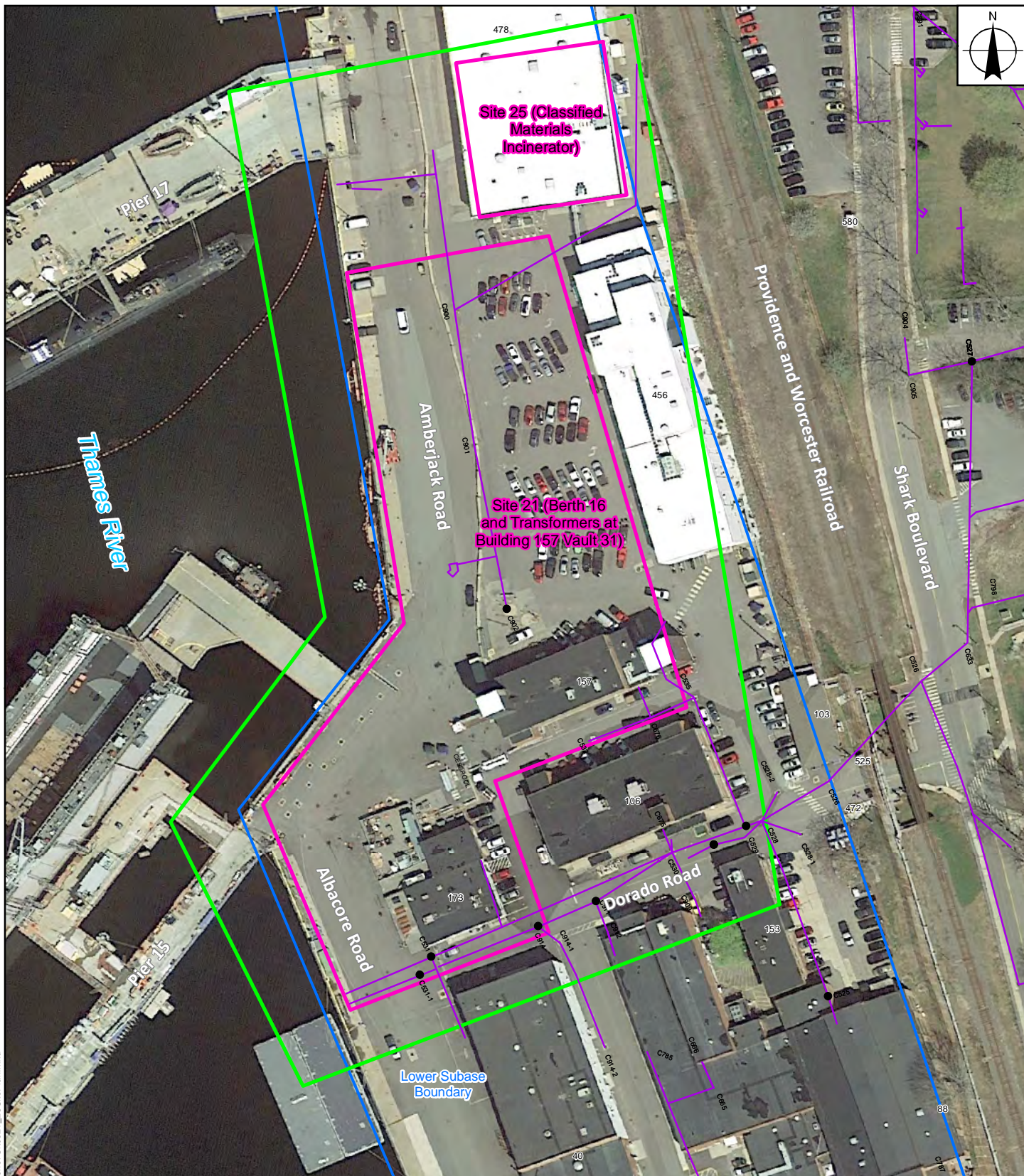
### **13.1 Site History and Background**

Table A-11 Appendix A summarizes the chronology of events at Zone 7 (Sites 21 and 25).

### **13.2 Conceptual Site Model**

PAHs and metals were detected in soil at concentrations exceeding CTDEEP RSRs; lead is the primary COC. Suspected contaminant sources in Zone 7 include the Former Classified Materials Incinerator (over which Building 478 was constructed), former diesel fuel UST and underground fuel distribution lines associated with Berth 16, former PCB-containing transformers at Building 157 Vault 31, former Dumpster Washing Area (over which Building 456 was constructed), and Site 21 activities. In addition, the steam, condensate, and electrical utility lines may have acted as conduits to transport contaminants. Lead detected in Zone 7 soil may also be associated with historical uses, maintenance of submarine batteries, historical use of lead ballast, and construction debris and ash that remain in the subsurface, possibly from former incinerator operations (NAVFAC August 2012).





- Storm Sewer Line
- Site Boundary
- Zone Boundary
- 245 Building Number

0 55 110  
Feet

Note - All site boundaries are approximate.

Figure 13-1  
Zone 7, Sites 21 and 25 - Site Plan  
Naval Submarine Base New London  
Groton, Connecticut



REQUESTED BY: A. Stark  
DRAWN BY: N. Rinehart

DATE: 11/17/2016  
TASK ORDER NUMBER: WE61

Data Sources: Google Earth Pro Imagery - 04/26/1016



### **13.2.1 Nature and Extent of Contamination**

#### **13.2.1.1 Soil**

PAHs were detected in surface and subsurface soil (to the water table at 15 feet bgs) at concentrations above CTDEEP RSRs. Maximum concentrations in surface and subsurface soil were 14,660 µg/kg and 22,860 µg/kg, respectively, in the same general locations west of Building 456. Inorganic compounds detected above regulatory criteria included antimony, arsenic, chromium, copper, and lead. Higher concentrations of lead (the primary Zone 7 COC) correlate with ash and cinders from the former incinerator (NAVFAC August 2012). Lead was detected above CTDEEP RSRs over most of the east-central portion of Zone 7 from ground surface to the water table. The maximum concentration of lead in subsurface soil (189,000 mg/kg) was detected in 20MW6 (where ash and cinders were observed). The maximum concentration of lead in surface soil (31,400 mg/kg) was detected in a boring outside the southwest corner of Building 456.

Antimony alloyed with lead for use in lead-acid batteries is the likely source of elevated antimony concentrations detected in roughly half of the surface and subsurface soil samples (NAVFAC August 2012). Total chromium was detected in each surface and subsurface soil sample analyzed for that parameter; hexavalent chromium was only detected in one surface and two subsurface samples.

Concentrations of PAHs and metals exceeded CTDEEP RSR PMC. Leachate tests performed for lead and antimony detected very high mass and leachate lead results corresponding to locations where ash and cinders were noted. Although soil data suggests the potential for migration from soil to groundwater, groundwater data (discussed below) indicates that inorganic contamination in soil has not migrated.

#### **13.2.1.2 Groundwater**

Trace concentrations of VOCs and SVOCs (including PAHs) were detected in Zone 7 groundwater; none exceeded CTDEEP groundwater volatilization criteria (Tetra Tech 2010). Based on the Lower Subbase FS, no additional VOC or SVOC/PAH data were collected during the PDI/FS Addendum, which focused on the nature and extent of arsenic, copper, and lead in Zone 7 groundwater. Although earlier investigations (Final Site Inspection Report [Atlantic February 1995] and 1997 Lower Subbase RI [Tetra Tech January 1999]) detected elevated levels of arsenic, copper, and lead, the PDI concluded the concentrations of arsenic, copper, and lead detected in Zone 7 groundwater did not warrant further investigation (Tetra Tech January 2012).

The CTDEEP classified groundwater beneath the Lower Subbase as a non-drinking water source area (GB) because it has been used for long-term intense industrial or commercial development and a public water supply service is utilized.

### **13.2.2 Basis for Taking Action**

#### **13.2.2.1 Human Health Risk Assessment**

A response action was necessary at Zone 7 because HHRAs (Tetra Tech January 1999, January 2012) identified unacceptable risks under current and hypothetical future land use scenarios for human receptors potentially exposed to PAHs and metals (antimony and lead) in soil.

The HHRAs evaluated the following potential human receptors plausibly exposed to media at Zone 7: current and future construction workers and full-time employees, and hypothetical residents (adults and children).<sup>1</sup> ILCRs for exposure to soil by current and potential future I/C receptors (construction workers and full-time employees) were within the U.S. EPA target risk range. The ILCRs for hypothetical child residents (2E-04) and hypothetical lifetime residents (3E-04) exceeded the U.S. EPA target risk range and CTDEEP acceptable risk threshold, and was due primarily to PAHs and arsenic in surface/subsurface soil (NAVFAC August 2012).

The HI for hypothetical adult residents, hypothetical child residents, and construction workers and were all greater than 1, due primarily to one antimony sample collected from 14 to 16 feet bgs. Because the sample was collected from 8 to 10 feet below the water table, exposures were considered unlikely (NAVFAC August 2012).

Lead was identified as a COPC in surface and subsurface soil at Zone 7. Potential exposure risks by current and future full-time employees and construction workers, and hypothetical future residents were evaluated using lead models. Exposures to the hypothetical child, construction workers, and full-time employee (with the fetus of a pregnant worker as the receptor of concern) were performed using either the IEUBK or the U.S. EPA Adult Lead Model. Both analyses indicated risks exceeded U.S. EPA blood lead goals.

Risks for hypothetical residents exposed to VOCs (chloroform and TCE) that have volatilized from groundwater and migrated through building foundations into the indoor air of a structure were evaluated using U.S. EPA's Johnson and Ettinger VI model. For hypothetical residents, the HI was

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<sup>1</sup> The HHRAs did not consider potable use of groundwater; due to the CTDEEP GB groundwater classification, only direct contact (not human consumption) was considered.

less than 1 and ILCR was 1E-06 (within the U.S. EPA target risk range). HIs and ILCRs for industrial workers would also be expected to be within acceptable levels because these receptors would be exposed to volatile compounds in indoor air on a less frequent basis than residential receptors (Tetra Tech January 2012).<sup>2</sup>

### **13.2.2.2 Ecological Risk Assessment**

The ERA for Zone 7 surface water and sediment was conducted as part of the Phase II RI (B&RE March 1997) and was updated during the Lower Subbase RI (Tetra Tech January 1999) and baseline ERA conducted as part of the Thames River Validation Study (Battelle 2008). Baseline ERA data collected in 2004 and 2007 were used in conjunction with sediment and tissue chemistry analyses to determine if the level of risk along the Thames River differed from regional risk within the river, and if further evaluation of Zone 7 was necessary (Battelle 2008). The Thames River Validation Study concluded no areas within Zone 7 required evaluation in the Lower Subbase FS. No complete exposure pathways were identified for ecological receptors for soil in Zone 7, and no unacceptable risks were identified for ecological receptors for surface water or sediment in Zone 7 (NAVFAC August 2012).

## **13.3 Remedial Actions**

The OU 4 ROD that included Zone 7 (Sites 21 and 25) was signed by the Navy on 16 August 2012 and by U.S. EPA Region 1 on 23 August 2012. Some components of the remedial action, such as LTM and LUCs, at OU 4 will be managed comprehensively with zone-specific plans and remedial design documents as discussed herein.

### **13.3.1 Remedial Action Objectives**

Table 13-1 lists the RAOs for Zone 7 (Sites 21 and 25) under the land use scenarios with unacceptable risks in soil for human receptors identified in the ROD.

<b>Table 13-1 Remedial Action Objectives — Zone 7 (Sites 21 and 25)</b>	
<b>Current Land Use</b>	<b>Hypothetical Future Land Use</b>
Prevent exposure of current and future full-time employees (FTEs) and construction workers to surface/subsurface soil containing concentrations of contaminants of concern (COCs) greater than Industrial/Commercial preliminary remedial goals (RGs).	Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than Residential preliminary RGs.

<sup>2</sup> Only chloroform and TCE were evaluated using the Johnson and Ettinger VI model; naphthalene is also present above screening criteria but was not modeled.



Table 13-1 Remedial Action Objectives — Zone 7 (Sites 21 and 25)	
Current Land Use	Hypothetical Future Land Use
Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than preliminary RGs.	Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than preliminary RGs.
Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.	Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.

### 13.3.2 Remedial Goals

#### 13.3.2.1 Soil

To achieve the RAOs, human health RGs were developed for each COC. COCs were identified based on CTDEEP I/C DEC (lead) and PMC (antimony and lead) and Residential DEC (PAHs, arsenic, and lead) and PMC (PAHs, antimony, and lead). Table 13-2 summarizes RGs for Zone 7 COCs in soil.

Table 13-2 Remedial Goals for Zone 7 Contaminants of Concern in Soil				
Contaminant of Concern	Selected Remedial Goals			
	Human Health	Basis	Pollutant Mobility	Basis
<b>Residential Scenario</b>				
Benzo(a)anthracene	1 mg/kg	CTDEEP DEC RSR	4.4 mg/kg	Alternative PMC <sup>[1]</sup>
Benzo(a)pyrene	1 mg/kg	CTDEEP DEC RSR	6.5 mg/kg	Alternative PMC <sup>[1]</sup>
Benzo(b)fluoranthene	1 mg/kg	CTDEEP DEC RSR	2.8 mg/kg	Alternative PMC <sup>[1]</sup>
Benzo(k)fluoranthene	Not a COC	Not Applicable	7.1 mg/kg	Alternative PMC <sup>[1]</sup>
Chrysene	Not a COC	Not Applicable	7.4 mg/kg	Alternative PMC <sup>[1]</sup>
Dibenzo(a,h)anthracene	1 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Indeno(1,2,3-cd)pyrene	1 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Antimony	31 mg/kg	HHRA Hazard Index <sup>[2]</sup>	0.06 mg/L	CTDEEP PMC RSR <sup>[3]</sup>
Arsenic	10 mg/kg	CTDEEP DEC RSR	Not a COC	Not Applicable
Hexavalent Chromium	0.3 mg/kg	HHRA ILCR <sup>[4]</sup>	Not a COC	Not Applicable
Copper	3,130 mg/kg	HHRA Hazard Index <sup>[2]</sup>	Not a COC	Not Applicable
Lead	400 mg/kg	CTDEEP DEC RSR	0.15 mg/L	CTDEEP PMC RSR <sup>[3]</sup>
<b>Industrial/Commercial Scenario</b>				
Antimony	Not a COC	Not Applicable	0.1 mg/L <sup>[5]</sup>	Alternative PMC <sup>[3]</sup>
Lead	1,090 mg/kg <sup>[6]</sup>	Target Action Level <sup>[7]</sup>	0.32 mg/L <sup>[5]</sup>	Alternative PMC <sup>[3]</sup>

**Notes:**

mg/kg	=	milligrams per kilogram
CTDEEP	=	Connecticut Department of Energy and Environmental Protection
DEC	=	Direct Exposure Criterion
RSR	=	Remediation Standard Regulations
PMC	=	Pollutant Mobility Criteria
COC	=	Contaminant of Concern
HHRA	=	Human Health Risk Assessment
mg/L	=	milligrams per Liter
ILCR	=	Incremental Lifetime Cancer Risk

- [1] In areas with GB groundwater where no non-aqueous phase liquid is present, CTDEEP allows for calculation of site-specific Alternative PMC. The Alternative PMC for residential site use was determined assuming no pavement would be present to reduce infiltration.
- [2] Risk values based on HHRA for hypothetical child residents, hypothetical adult residents, or hypothetical lifelong residents.
- [3] The higher of the calculated Alternative PMC and CTDEEP PMC RSR was used as the Remedial Goal.
- [4] HHRA value based on 1.0E-06 ILCR to future residents after remediation
- [5] In areas with GB groundwater where no non-aqueous phase liquid is present, CTDEEP allows for calculation of site-specific Alternative PMC. The Alternative PMC for I/C site use was determined assuming pavement would be present to reduce infiltration.
- [6] Derived using U.S. EPA's Adult Lead Methodology; lead is evaluated separately from other COCs and is not included in risk totals.
- [7] Cumulative risk in Zone 7 meets U.S. EPA requirement of less than 1.0E-04.

The FS Addendum estimated 42,686 and 3,020 cubic yards of contaminated soil that needs to be addressed to eliminate potentially unacceptable risk to Residential and I/C receptors, respectively (NAVFAC August 2012).

### **13.3.2.2 Groundwater**

No groundwater COCs were identified for Zone 7; therefore, no RGs were established (NAVFAC August 2012).

### **13.3.3 Remedy Selection**

The remedy selected in the ROD includes the following components.

#### **13.3.3.1 Land Use Controls**

- Institutional controls (creating an implementable 199,500-square-foot LUC boundary) through a LUC RD
  - CTDEEP RSR engineered controls to meet I/C RGs.<sup>3</sup>
    - 20,480 square feet of existing pavement
    - 1,960 square feet of asphalt pavement to be installed over soil with COCs above the CTDEEP I/C DEC and Alternative PMC RGs)
  - CERCLA risk-based engineering controls (buildings and 121,600 square feet of pavement) to meet Residential RGs.<sup>4,5</sup>
  - Regular inspections and maintenance of buildings and pavement.

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<sup>3</sup> Under I/C site use, CTDEEP RSRs allow low permeability pavement to be a CTDEEP RSR engineered control, which is required in an area classified as I/C site use when concentrations of COCs are greater than the I/C DEC in the top 2 feet of soil beneath paved areas and/or where COCs are greater than the Alternative GB PMC RGs for I/C site use in soil above the water table.

<sup>4</sup> CTDEEP RSRs require CERCLA risk-based engineering controls to be comprised of a minimum of 3 inches of bituminous concrete or concrete, or be an existing building or another existing permanent structure.

<sup>5</sup> Soil beneath Buildings 106, 157, and 456 contains concentrations of COCs that exceed I/C RGs; however, this soil is considered inaccessible under CTDEEP RSRs and the CERCLA LUC in place would meet CTDEEP RSRs (NAVFAC August 2012). Under the I/C site use, CTDEEP RSR standards classify contaminated soil as inaccessible if it is unpaved and more than 4 feet bgs, more than 2 feet below a paved surface comprising a minimum of 3 inches of bituminous concrete or concrete, or beneath an existing building or another existing permanent structure (NAVFAC August 2012).

- Storm sewer upgrades (slip lining or sewer line replacement) and maintenance to address leachability issues at an estimated 170 linear feet where storm sewers pass through contaminated soil.

#### **13.3.3.2 Long-Term Monitoring**

- Groundwater monitoring for all COCs that exceed Residential RGs in soil to confirm that the remedy remains protective and contaminants are not migrating to groundwater.
- Regular inspections to ensure monitoring wells are maintained.

#### **13.3.3.3 Five-Year Reviews**

- Performing five-year reviews because contamination will remain in place above levels that allow for UU/UE.

### **13.3.4 Remedy Implementation**

#### **13.3.4.1 Engineered Controls and Storm Sewer Upgrades**

The following construction activities were implemented from April to July 2015 and are documented in the Draft CCR (AGVIQ May 2016): pavement removal in two areas, surface water runoff regrading and concrete CTDEEP RSR Engineered Controls cover placement behind Building 456, and storm water system drain upgrades, backfill, and placement of new asphalt north and east of Building 106, as explained in detail below. NSB NLON replaced portions of the storm sewer line as part of routine maintenance associated with construction of a building addition prior to preparation of the remedial design document (Resolution Consultants October 2013).

- CTDEEP RSR Engineered Controls were installed on the east side of Building 456. Existing asphalt pavement was removed and a sufficient volume of soil was excavated to allow creation of adequate surface grades. Once grades were achieved, exposed areas were repaved with concrete.<sup>6</sup> Approximately 1,960 square feet of concrete was poured (AGVIQ May 2016). In addition to the planned installation of the pavement, a retaining wall was designed and built to prevent erosion of the embankment leading up to the railroad tracks and an additional storm water drain inlet was placed to prevent storm water ponding behind Building 456.

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<sup>6</sup> Due to limited access between Building 456 and a transformer pad, the use of asphalt as indicated in the Final 60 Percent Design Report for cover was impractical; concrete was pumped in place as an alternative approved by the Navy (AGVIQ May 2016). Expansion joints between asphalt and concrete were sealed after a 30-day cure time (AGVIQ May 2016).

- Approximately 85 feet of terra cotta storm drain lines were replaced with new PVC pipe and catch basins (C532, C676, and C535) located north of Building 106 were replaced with new solid precast concrete structures and piped together. A new manhole and piping were installed east of catch basin C535. Existing piping between catch basins outside the southeast corner of Building 106 (C528 and C528-2) were replaced with new PVC pipe. Both catch basins required significant repairs, which was completed using brick and mortar (AGVIQ May 2016). A total of 1,904 square feet of asphalt was applied to Zone 7 to cover storm water replacement areas. Asphalt was applied in 3-inch thickness, except where existing asphalt was thicker, in which case the asphalt pour matched existing thickness (AGVIQ May 2016).
- Roof leaders (drains) encountered during installation of engineered covers along Building 456 and during removal of existing storm water lines were evaluated and either protected or replaced as necessary.
- Waste streams generated from Zone 7 construction work included soil, asphalt, concrete, construction debris, and general site refuse. Stockpiled soil was tested, treated, and transported offsite for disposal (210 tons of non-hazardous lead-contaminated soil and 1 ton of construction debris) or recycling (69 tons of pavement).

#### **13.3.4.2 Land Use Controls**

SUBASENLONINST 5090.25 is the current instruction that restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without LUC RDs throughout NSB NLON (Navy April 2013). The OU 4 Soil LUC RD will be finalized and implemented after remedial actions are completed at Zone 4.<sup>7</sup> Once finalized, the OU 4 Soil LUC RD will become the primary LUC document at Zone 7 (information from the LUC RD will also be incorporated into SUBASENLONINST 5090.25).

The OU 4 Soil LUC RD at Zone 7 will establish specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy:

- Restricting residential land use and development.
- Restricting disturbance of contaminated soil.

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<sup>7</sup> A Draft Final OU 4 Soil LUC RD (Resolution Consultants February 2013) updated a Draft OU 4 Soil LUC RD (Resolution Consultants November 2012) issued within 90 days of ROD signature.

- Maintaining a protective cover layer that meets CTDEEP RSR standards for I/C use.
- Maintaining a protective cover layer to provide CERCLA risk-based engineering controls (including features such as existing buildings and pavement that already cover inaccessible or environmentally isolated soil) and CTDEEP engineered controls (including pavement that already covers soil with concentrations of COCs greater than I/C DEC and PMC RGs).

#### **13.3.4.3 Long-Term Monitoring**

A GMP will be developed after remedial actions are completed at Zone 4 and incorporated into the O&M Manual. The post-remedial action GMP and O&M Manual will document inspection and maintenance protocols for institutional and engineering controls (e.g., pavement and building structures), as required by LUCs. The selected remedy will also include annual confirmation of compliance with LUCs (e.g., preventing intrusive activities, changes in land use). Results of the O&M Manual and annual LUC inspections will be provided to U.S. EPA Region 1 and CTDEEP.

#### **13.4 Progress Since the Last Five-Year Review**

This is the fourth five-year review of Sites 21 and 25.<sup>8,9</sup> The last five-year review recommended completion of the Lower Subbase ROD to select remedial action for Sites 21 and 25 (Zone 7) protective of human health and the environment, and strengthened enforcement of SOPA (ADMIN) NLONINST 5090.25 until selection and implementation of the final remedy (NAVFAC December 2011).

The 2011 Five-Year Review identified stockpiled soil from an excavation near the southeast corner of Building 106 that was not protected in compliance with SOPA ADMIN NLONINST 5090.25 (the instruction applicable at that time). This stockpiled soil was not observed during the site visit for the Fourth Five-Year Review.

Since the Third Five-Year Review, the ROD was signed (NAVFAC August 2012) and SUBASENLONINST 5090.25 replaced SOPA (ADMIN) NLONINST 5090.25. Table A-11 in Appendix A summarizes information from documents generated that include Zone 7 (Sites 21 and 25) since the last five-year review and reviewed for this five-year review: Lower Subbase Soil and Groundwater PDI Completion Report and FS Addendum (Tetra Tech January 2012), Proposed Plan (NAVFAC March 2012), OU 4 ROD (NAVFAC August 2012), OU 4 Soil LUC RD (Resolution Consultants

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<sup>8</sup> Previous five-year reviews included OU 4 (Lower Subbase) for informational purposes only, as the ROD had not been signed.

<sup>9</sup> The First, Second, and Third Five-Year Review reports discussed Site 21 and Site 25 in separate sections.

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Draft November 2012, Draft Final February 2013), SUBASENLONINST 5090.25 (Navy April 2013), 60 Percent Design Report for CERCLA Soil, Lower Subbase, OU 4 (Resolution Consultants November 2014), and Draft CCR (AGVIQ May 2016). Complete document references are in Section 14.

### **13.5 Technical Assessment**

#### **13.5.1 Question A: Is the Remedy Functioning as Intended by Decision Documents?**

##### **13.5.1.1 Data Summary**

Long-term monitoring data has not been generated at Zone 7 (Site 21 or Site 25) since the ROD was signed. GMPs will be developed comprehensively for OU 4; the GMP for Zone 7 will be prepared after remedial actions at Zone 4 are complete.

##### **13.5.1.2 Land Use Control Status**

The OU 4 Soil LUC RD is pending finalization following the completion of remedial actions at Zone 4. In the interim, SUBASENLONINST 5090.25 (Navy April 2013) restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at ER Program Sites without finalized LUC RDs throughout NSB NLON. As noted in Section 2.11.1, while SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as CTDEEP allows industrial use under this classification, which could potentially present exposure risks.

##### **13.5.1.3 Operations and Maintenance Summary**

SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subbase engineering controls (existing buildings and pavement). U.S. EPA's *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"* (OSWER Directive 9355.7-18) (U.S. EPA September 2011) identifies the need for clarity in long-term stewardship of LUCs (e.g., implementing, maintaining, and enforcing). Review of SUBASENLONINST 5090.25 indicated that no clear instructions for implementing, maintaining, or enforcing LUCs (e.g., inspection of pavement and buildings) have been provided in the interim period until the final OU 4 Soil LUC RD is implemented. While informal inspections may be performed by NSB NLON personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed.

#### 13.5.1.4 Five-Year Review Site Visit Findings

Buildings and pavement that covered most of Zone 7 remain as identified in the ROD or described in the CCR (AGVIQ pending 2016). There has been no demolition or removal of buildings or pavement that act as CERCLA risk-based engineering controls or CTDEEP RSR engineered controls to prevent exposure to underlying contaminated soil. Land use at Zone 7 has not changed since the last five-year review.

#### 13.5.1.5 Technical Evaluation

Table 13-3 summarizes the technical evaluation for Question A.

<b>Table 13-3</b> <b>Zone 7 (Sites 21 and 25) — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Remedial Action Performance	<p>The Operable Unit (OU) 4 remedy is in progress, as follows.</p> <ul style="list-style-type: none"> <li>• Buildings and approximately 121,600 square feet of pavement were designated as Comprehensive Environmental Response, Compensation, and Liability Act risk-based engineering controls to meet Residential remedial goals are in place.</li> <li>• 22,440 square feet of pavement designed as Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations engineered controls to meet Industrial/Commercial remedial goals is in place.</li> <li>• Completion of storm sewer repairs.</li> <li>• Land Use Controls (LUCs) — The OU 4 Soil Land Use Control Remedial Design (LUC RD) will be finalized after remedial action is completed at Zone 4. Until that time, Subase New London Instruction (SUBASENLONINST) 5090.25 is the functional LUC document for Zone 7. SUBASENLONINST 5090.25 has procedures to prevent unauthorized ground-disturbing activity and monitoring well abandonment.</li> <li>• Long-Term Monitoring — A Groundwater Monitoring Plan will be developed after remedial actions are completed at Zone 4 as a component of remedial design and incorporated into the Operations and Maintenance Manual.</li> </ul>
Systems Operation/ Operations and Maintenance	<p>SUBASENLONINST 5090.25 does not clearly define inspection requirements for Lower Subase engineering controls (existing buildings and pavement). While informal inspections may be performed by Naval Submarine Base New London personnel with maintenance conducted on an as-needed basis, formal LUC inspections and associated documentation have not been performed. As noted in Section 13.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.</p>
Opportunities for Optimization	<p>The long-term groundwater monitoring portion of the selected remedy at OU 4 has not been implemented so there have been no opportunities for optimization.</p>

<b>Table 13-3 Zone 7 (Sites 21 and 25) — Technical Evaluation — Question A</b>	
<b>Question</b>	<b>Summary</b>
Implementation of LUCs and Institutional/Engineering Controls	<p>SUBASENLONINST 5090.25 restricts ground surface disturbance of soils and any subsurface disturbance of soils and groundwater at Environmental Restoration Program Sites without finalized LUC RDs throughout Naval Submarine Base New London. Engineering and engineered controls at Zone 7 (Sites 21 and 25) are existing buildings and pavement present at the time of remedy selection, and pavement installed as a component of the selected remedy. As noted in Section 13.5.1.2, additional clarity is required to ensure implementation, maintenance, and enforcement of LUCs (e.g., inspection of pavement) occurs in the interim period prior to finalization of the OU 4 Soil LUC RD.</p> <p>While SUBASENLONINST 5090.25 prohibits use of groundwater, additional clarity is required in the pending OU 4 Soil LUC RD to prevent both potable and industrial/non-potable use. Further clarity may also be required in SUBASENLONINST 5090.25 in the interim to remove the reference to the GB groundwater classification, as Connecticut Department of Energy and Environmental Protection allows industrial use under this classification, which could potentially present exposure risks.</p>
Early Indicators of Potential Remedy Problems	None

### **13.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the time of the remedy selection still valid?**

#### **13.5.2.1 Risk Assessment Review: Current Conditions**

The basis for action at Zone 7 (Sites 21 and 25) was summarized in Section 13.2.2. Changes to exposure pathways, emerging contaminants, toxicity, and risk assessment methods that could affect protectiveness of the remedy are discussed below.

Unacceptable risks were identified for human receptors under both the current industrial and hypothetical future residential land-use scenarios. No unacceptable human health risks were identified for the current or reasonably anticipated future Residential or I/C scenarios for groundwater, surface water, or sediment; RGs were not identified for groundwater, which is classified GB (non-potable).

Remedial actions in Zone 7 were primarily due to PAHs, antimony, and lead in surface/subsurface soil; RGs were not identified for groundwater, which is classified GB (non-potable). Concern regarding migration of contaminants from soil to groundwater will be addressed via a GMP that will be developed and implemented to confirm that the remedy remains protective and that soil contaminants are not migrating to groundwater. No unacceptable ecological risks have been identified for Zone 7. A VI evaluation for Zone 7 conducted as part of this five-year review (shown in Table 2-1) concluded that no further evaluation of the VI pathway is necessary.<sup>10</sup>

<sup>10</sup> Chloroform present in groundwater at Zone 7 at concentrations which slightly exceed residential VISLs; however, these concentrations may be associated with numerous potable water lines which are located in Lower Subbase, and may not be associated with waste handling/disposal activities. They are not considered in this VI screening evaluation.

### 13.5.2.2 Technical Evaluation

The technical evaluation for Question B is in Table 13-4.

<b>Table 13-4</b> <b>Zone 7 (Sites 21 and 25) — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Applicable or Relevant and Appropriate Requirements or To-Be-Considered Criteria	In June 2013, the Connecticut Department of Energy and Environmental Protection (CTDEEP) updated the 1996 Residential Direct Exposure Criteria Remediation Standard Regulation (RSR) for lead in soil. The updated Direct Exposure Criteria RSR for lead is the same as the Remedial Goal for lead in the Record of Decision (ROD), so these changes do not affect the cleanup goals or the protectiveness of the remedy.
Changes in Exposure Pathways	Lead, antimony, and polynuclear aromatic hydrocarbons were the primary contaminants of concern at this site; therefore, vapor intrusion (VI) is not a pathway of concern.
Changes in Land Use	There have been no changes in land use since the Operable Unit (OU) 4 ROD was signed. There are no plans to close the base or transfer ownership outside the Navy. Buildings and pavement that cover Zone 7 and act as engineering controls in addition to pavement installed as CTDEEP RSR engineered controls prevent exposure to contaminated soil have been maintained to ensure continued protection. Subase New London Instruction (SUBASENLONINST) 5090.25 prevents land use changes without notification.
	During this five-year review, it was noted that although the human health risk assessment did not consider an unlimited use/unrestricted exposure scenario (e.g., potable use of groundwater), land use controls prohibiting groundwater use were not required in the OU 4 ROD. The need for future institutional controls to protect against the unlimited use/unrestricted exposure scenario should be evaluated further.
New/Emerging Contaminants and Contaminant Sources	<p><b>Dioxins</b> — A historical investigation of Berth 16 and the former incinerator included six soil samples analyzed for dioxins. Dioxin (2,3,7,8-tetrachlorodibenzodioxin [TCDD] equivalent of 0.16 nanograms per kilogram [ng/kg]) was detected in one boring where ash and cinders were observed. The methodology for calculating 2,3,7,8-TCDD has changed since the Lower Subase Remedial Investigation (RI) was prepared; based on current methodology, the 2,3,7,8-TCDD equivalent concentration would be 0.49 ng/kg, which is below the United States Environmental Protection Agency Residential Regional Screening Level at the 1.0E-06 threshold. The dioxin results were not used in the Lower Subase RI or Feasibility Study Human Health Risk Assessment.</p> <p><b>PFCs</b> — As noted in Section 2.8, there is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Site 2A; however, a basewide perfluorinated compound (PFC) desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.</p> <p><b>1,4-Dioxane</b> — The contaminant 1,1,1-trichloroethane was detected in groundwater at Site 21. The stabilizer 1,4-dioxane is commonly associated with this solvent. Previous investigations did not include soil or groundwater analysis for 1,4-dioxane. The Navy will perform presence/absence sampling for 1,4-dioxane at Zone 7 (Sites 21 and 25) in accordance with an approved Sampling and Analysis Plan.</p> <p>Remedy protectiveness is not affected by emerging contaminant issues relative to dioxins, PFCs, or 1,4-dioxane, as SUBASENLONINST 5090.25 prevents groundwater use.</p>

<b>Table 13-4 Zone 7 (Sites 21 and 25) — Technical Evaluation — Question B</b>	
<b>Question</b>	<b>Summary</b>
Changes in Toxicity, Risk Assessment Methods, and Cleanup Levels	No changes in toxicity values were found that would affect protectiveness of the remedy. From 2014 to December 2015, the United States Environmental Protection Agency updated its risk screening table, which includes exposure model assumptions, toxicity values, and criteria used to determine if a chemical is a volatile compound. The changes were incorporated into the risk models for volatile organic compounds, which may affect some sites where volatile organic compounds are a concern in groundwater if groundwater could be used as a potable source in the future. VI information was reviewed for Zone 7 (Sites 21 and 25) as shown in Table 2-1, which concluded that no further evaluation of the VI pathway was necessary.
Expected Progress towards Meeting Remedial Action Objectives	<p>The construction activity components of the selected remedy for Zone 7 (i.e., engineered control installation and storm sewer repair/upgrades) were completed and documented in a Draft Construction Completion Report (AGVIQ-CH2M HILL Constructors, Inc. Joint Venture III May 2016).</p> <p>Some components of the selected remedies for OU 4 zones and sites are being managed comprehensively; therefore, a Remedial Action Completion Report that will include Zone 7 will be issued following completion of remedial actions at Zone 4. In addition, the Draft OU 4 Soil Land Use Control Remedial Design (LUC RD) was prepared in November 2012 in accordance with the ROD, which required development of a LUC RD within 90 days of ROD signature. The OU 4 Soil LUC RD (currently Draft Final) and Groundwater Monitoring Plan for Zone 7 will be finalized following completion of remedial actions at Zone 4.</p>

### **13.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No other information has come to light that could call into question the protectiveness of the remedy.

## **13.6 Issues and Recommendations**

Issues and recommendations for Zone 7 (Sites 21 and 25) are identified in Table 13-5.

## **13.7 Protectiveness Statement**

Remedial actions at OU 4 are still ongoing. Currently, human and ecological exposures are under control and no unacceptable risks are occurring. The remedy at Zone 7 (Sites 21 and 25) will be protective of human health and the environment upon completion. Storm sewer upgrades have been completed, CERCLA risk-based engineering controls (existing building foundations and pavement) and CTDEEP RSR engineered controls (pavement installed as a component of the remedy) are in place, and LUCs and LTM will be established to enforce remedy implementation. Implementation of SUBASENLONINST 5090.25 provides institutional controls until the LUC RD is finalized.



Table 13-5 Zone 7 (Sites 21 and 25) — Issues and Recommendations/Follow-Up Actions								
Issue Number	Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date <sup>[1]</sup>	Affects Protectiveness (Y/N)		
						Current	Future	
Institutional Controls								
1	Annual LUC inspections and certifications were not performed in accordance with the Draft Final OU 4 Soil LUC RD at Sites 10 and 11 in 2013, 2014, and 2015. SUBASENLONINST 5090.25 does not clearly define implementation, maintenance, and enforcement requirements for OU 4 engineering controls during the interim period prior to finalization of the OU 4 Soil LUC RD.	Modify procedures to ensure that annual LUC inspections and certifications are performed in accordance with the OU 4 Soil LUC RD at Site 10 and 11.	Navy	U.S. EPA, CTDEEP	31 March 2017	N	N	
2	Review of SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD identified the following: <ul style="list-style-type: none"><li>Additional clarity is required in the pending OU 4 Soil LUC RD to prevent potable use of groundwater.</li><li>SUBASENLONINST 5090.25 and the Draft Final OU 4 Soil LUC RD language do not consider the potential for vapor intrusion during the event of future construction scenarios at Zone 7.</li></ul>	Review SUBASENLONINST 5090.25 to determine whether modifications are required. (When the OU 4 Soil LUC RD is finalized, include these provisions as necessary [e.g., language that explicitly prohibits potable use of groundwater].)	Navy	U.S. EPA, CTDEEP	31 December 2017	N	N	
3	SUBASENLONINST 5090.25 cites CTDEEP's GB classification within the instruction; however, CTDEEP does allow industrial use under the GB groundwater classification which could potentially present exposure risks.	Given the presence of VOCs in groundwater at multiple sites within the ER program, SUBASENLONINST 5090.25 should be updated to remove the reference to the GB groundwater classification.	Navy	U.S. EPA, CTDEEP	31 July 2017	N	N	
Monitoring								
4	The contaminant 1,1,1-trichloroethane was detected in groundwater at Site 21. The stabilizer 1,4-dioxane is commonly associated with this solvent. Previous investigations at Zone 7 (Sites 21 and 25) did not include soil or groundwater analysis for 1,4-dioxane.	Perform presence/absence sampling for 1,4-dioxane at Zone 7 (Sites 21 and 25) in accordance with an approved Sampling and Analysis Plan.	Navy	U.S. EPA, CTDEEP	30 April 2018	N	N	
5	There is no documented use of perfluorooctanoic acids/perfluorooctanesulfonic acids at Sites 21 and 25; however, a basewide PFC desktop study/preliminary assessment is underway and will be performed in accordance with Navy policy.	Complete basewide PFC desktop study/preliminary assessment.	Navy	U.S. EPA, CTDEEP	31 January 2018	N	N	



**Notes:**

<sup>[1]</sup> Milestone dates presented in this table reflect draft submittals, where applicable.

LUC	=	Land Use Control	LUC RD	=	Land Use Control Remedial Design
SUBASENLONINST	=	Subbase New London Instruction	OU	=	Operable Unit
U.S. EPA	=	United States Environmental Protection Agency	CTDEEP	=	Connecticut Department of Energy and Environmental Protection
VOC	=	Volatile Organic Compound	PFC	=	Perfluorinated Compound

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**Appendix A**  
**Site Histories**

**Table A-1**  
**Site 2A — Site History and Background**

<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1957 to 1973	Area A Landfill operational	All combustible materials generated by base operations that were not salvageable were incinerated, and the residues were disposed in the former Defense Reutilization and Marketing Office (Site 6), Goss Cove Landfill (Site 8), and Area A Landfill (Site 2A). The former base incinerator, located in the Lower Subbase (Operable Unit [OU] 4), ceased operating in 1963. From 1963 to 1973, refuse and debris were disposed in the Area A Landfill; landfilling at Area A ceased in 1973. The thickness of the landfill materials is estimated to range from 10 to 20 feet, based on test boring data. The area fill method was reportedly used in landfill operations — new refuse was dumped along the face of previously deposited refuse and covered with sand and gravel obtained from the Groton water supply reservoir. After closure, a concrete pad was constructed in the southwestern portion of the landfill, adjacent to and northeast of Building 373, for aboveground storage of industrial wastes.
March 1983	Initial Assessment Study (IAS) <i>Envirodyne Engineers March 1983</i>	In the early 1980s, 42 steel drums, 87 transformers (containing mineral oil and polychlorinated biphenyls [PCBs]), and 60 to 80 electrical switches were found stored on the pad. Two transformers and several electrical switches were reportedly leaking and oil stains from past leakage were evident. Most drums were stacked on wooden pallets; those having PCB labels were covered and bound with plastic sheeting. All these materials were properly disposed offsite (Brown & Root Environmental, Inc. [B&RE] March 1997). The IAS Report identified that refuse, including steel drums, oxygen candles, wood and metal scrap, concrete, and tires, was exposed at the edge of the landfill adjacent to the Area A Wetland (Site 2B). Petroleum and battery acid releases were also documented in the IAS. The IAS also concluded the potential for past disposal of radioactive material was "effectively zero."
February 1988	Verification Step 1A Study <i>Wehran February 1988</i>	During a 1988 inspection of the site, iron floc was observed along the toe of the slope of the landfill, extending from the dike to the eastern end of the Deployed Parking Area. Sand bags, salt, supplies, and equipment were stored on top of the landfill. Several transformers, underground storage tanks, crane weights, and other equipment were observed on the concrete pad designed for industrial waste storage.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services, Inc. (Atlantic) August 1992</i>	Field activities conducted from 1990 to 1992 for the Phase I RI encountered landfill materials such as glass, brick, wood, plastic, and ash intermixed with sand and gravel material used as cover. The Phase I RI concluded that risks associated with several exposure scenarios exceeded applicable regulatory levels and recommended that a feasibility study (FS) be performed.
1995	Focused FS for OU 1 <i>Atlantic May 1995</i>  Proposed Plan for OU 1 <i>Navy May 1995</i>  Record of Decision (ROD) for OU 1 <i>Navy September 1995</i>	The selected remedy was: cap installation (Resource Conservation and Recovery Act Subtitle C), access restrictions (which included institutional controls), site grading and stormwater management, leachate collection and treatment (if needed), and post-closure groundwater monitoring.
December 1996	Area A East End Investigation Report <i>B&amp;RE December 1996</i>	Additional field activities were performed to define the eastern Area A Landfill boundary. The report concluded that the cap designed for the Area A Landfill remediation did not need to be extended to encompass the Area A east end recreational facilities; thereby reducing the site boundary from what was originally presented in the ROD.
December 1996	Remedial Design (RD) for OU 1 <i>Atlantic January 1994 and May 1994, Halliburton NUS May 1995, and B&amp;RE December 1996</i>	The RD for OU 1 began in 1994 and was completed in December 1996. Additional field work was conducted to collect the data necessary to complete the design and an extensive groundwater modeling study was also completed to address design issues (i.e., leachate collection system, slope stability, etc.).



<p align="center"><b>Table A-1</b> <b>Site 2A — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
March 1997	Phase II RI Report <i>B&amp;RE March 1997</i>	Field activities performed from 1993 to 1995 for the Phase II RI concluded that shallow groundwater contamination (i.e., volatile organic compounds, PCBs, and inorganics) exists at the site, landfill soil may pose a threat to human receptors due to PCB concentrations, and chemicals in soil could adversely impact ecological receptors. The Phase II RI recommended the implementation of a groundwater monitoring program and access/use restrictions.
September 1997	Remedial Action (RA) completed  Final Work Plan for Area A Landfill Cap <i>Foster Wheeler Environmental Corporation February 1997</i>  Final Report for Interim Remedial Action at Area A Landfill <i>B&amp;RE March 1998</i>	The RA was completed in accordance with the Final Work Plan and documented in the Final Report. The final cover system developed during the design included most of the components selected in the ROD with minor modifications as a result of normal refinement of RD. The two most significant modifications were: no leachate collection system and increased protection at the toe of the side slope area.
October 1999	Groundwater and Surface Water Monitoring Program initiated  Groundwater Monitoring Plan for Area A Landfill <i>Tetra Tech January 1999</i>	Groundwater and surface water sampling began at Site 2A and in the adjacent wetland (Site 2B) in accordance with the Groundwater Monitoring Plan. The groundwater and surface water monitoring program was initiated to assess the Site 2A RA.
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	The First Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following: <ul style="list-style-type: none"> <li>• Prepare and implement an Operations and Maintenance (O&amp;M) Plan for the Area A Landfill to address deficiencies.</li> <li>• Continue the Groundwater Monitoring Program, but optimize the sampling frequency and analytical parameter list. Determine the appropriate RA for the groundwater OU, if necessary, when sufficient data has been collected.</li> <li>• Consider further restricting access to the site.</li> <li>• Continue enforcement of Standard Operation Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18. (Note: SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>
December 2001	Basewide Groundwater Operable Unit Remedial Investigation (BGOURI) Report <i>Tetra Tech December 2001</i>	The analytical results from Year 1, Round 4 of the post-RA Site 2A monitoring program were evaluated in the BGOURI. The BGOURI at Sites 2A and 2B included groundwater sampling at existing permanent monitoring wells and concluded that groundwater impacts associated with the Area A landfill at Sites 2A and 2B were minimal and localized. The BGOURI recommended continuation of groundwater monitoring and assessment of data to determine the need for additional RA evaluation (i.e., an FS).

<p align="center"><b>Table A-1</b> <b>Site 2A — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Continue O&amp;M of the site and address the deficiencies noted.</li> <li>• Install screens on every gas vent and add an additional jersey barrier for gas vents GVR-1 and GVR-11.</li> <li>• Continue the monitoring program, but reduce sampling frequency to annual and further optimize the analytical parameter list, as appropriate. Develop and implement a well abandonment program to eliminate wells that were no longer required for the monitoring program (e.g. 2LMW8S, 2LMW18S, 2LMW18D, 2LMW20D, and 2LMW34DS).</li> <li>• Develop and implement an equipment storage plan that would organize storage, provide safe methods for storage of equipment on the cap, and eliminate storage of equipment on top of active monitoring wells.</li> <li>• Select an appropriate RA for the groundwater OU and document the remedy in a Proposed Plan and ROD.</li> <li>• Continue enforcement of SOPA (ADMIN) NLOINST 5090.18. Continue control of the site by Command Masters at Arms, but consider further restricting access to the site to eliminate dumping of waste.</li> <li>• Conduct at least yearly monitoring of Institutional Control compliance, and document in the monitoring reports and future five-year reviews.</li> <li>• Amend the O&amp;M Manual to remove federal ambient water quality criteria.</li> </ul>
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	The inventory included 47 Site 2A wells; 41 Site 2A wells that were not part of an active monitoring program were abandoned in 2007.
2008	Proposed Plan for Basewide Groundwater OU 9 <i>NAVFAC June 2008</i>  ROD for Basewide Groundwater OU 9 <i>NAVFAC September 2008</i>	OU 9 includes groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23. The ROD included an updated human health risk assessment for groundwater at Sites 2A and 2B. No additional action was required under OU 9 to address groundwater at Site 2; the selected remedy was the continuation of institutional controls and groundwater monitoring as specified in the OU 1 ROD.
November 2009	Land Use Control Remedial Design (LUC RD) for Basewide Groundwater OU 9 <i>Tetra Tech November 2009</i>	The OU 9 LUC RD included Sites 2A and 2B groundwater; see Sections 2.11.2 and 3.5.1.2 of the Fourth Five-Year Review Report for additional information on groundwater land use controls (LUCs) at Sites 2A and 2B.
June 2010	Remedial Action Completion Report for Basewide Groundwater OU 9 <i>Tetra Tech June 2010</i>	The OU 9 Remedial Action Completion Report documented that institutional controls and monitoring were in place for groundwater Sites 2A and 2B.
July 2011	O&M Manual Volumes I, II, III, IV, V, and VI <i>Tetra Tech July 2011</i>	This version, Revision 2, included a revised Groundwater Monitoring Plan (Volume II) and updated inspection plan (Volume III) for Site 2A. Monitoring criteria was updated with values selected in the Resolution of Monitoring Criteria Technical Memorandums (Tetra Tech 31 March 2010; 27 April 2011). Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 3.5.1.3 of the Fourth Five-Year Review Report.

Table A-1 Site 2A — Site History and Background		
Date	Event/Document	Description
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the remedy for Site 2A was protective of human health and the environment. Recommendations are described in Section 3.4 of the Fourth Five-Year Review Report.
November 2012	O&M Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged.
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 2A until a LUC RD is finalized. Additional information can be found in Sections 2.11.1 and 3.5.1.2 of the Fourth Five-Year Review Report.
March 2015	Draft OU 1 LUC RD <i>Resolution Consultants March 2015</i>	The OU 1 LUC RD included source control at Site 2A; see Sections 2.11.5 and 3.5.1.2 of the Fourth Five-Year Review Report for additional information on source control LUCs at Site 2A.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-2</b> <b>Site 2B — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1950s	Wetland created with Thames River dredge spoils. A small pond in the southern portion of Site 2B has between 1 and 3 feet of standing water based on the season. The invasive species Phragmites is the predominant vegetation. Pesticide bricks were reportedly placed on ice that formed during winter months and allowed to dissolve as a mosquito control measure. The bricks consisted of formulated (water-soluble) 4,4'-dichlorodiphenyltrichloroethane and were used in the 1960s, prior to the 1972 ban on 4,4'-dichlorodiphenyltrichloroethane.	
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic August 1992</i>	Field activities performed from 1990 to 1992 for the Phase I RI of Site 2B concluded that risks associated with several exposure scenarios exceeded acceptable regulatory levels. The Phase I RI recommended that a feasibility study (FS) be performed.
March 1997	Phase II RI Report <i>Brown &amp; Root Environmental, Inc. March 1997</i>	Field investigation activities conducted from 1993 to 1995 for the Phase II RI report concluded that little surface water or groundwater contamination existed at the site; the site could pose risk to a construction worker due to potential exposure to manganese in groundwater; and significant pesticide, polychlorinated biphenyl, and polynuclear aromatic hydrocarbon concentrations existed in site soil and sediments. The Phase II RI recommended an FS be performed.
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	The First Five-Year Review did not make a protectiveness determination for Site 2B. The report recommended completing the RI/FS process for the Area A Wetland and determining the appropriate remedial action (RA).
December 2001	Basewide Groundwater Operable Unit Remedial Investigation (BGOURI) Report <i>Tetra Tech December 2001</i>	The analytical results from Year 1, Round 4 of the post-RA Site 2A monitoring program were evaluated in the BGOURI. The BGOURI at Sites 2A and 2B included groundwater sampling at existing permanent monitoring wells and concluded that groundwater impacts associated with the Area A landfill at Sites 2A and 2B were minimal and localized. The BGOURI recommended continuation of groundwater monitoring and assessment of data to determine the need for additional RA evaluation (i.e., an FS).
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	The Second Five-Year Review did not make a protectiveness determination for Site 2B. The report recommended completing the RI/FS process for the Area A Wetland and determining the appropriate RA.
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	The inventory included 24 Site 2B wells, three Site 2B wells that were not part of an active monitoring program were abandoned in 2007.
February 2008	Phase III RI Technical Memorandum for Area A Wetland <i>Tetra Tech February 2008</i>	The Phase III RI, conducted in October 2007, further refined the nature and extent of contamination in sediments, provided sufficient data to determine potential risks to ecological receptors, and determined the thickness of the overlying organic layer that had formed above the dredge spoils. The Phase III RI Technical Memorandum stated that risks to sediment invertebrates and wildlife (mammals and birds) were not likely to be significant enough to warrant further evaluations (e.g., toxicity testing). The depth of dredge spoils ranged from 2.5 to 20 feet at the site; generally shallower along the edge of the site and deeper towards the middle. The greatest concentrations were generally found in the western portion of the wetland, adjacent to the Area A Weapons Center (Site 20) and Area A Landfill (Site 2A). The Phase III RI concluded that the deeper dredge spoils are generally less contaminated than surface sediment, indicating the source of contamination in the Area A Wetland were from surface releases such as runoff and placement of pesticide bricks and not from placement of dredge spoils.
2008	Proposed Plan for Basewide Groundwater Operable Unit (OU) 9 <i>NAVFAC June 2008</i>  Record of Decision (ROD) for Basewide Groundwater OU 9 <i>NAVFAC September 2008</i>	OU 9 includes groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23. The ROD included an updated human health risk assessment for groundwater at Sites 2A and 2B. No additional action was required under OU 9 to address groundwater at Site 2; the selected remedy was the continuation of institutional controls and groundwater monitoring as specified in the OU 1 ROD.

<b>Table A-2</b> <b>Site 2B — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
October 2008	Phase IV RI <i>Tetra Tech October 2008</i>	A Phase IV RI of the sediments at Site 2B included collection of sediment samples for chemical analysis and toxicity testing for sediment invertebrates.
November 2009	Land Use Control Remedial Design (LUC RD) for Basewide Groundwater OU 9 <i>Tetra Tech November 2009</i>	The OU 9 LUC RD included Sites 2A and 2B groundwater; see Sections 2.11.2 and 3.5.1.2 of the Fourth Five-Year Review Report for additional information on groundwater land use controls (LUCs) at Sites 2A and 2B.
June 2010	RI Update/FS for Sediment at Area A Wetland <i>Tetra Tech June 2010</i>	The RI update and FS for sediments in OU 12 included documentation of field activities performed during the Phase IV RI. A screening ecological risk assessment identified unacceptable risks to ecological receptors and preliminary remedial goals were developed and used in the FS to establish areas for remediation and wetland restoration.
June 2010	Remedial Action Completion Report (RACR) for Basewide Groundwater OU 9 <i>Tetra Tech June 2010</i>	The OU 9 RACR documented that institutional controls and monitoring were in place for groundwater at Sites 2A and 2B.
2010	Proposed Plan for Sediment at Area A Wetland — Site 2B, Operable Unit 12 <i>NAVFAC June 2010</i>  ROD for Site 2B — Area A Wetland <i>NAVFAC August 2010</i>	The selected remedy was excavation, offsite disposal, site restoration, and LUCs.
March 2011	Field Sampling and Analysis Plan for Sediment at Area A Wetland <i>Tetra Tech March 2011</i>	The Field Sampling and Analysis Plan was prepared to address data gaps in the RI Update/FS Report. The results were used to refine the extent of contamination and volume of contaminated sediment that required excavation.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that a protectiveness statement could not be made for Site 2B because the remedy was not in place. Recommendations are described in Section 4.4 of the Fourth Five-Year Review Report.
January 2012	Site 2B LUC RD <i>Tetra Tech January 2012</i>	See Sections 2.11.3 and 4.5.1.2 of the Fourth Five-Year Review Report for additional information on sediment LUCs at Site 2B.
July 2012	Final 30 Percent Remedial Design for Area A Wetland Remedial Action <i>Tetra Tech July 2012</i>  Site 2B Final Remedial Action Work Plan (RAWP) <i>Shaw July 2012</i>	The 30 Percent RD included the basis of design, environmental permits report, erosion and sediment control plan report, specifications, and drawings to be incorporated into the RAWP. The RAWP detailed the design components and implementation steps of the selected remedy for Site 2B sediment.
November 2012	O&M Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 4.5.1.3 of the Fourth Five-Year Review Report.
January 2013	Site 2B Remedial Action completed  Final Site 2B RACR <i>CB&amp;I Federal Services June 2015</i>	The remedy selected in the OU 12 was completed, as documented in the RACR and described in Section 4.3.4 of the Fourth Five-Year Review Report.
June 2013	Long-term restoration monitoring began	Post-construction monitoring began upon completion of the remedial action. The results of Years 1 to 3 monitoring (inspections) are discussed in Section 4.5.1.1 of the Fourth Five-Year Review Report; based on information in three CB&I Federal Services.



***Note:***

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-3</b> <b>Site 3 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1960s	Pesticides used	Pesticides were applied to surface water bodies at Site 3 to control mosquito populations adjacent to North Lake and the golf course.
March 1983	Initial Assessment Study (IAS) <i>Envirodyne Engineers March 1983</i>	The IAS reported the Overbank Disposal Area (OBDA) was used as a disposal site after the Area A Dike was constructed 1957 and disposal operations ceased sometime before 1982, when the IAS identified the material. The materials were not covered and included 30 partially buried 200-gallon metal fuel tanks and scrap lumber.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services (Atlantic) August 1992</i>	Field activities conducted from 1990 to 1992 for the Phase I RI concluded that risks associated with several exposure scenarios exceeded applicable regulatory levels. The Phase I RI recommended that a feasibility study (FS) be performed.
April 1994	Draft Focused FS <i>Atlantic April 1994</i>	Additional soil and sediment samples were collected and analyzed during the Focused FS to further define the extent of contamination.
March 1997	Phase II RI Report <i>Brown &amp; Root Environmental (B&amp;RE) March 1997</i>	Field activities performed from 1993 to 1995 for the Phase II RI concluded that volatile organic compounds (VOCs) were present in groundwater, the site posed non-carcinogenic risks to the site worker and older child trespasser, and notable concentrations of pesticides exist in site soil and sediments. The Phase II RI recommended revisiting the Site 3 Focused FS to focus on pesticides in soil and sediment, additional sampling to delineate pesticide contamination and determine the origin of VOCs in groundwater, and removal of waste materials associated with the OBDA.
March 1997	OBDA Non-Time Critical Removal Action completed  Final Work Plan for OBDA <i>Foster Wheeler Environmental Corporation (FWEC) January 1997</i>  Final Post Removal Report for Over Bank Disposal Area <i>FWEC July 1997</i>	Waste materials identified during the Phase II RI were removed from the OBDA. Activities included installation of sedimentation and erosion control, clearing, and removal and disposal of debris in accordance with the Final Work Plan and documented in the Final Post Removal Report.
1997	FS for Soil and Sediment <i>B&amp;RE December 1997</i>  Proposed Plan for Area A Downstream <i>Naval Facilities Engineering Command (NAVFAC) July 1997</i>  Record of Decision (ROD) for Soil and Sediment, Area A Downstream Watercourses/OBDA <i>NAVFAC December 1997</i>	The selected remedy was: excavation and dredging of sediment and soil, onsite dewatering, offsite disposal of sediment and soil, restoration of wetlands and waterways, and monitoring.
1999	Preliminary Design Report <i>FWEC April 1999</i>	The Preliminary Design Report detailed the results of an additional investigation performed to more accurately delineate the extent of contamination and calculate volumes of contaminated media.
August 1999	Engineering Evaluation/Cost Analysis for OBDA, and Action Memorandum for OBDA <i>Navy August 1999</i>	The Engineering Evaluation/Cost Analysis and Action Memorandum documented the decision process followed and provided a cost evaluation of the Non-Time Critical Removal Action.

<p align="center"><b>Table A-3</b> <b>Site 3 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1999 to 2000	<p>Site 3 — Soil and Sediment Remedial Action (RA) performed</p> <p>100 Percent Design, Area A Downstream/OBDA Remediation <i>FWEC April 2000</i></p> <p>Remedial Action Report, Area A Downstream/OBDA Remediation <i>FWEC February 2001</i></p>	<p>All aspects of the selected remedy were implemented in accordance with the 100 Percent Design and documented in the Remedial Action Report. During the RA, contaminated soil and sediment were discovered in and around two abandoned pipes at Stream 4. The material could not be removed without compromising the integrity of the Area A Dike; the ends of the pipes were isolated and encapsulated with concrete.</p> <p>During the RA, a new source of petroleum contamination was detected on the north side of Stream 5; a small disposal area (buried drums, cable, etc.) discovered and named Site 3 — New Source Area (NSA). The NSA was not remediated during the RA because the nature and extent of the contamination had not been delineated; however, absorbent booms, hay bales, and sheeting were put in place to minimize migration into and downstream of Stream 5.</p>
August 2000 to September 2003	<p>Post-construction restoration monitoring performed <i>FWEC November 2002, June 2003, October 2004</i></p>	<p>Three years of post-construction monitoring was performed upon completion of the RA as documented in the Year 1, Year 2, and Year 3 Long-Term Monitoring Reports. Monitoring was performed in accordance with the Final Long-Term Wetland Monitoring Plan (FWEC September 2001)</p>
December 2001	<p>First Five-Year Review <i>NAVFAC December 2001</i></p>	<p>The First Five-Year Review stated that the soil and sediment remedy was “generally protective of human health and the environment” and that there was a limitation of the remedy because it did not address Site 3 — NSA. Groundwater was still under investigated, but the report stated that there were no immediate threats to human health or the environment due to groundwater. The report recommended the following:</p> <ul style="list-style-type: none"> <li>• Continue the post-construction/long-term monitoring and restoration program.</li> <li>• Address erosion of Stream 5.</li> <li>• Complete planning documents and conduct the removal action for the NSA.</li> <li>• Maintain the existing monitoring well network and/or properly abandon unnecessary monitoring wells.</li> <li>• Continue the RI/FS process and develop and implement an appropriate remedial alternative for the groundwater operable unit (OU).</li> <li>• Enforce the Standard Operating Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLOINST) 5090.18. (Note: SOPA [ADMIN] NLOINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>
December 2001	<p>Basewide Groundwater Operable Unit RI (BGOURI) Report <i>Tetra Tech December 2001</i></p>	<p>The BGOURI at Site 3 identified chlorinated VOCs similar to those detected during the Phase II RI, and hypothesized that Site 3 — NSA or another upgradient source, such as the leach fields at Site 7, may be the source of VOCs.</p>

**Table A-3**  
**Site 3 — Site History and Background**

Date	Event/Document	Description
July 2004	BGOURI Update/FS <i>Tetra Tech July 2004</i>	A data gap investigation was conducted in fall 2002 to investigate Site 3 — NSA and confirm groundwater results of the BGOURI. The results of the data gap investigation and the FS for Site 3 — NSA were presented in the BGOURI/FS. Petroleum contamination, but no source of VOC contamination, was identified at Site 3 — NSA. Groundwater data indicated that VOCs originally released upgradient, in the vicinity of Site 7, were migrating through Site 3; the primary original compound was likely trichloroethene. Comparison of results to previous investigations concluded that VOC concentrations in groundwater were decreasing steadily and degradation products from the dechlorination of trichloroethene had been detected, indicating that natural attenuation was occurring. No further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) was the selected remedy for Site 3 — NSA soil. Total petroleum hydrocarbon contamination at Site 3 — NSA would be addressed under Connecticut Department of Energy and Environmental Protection (CTDEEP).
2004	Proposed Plan for Site 3 — NSA Soil <i>NAVFAc July 2004</i>  Record of Decision for Site 3 — NSA Soil <i>NAVFAc September 2004</i>	Although no further action was selected for petroleum-contaminated soil under CERCLA, the ROD detailed the Navy's cleanup plan to address petroleum-contaminated soil under other applicable regulations. Those actions are not included in this chronology, because they were non-CERCLA response actions.
2004	Proposed Plan for Sites 3, 7, 14, 15, 18, and 20 Groundwater (OU 9) <i>NAVFAc September 2004</i>  Interim ROD for Sites 3, 7, 14, 15, 18, and 20 Groundwater (OU 9) <i>NAVFAc December 2004</i>	The Proposed Plan and the Interim ROD selected remedies for groundwater at several sites which comprised OU 9 at that time, including Site 3. The selected remedy was: institutional controls and groundwater monitoring.
June 2005	Land Use Control Remedial Design (LUC RD) for Sites 3 and 7 Groundwater <i>Tetra Tech June 2005</i>	The LUC RD included Site 3 groundwater and was superseded by the OU 9 LUC RD (Tetra Tech November 2009).
March 2006	Work Plan for RA at Sites 3 and 7 <i>Tetra Tech March 2006</i>	Additional RA work was performed, including: well installation and redevelopment, installation of dedicated sampling equipment, sampling, and surveying of site boundaries. The Work Plan for RA also detailed groundwater monitoring program requirements.
May 2006	Groundwater Monitoring Program initiated	Groundwater sampling began at Site 3 in accordance with the Work Plan for RA.

<p align="center"><b>Table A-3</b> <b>Site 3 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the soil and sediment remedy at Site 3 was protective of human health and the environment. The groundwater remedy was expected to be protective of human health and the environment. The five-year review identified no immediate threats to human health or the environment from OU 3 because groundwater was not used as a drinking water source and implementation of institutional controls and monitoring would maintain future effectiveness of the remedy. The report recommended the following:</p> <ul style="list-style-type: none"> <li>• Continue the groundwater monitoring program.</li> <li>• Conduct the (non-CERCLA) removal action for Site 3 — NSA so that the RAs for soil and sediment at Site 3 would be completely protective for human health and the environment.</li> <li>• Continue to enforce SOPA (ADMIN) NLONINST 5090.18C.</li> <li>• Maintain the existing monitoring well network and/or properly abandon unnecessary monitoring wells.</li> <li>• Conduct at least yearly monitoring of Institutional Control compliance, and document in the monitoring reports and future five-year reviews.</li> <li>• Prepare and issue an Explanation of Significant Difference (ESD) for the encapsulated soil at Stream 4 that addresses CERCLA requirements.</li> </ul>
May 2007	ESD for OU 3 Site 3 – Soil and Sediment ROD <i>NAVFAC May 2007</i>	Due to the concrete-encapsulated soil that remains after the RA, an ESD was issued. The ESD selected land use controls (LUCs) and long-term monitoring (groundwater monitoring and inspections).
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	The inventory included 22 Area A Downstream Watercourses wells and four OBDA wells; 11 Area A Downstream Watercourses wells and two OBDA wells not part of an active monitoring program were abandoned in 2007.
2008	Proposed Plan for Basewide Groundwater OU 9 <i>NAVFAC June 2008</i>  ROD for Basewide Groundwater OU 9 <i>NAVFAC September 2008</i>	OU 9 includes groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23. The selected remedy at Site 3 was: institutional controls and groundwater monitoring as a continuation of the remedy presented in the Interim ROD (NAVFAC December 2004).
March 2009	Letter from the Navy to CTDEEP <i>Navy March 2009</i>	Groundwater samples collected from monitoring well 2DMW29S in 2006, 2007, and 2008 contained concentrations of vinyl chloride above the CTDEEP Remediation Standard Regulation residential volatilization criteria. As a result, the Navy submitted this letter that explained a self-imposed limitation which prohibited construction of buildings or other structures within 100 feet of the monitoring well.
November 2009	LUC RD for Basewide Groundwater OU 9 <i>Tetra Tech November 2009</i>	The OU 9 LUC RD includes Site 3 groundwater; see Sections 2.11.2 and 5.5.1.2 of the Fourth Five-Year Review Report for additional information on LUCs at Site 3.
June 2010	Remedial Action Completion Report for Basewide Groundwater OU 9 <i>Tetra Tech June 2010</i>	The OU 9 Remedial Action Completion Report documented that institutional controls and monitoring were in place for groundwater at Site 3.
July 2011	Operations and Maintenance Manual Volumes I, II, III, IV, V, and VI <i>Tetra Tech July 2011</i>	This version, Revision 2, included a groundwater monitoring plan (Volume II) and inspection plan (Volume VI) for Site 3. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 5.5.1.3 of the Fourth Five-Year Review Report.



<b>Table A-3</b> <b>Site 3 — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the soil and sediment remedy for Site 3, including the NSA, was protective of human health and the environment. The groundwater remedy for Site 3 was expected to be protective of human health and the environment and there were no immediate threats to human health or the environment. Recommendations are described in Section 5.4 of the Fourth Five-Year Review Report.
November 2012	Operations and Maintenance Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged.
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 3 until a LUC RD is finalized. Additional information can be found in Sections 2.11.1 and 5.5.1.2 of the Fourth Five-Year Review Report.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-4</b> <b>Site 6 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1950 to 1969	Defense Reutilization and Marketing Office (DRMO) operational	<p>All combustible materials generated by base operations that were not salvageable were incinerated, and the residues were disposed in the former DRMO (Site 6), Goss Cove Landfill (Site 8), and Area A Landfill (Site 2A). The former base incinerator, located in the Lower Subbase, ceased operating in 1963. Wastes were also burned at Site 6.</p> <p>An inspection on 30 September 1988 noted that metal and wood products were stored throughout most of the site. Buildings 355 and Building 479 were primarily used for storage, located in the southern, paved portion of the site. A large scrap yard was located north of Building 479. Building 491, located in the northern, unpaved, portion of the site was used to store miscellaneous items including batteries and formerly housed a battery acid-handling facility. Metal scrap bailing operations were performed adjacent to Building 491 on a gravel surface. Submarine batteries were previously stored in the southeast portion of the site, adjacent to the Providence and Worcester Railroad tracks. No evidence of leaks was observed. An in-ground rubber-lined tank and associated pumping facilities were noted on site drawings (Brown &amp; Root Environmental [B&amp;RE] March 1997).</p>
March 1983	Initial Assessment Study (IAS) <i>Envirodyne Engineers March 1983</i>	The IAS determined that the potential for contaminants entering the surrounding environment from this site was high and that most of the landfill portion of the site was prone to flooding and unknown materials had been landfilled at groundwater level. Operations within the site may have released petroleum and other waste chemicals to surface soils through leaks and spills. The underground drainage lines crossing the site drain Area A (Sites 2A, 2B, and 3) and discharge to the Thames River via an outfall on the Site 6 shoreline. Discharge observed during a June 1982 survey for the IAS had a fluorescent green color indicating potential chemical contamination. The report recommended that additional sampling (soil borings) be performed in the vicinity of the old burning area at the DRMO.
1988	Confirming Storage Facility Report <i>Goldberg-Zoino &amp; Associates 1988</i>	This report was prepared as a requirement for the siting of a hazardous waste storage facility in the northern portion of Site 6. The study indicated the presence of polychlorinated biphenyls and other contaminants at Site 6.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services (Atlantic) August 1992</i>	Field activities conducted from 1990 to 1992 for the Phase I RI encountered evidence (e.g., wood fragments, brick, and metal) of the former landfill during drilling, but encountered mostly earth fill material. The thickness of the fill varied from 0 to 8 feet. The Phase I RI recommended that a feasibility study (FS) be prepared and that specific health and safety provisions be made for all subgrade construction projects at the site. Risks to site workers were primarily related to incidental oral and dermal exposure to surface soils.
March 1994	Draft Focused FS <i>Atlantic March 1994</i>	Additional soil samples were collected during the Focused FS to further define the extent of contamination. The soil borings indicated that the depth of fill ranged from approximately 1.5 to 20 feet. Fill material consisted of wood, glass, and metal scrap in a predominately sand-and-gravel matrix.
January 1995	<p>Time-Critical Removal Action (TCRA) completed</p> <p>Action Memorandum for the Defense Reutilization and Marketing Office and the Spent Acid Storage and Disposal Area <i>Atlantic March 1995</i></p> <p>Final Report for Interim Remedial Action, Site 6 <i>OHM Remediation Services Corp. September 1995</i></p>	Initial activities associated with the TCRA included pre-excavation sampling and analysis, excavation of soil containing elevated concentrations of lead, polynuclear aromatic hydrocarbons, and polychlorinated biphenyls from the northern half of Site 6, and confirmatory soil sampling and analysis were conducted on the sidewalls of the excavations. After excavation activities were complete, the landfill was covered with an engineered cap, as documented in the Final Report. Decisions made during planning of the TCRA were documented in the Action Memorandum.

<b>Table A-4</b> <b>Site 6 — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
March 1997	Phase II RI Report <i>B&amp;RE March 1997</i>	Field activities performed from 1993 to 1995 for the Phase II RI concluded that most of the contaminated soil had been removed during the TCRA, groundwater was not significantly affected, and relatively low human health and ecological risks were associated with the Former DRMO. The Phase II RI recommended no further removal action at Site 6 but recommended groundwater monitoring to verify that significant contamination is not leaching to groundwater.
September 1997	FS <i>B&amp;RE September 1997</i>	The FS calculated volumes of soil that exceeded preliminary remedial goals (RGs) remaining at the site after the TCRA and concluded that most of the remaining contaminated soil is below the water table. Volumes exceeding Industrial/Commercial preliminary RGs remain in three areas totaling 11,230 square feet to depths from 6 to 10 feet (3,150 cubic yards). Volumes exceeding Residential preliminary RGs remained in six areas, totaling 107,780 square feet to depths from 3 to 10 feet (13,572 cubic yards).
1997 to 1998	Proposed Plan for the Defense Reutilization and Marketing Office (Site 6) <i>Naval Facilities Engineering Command (NAVFAC) September 1997</i>  Final Interim Record of Decision (ROD) for the Defense Reutilization and Marketing Office (Site 6) <i>NAVFAC March 1998</i>	The selected remedy for soil and groundwater contamination was institutional controls and groundwater monitoring.
April 1998	Groundwater Monitoring Program initiated  Groundwater Monitoring Plan for Defense Reutilization and Marketing Office <i>B&amp;RE February 1998</i>	Groundwater monitoring began at Site 6 in accordance with the Groundwater Monitoring Plan.
December 2001	First Five-Year Review <i>NAVFAC December 2001</i>	<p>The First Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Using the results of three years of groundwater monitoring, determine if a final ROD for all media at Site 6 could be prepared.</li> <li>• Continue the groundwater monitoring program, but optimize the sampling frequency, monitoring well network, and analytical parameter list.</li> <li>• Prepare an Operations and Maintenance (O&amp;M) Plan for Site 6 and address the items noted during implementation of the plan.</li> <li>• Continue enforcement of Standard Operating Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18. (Note: SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>

<p align="center"><b>Table A-4</b> <b>Site 6 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Continue O&amp;M of the site and address the O&amp;M deficiencies noted.</li> <li>• Continue the groundwater monitoring program, but reduce sampling frequency to every 2 years and further optimize the analytical parameter list, as appropriate. Develop and implement a well abandonment program to eliminate wells that are no longer required for the monitoring program (e.g., 6MW5S, 6MW5D, and 6MW7S).</li> <li>• Develop and implement an equipment storage plan that would prevent storage of equipment on top of active monitoring well(s).</li> <li>• Address ponding and sediment buildup due to jersey barriers.</li> <li>• Continue enforcement of SOPA (ADMIN) NLONINST 5090.18C, even if the site use changes to yacht club parking.</li> <li>• Conduct at least yearly monitoring of Institutional Control compliance, and document in the monitoring reports and future five-year reviews.</li> <li>• Amend the O&amp;M Manual to remove federal Ambient Water Quality Criteria.</li> </ul>
December 2006	ROD for Operable Unit 2 – Soil and Groundwater <i>NAVFAC December 2006</i>	The selected remedy was: institutional controls, monitoring, and five-year reviews. The final remedy was consistent with the remedy selected in the Final Interim ROD.
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	The inventory included 15 Site 6 wells; 7 Site 6 wells that were not part of an active monitoring program were abandoned in 2007.
July 2011	O&M Manual Volumes I, II, III, IV, V, and VI <i>Tetra Tech July 2011</i>	This version, Revision 2, included an updated Groundwater Monitoring Plan (Volume II) and updated inspection plan (Volume IV) for Site 6. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 6.5.1.3 of the Fourth Five-Year Review Report.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the remedy for Site 6 was protective of human health and the environment. Recommendations are described in Section 6.4 of the Fourth Five-Year Review Report.
November 2012	O&M Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged.
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides land use controls and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 6 until a Land Use Control Remedial Design is finalized. Additional information can be found in Sections 2.11.1 and 6.5.1.2 of the Fourth Five-Year Review Report.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

**Table A-5**  
**Site 8 — Site History and Background**

Date	Event/Document	Description
1946 to 1957	Goss Cove Landfill operational	All combustible materials generated by base operations that were not salvageable were incinerated, and the residues were disposed in the former Defense Reutilization and Marketing Office (Site 6), Goss Cove Landfill (Site 8), and Area A Landfill (Site 2A). The former base incinerator, located in the Lower Subbase, ceased operating in 1963. Incinerator ash and inert rubble were disposed at the site in what was then the northern portion of Goss Cove.
March 1983	Initial Assessment Study <i>Envirodyne Engineers March 1983</i>	The Initial Assessment Study did not determine if materials other than ash and rubble were disposed in the former landfill. Several large compressed gas cylinders were uncovered during excavation of a utility trench in the parking area north of the Nautilus Museum building: one of the cylinders was leaking propane, one was filled with ammonia, and the others were empty.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services August 1992</i>	Field activities performed from 1990 to 1992 for the Phase I RI concluded that additional investigations were necessary at the site.
March 1997	Phase II RI Report <i>Brown &amp; Root Environmental, Inc. (B&amp;RE) March 1997</i>	Field activities performed from 1993 to 1995 for the Phase II RI concluded that high concentrations of organics and inorganics were in soil and groundwater. Evidence of offsite impacts were encountered and elevated potential human health and ecological risks were estimated. The Phase II RI recommended a feasibility study (FS) and groundwater investigation be performed.
January 1997	Data Gap Investigation (DGI) Report <i>B&amp;RE August 1999</i>	The DGI was conducted to determine the source of tetrachloroethene (PCE) detected in groundwater samples during the Phase II RI. The DGI concluded the likely source of PCE contamination detected in groundwater was the former Fusconi Cleaners.
1998	Phase I/II Environmental Site Assessment (ESA) Report <i>Connecticut Department of Energy and Environmental Protection (CTDEEP) March 1999</i>	CTDEEP conducted a Phase I/II ESA of Fusconi Cleaners in 1998 (located outside of Navy property and approximately 100 feet upgradient of Site 8). The ESA included interviewing the operator of the former Fusconi Cleaners (Mr. Fusconi) and collecting medium-specific samples.  Fusconi Cleaners operated as a dry cleaner from 1951 to 2003. CTDEEP investigations identified PCE as the primary dry cleaning solvent, with approximately 2,000 to 3,000 pounds of waste generated annually. The results of the investigation conclusively showed that the dry cleaner released PCE to the environment, and indicated that the dry cleaner was the source of the PCE detected in downgradient groundwater at Site 8 (CTDEEP 1999).
September 1999	FS for Soil and Sediment <i>Tetra Tech September 1999</i>	The FS included desktop modeling to evaluate the potential for migration of contaminants of concern (COCs) from the former Goss Cove Landfill into Goss Cove. A Wetlands Functions and Values Assessment was completed to evaluate if the ecological stress in the Goss Cove water body was a result of natural conditions or due to migration of contaminants from Naval Submarine Base New London sites; further investigation and evaluation of the sediment was completed. Based on these findings, no further action was recommended for these sediments or surface water.
1999	Proposed Plan for Goss Cove Landfill (Site 8) <i>Naval Facilities Engineering Command (NAVFAC) June 1999</i>  Record of Decision (ROD) for Site 8, Goss Cove Landfill, Soil and Sediment <i>NAVFAC September 1999</i>	The selected remedy was installation of an engineered control cap (presumptive remedy), institutional controls, and monitoring.
November 2000	Remedial Design for Goss Cove Landfill <i>Tetra Tech November 2000</i>	The Remedial Design for Site 8 soil began in October 1999. Additional field work (i.e., field survey, geotechnical field investigation, and geotechnical laboratory testing program) was conducted to collect the necessary data to complete the design.



<p align="center"><b>Table A-5</b> <b>Site 8 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
June 2001	Remedial action (RA) for soil completed  Final Remedial Action Report for Site 8 — Goss Cove Landfill <i>Foster Wheeler Environmental Corporation</i> <i>September 2002</i>	Construction of the engineered cap began in September 2000 and was completed in June 2001 as documented in the Final Remedial Action Report.
December 2001	First Five-Year Review <i>NAVFAC December 2001</i>	<p>The First Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Complete the Final Report for RA at Goss Cove Landfill.</li> <li>• Implement the Groundwater Monitoring Plan and prepare an appropriate decision document for the groundwater operable unit (OU) when sufficient data has been collected.</li> <li>• Prepare a No Further Action Decision Document for the surface water OU.</li> <li>• Prepare and implement an Operations and Maintenance (O&amp;M) Plan.</li> <li>• Continue enforcement of Standard Operating Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18. (Note: SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>
December 2001	Basewide Groundwater Operable Unit Remedial Investigation (BGOURI) Report <i>Tetra Tech December 2001</i>	The BGOURI at Site 8 was completed prior to construction of the engineered cap system. Groundwater samples were collected from existing permanent monitoring wells to further characterize the site. Analytical data indicated that sources of volatile organic compounds, semivolatile organic compounds, and metals within the fill material were continuing to impact shallow groundwater at the site. The BGOURI recommended the decision to prepare an FS for groundwater at Site 8 be postponed until site conditions stabilized and trends in groundwater contaminant concentrations were determined, based on results of the groundwater monitoring program. Groundwater monitoring, as detailed in the ROD, was subsequently determined to be sufficient and a separate groundwater ROD was not required.
January 2002	Groundwater Monitoring Program initiated  Groundwater Monitoring Plan for Goss Cove Landfill <i>Tetra Tech March 2001</i>	Groundwater monitoring began at Site 8 in accordance with the Groundwater Monitoring Plan.

**Table A-5**  
**Site 8 — Site History and Background**

Date	Event/Document	Description
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Continue O&amp;M of the site and address the deficiencies noted (e.g., repair damaged road boxes found at wells 8MW1 and 8MW4 and extend well 8MW10S to the ground surface or install a replacement well).</li> <li>• Install screens on every gas vent and add a lock to the gates at Gas Vents M and L.</li> <li>• Continue the groundwater monitoring program, but reduce the sampling frequency to annual and optimize the analytical parameter list, as appropriate. Develop and implement a well abandonment program to eliminate wells that are no longer required for the monitoring program (e.g., 8MW4S, 8MW8S, and 8MW9S).</li> <li>• Conduct an inspection of the drains leading into the box culvert (by video or other means).</li> <li>• Select an appropriate RA for the groundwater OU and document the remedy in a Proposed Plan and ROD.</li> <li>• Continue enforcement of SOPA (ADMIN) NLONINST 5090.18C and add signs to the entrance gate that warn about the cap and the restrictions on digging at the site.</li> <li>• Conduct at least yearly monitoring of Institutional Control compliance, and document in the monitoring reports and future five-year reviews.</li> <li>• Amend O&amp;M Manual to remove federal Ambient Water Quality Criteria.</li> </ul>
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	The inventory included 13 Site 8 wells, one of which required repair; no wells were abandoned.
April 2011	The Navy Environmental Restoration Manager became aware that a portion of the Site 8 cap had been excavated and an aboveground storage tank (AST), its foundation, and associated piping were installed on the cap system without authorization from or coordination with the Environmental Restoration Manager, as required by SOPA (ADMIN) 5090.25. An investigation in October 2011 determined there were no adverse impact to the cap system from the AST or its associated components; construction did not penetrate the geosynthetic drainage layer or geomembrane. However, the investigation found that institutional controls were not effectively implemented and the AST installation did not comply with Site 8 action-specific Applicable or Relevant and Appropriate Requirements (NAVFAC December 2011).	
July 2011	O&M Manual Volumes I, II, III, IV, V, and VI <i>Tetra Tech July 2011</i>	This version, Revision 2, included an updated Groundwater Monitoring Plan (Volume II) and updated inspection plan (Volume V) for Site 8. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 7.5.1.3 of the Fourth Five-Year Review Report.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the remedy for Site 8 was protective of human health and the environment. Recommendations are described in Section 7.4 of the Fourth Five-Year Review Report.
November 2012	O&M Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged.

<b>Table A-5</b> <b>Site 8 — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
April 2013	Subbase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides land use controls and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 8 until a Land Use Control Remedial Design is finalized. Additional information can be found in Sections 2.11.1 and 7.5.1.2 of the Fourth Five-Year Review Report.
December 2014	Soil remedial action completed at Former Fusconi Dry Cleaners  Supplemental Investigation and Remedial Action Plan, Former Fusconi Dry Cleaners <i>Fuss and O'Neill November 2013</i>  Soil Remedial Action Report, Former Fusconi Dry Cleaners <i>Fuss and O'Neill February 2015</i>	Remedial activities were performed by CTDEEP to address the PCE contamination from the Former Fusconi Dry Cleaners; additional information is in Section 7.4.2.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

**Table A-6**  
**Site 23 — Site History and Background**

Date	Event/Document	Description
Early 1940s	Crystal Lake was drained and dredged for the construction of nine concrete underground storage tanks (USTs) (oily tanks [OT]-1 through OT-9). Depending on the season, the depth to groundwater in some areas of the site was just 2 feet below grade, which caused stability problems within the tanks in approximately 30 percent of the site. A site-wide drainage system was installed to improve stability, which consisted of numerous catch basins, corrugated metal pipe, perforated corrugated metal pipe, vitrified clay pipe, and reinforced concrete pipe. According to Naval Submarine Base New London (NSB NLON) personnel, the drainage system served approximately one-third of the entire NSB NLON facility. Portions of the drainage system were installed to depress the water table in the Fuel Farm. The surface water and groundwater collected by the storm sewer system ultimately discharge to a boomed area of the Thames River, adjacent to the Goss Cove Landfill (Brown & Root Environmental, Inc. [B&RE] September 1997).	
1970s	OT-6 decommissioned	Due to reduced demand for diesel fuel at NSB NLON in the mid-1970s, OT-6 was decommissioned and demolished; OT-5 was modified for storage of bilge water and other waste solutions and used as part of an oil/water separator system (B&RE September 1997).
1989	Hydrogeologic Investigation — USTs OT-4, OT-7, OT-8, and OT-9 <i>Fuss and O'Neill 1989</i>	During the investigation, total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected in groundwater; TPH greater than 500 milligrams per kilogram (mg/kg) and benzene were detected in soil; and no free product was detected. The report did not definitely conclude that the tanks were leaking; groundwater monitoring was recommended.
August 1989 to August 1990	Petroleum spills documented	Eight petroleum spills were documented by the Navy in the vicinity of the Fuel Farm; recovered quantities varied from 0.5 gallons to nearly 15 gallons (B&RE September 1997).
1990 to 1995	OT-5 decommissioned	See Section 9 of the Fourth Five-Year Review Report for information regarding OT-5 decommissioning.
1990	OT-10 installed; OT-4 and OT-7 through OT-9 were decommissioned	OT-4 was decommissioned after the installation of a new 30,000-gallon waste oil UST (OT-10 [NN-03]). OT-7 through OT-9 were decommissioned in the summer of 1990.
June 1991	Installation and Sampling of Monitoring Wells Report at the Fuel Farm <i>ERM-Northeast June 1991</i>	During the investigation, performed in March 1991, which focused on OT-1, OT-2, and OT-3, BTEX were detected in groundwater, TPH greater than 2,500 mg/kg were detected in soil, and free product was detected. The report recommended additional field investigation to delineate contamination at the site.
Circa 1991	OT-12 and OT-13 installed	Two 150,000-gallon above ground storage tanks, OT-12 and OT-13, were installed to store diesel fuel. <sup>(1)</sup>
Summer 1991	OT-1 through OT-3 decommissioned	OT-1 through OT-3 removed from service, demolished, and closed in place (B&RE September 1997).
Fall 1991	Naval Exchange Service Station Investigation performed and Air Sparge/Soil Vapor Extraction System installed  Final Remediation of Contaminated Soil and Ground Water, Naval Exchange and Dolphin Mart Service Stations <i>ERM-Northeast August 1992</i>	The Naval Exchange Service Station is located outside and upgradient of Site 23. Groundwater was sampled for BTEX, methyl tert-butyl ether, TPH, and lead with select samples analyzed for gasoline, diesel, and No. 6 fuel oil. Soil contained BTEX and TPH and exhibited visible staining and petroleum odor and two BTEX plumes were found emanating from the service station. An air sparging/soil vapor extraction system was installed outside and upgradient of Site 23 in 1991.
December 1991	OT-5 Site Characterization  Environmental Services UST Removal — Waste Oil Tank #5 <i>Goldberg-Zoino Associates December 1991</i>	See Section 9 of the Fourth Five-Year Review Report for additional information regarding the OT-5 1991 Site Characterization.
Early 1993	OT-10 cleaned	The 30,000-gallon tank and oil/water separator at OT-10 were pumped out, the debris clogging the pumps was removed, and steam cleaned (B&RE June 1996).

<p align="center"><b>Table A-6</b> <b>Site 23 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
May 1994	Site Characterization Report for Waste Oil Tank 5 <i>Haliburton, NUS May 1994</i>	See Section 9 of the Fourth Five-Year Review Report for information regarding the OT-5 Site Characterization.
September 1994	Removal Action completed Post Removal Action Report for Waste Oil Tank No. 5 <i>Haliburton, NUS August 1995</i>	See Section 9 of the Fourth Five-Year Review Report for information regarding the OT-5 Removal Action.
June 1996	Site Characterization Report for OT-10 <i>B&amp;RE June 1996</i>	Soil was evaluated for Industrial/Commercial and Residential site use and groundwater was evaluated as GAA or GA (groundwater suitable for drinking without treatment). TPH exceeded Connecticut Department of Energy and Environmental Protection (CTDEEP) Residential Direct Exposure Criteria in only one sample. Toxicity characteristic leaching procedure lead concentrations above CTDEEP Pollutant Mobility Criteria, manganese concentrations above CTDEEP Groundwater Protection Criteria, and heptachlor (which did not exceed CTDEEP Groundwater Protection Criteria or Surface Water Protection Criteria [SWPC]) was determined to likely be a result other sources (i.e., pest control, background concentrations) at the site, and not OT-10. Continued monitoring of groundwater was recommended.
September 1997	Site Investigation Report for Tank Farm Investigation <i>B&amp;RE September 1997</i>	<p>Soil and groundwater samples from former OT-4, former OT-5, and locations not in the immediate vicinity of the tanks and groundwater at the loading area were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls, metals, cyanide, and TPH. Soil and groundwater samples from other locations at Site 23 were analyzed only for UST parameters. Soil was evaluated for Industrial/Commercial site use and groundwater was evaluated as GB (groundwater presumed not suitable for human consumption without treatment).</p> <p>Inorganics were determined to be a result of the fill material used to construct the Fuel Farm and high background levels throughout NSB NLON; it was determined that there was no cost effective means for reducing these concentrations. Former OT-8 was found to have free product in one of the associated wells and TPH contamination in the soil and groundwater. Replacement of the existing storm sewer was expected to address groundwater concerns and ensure that offsite sources no longer had a pathway to the site. No further action (NFA) was recommended at former OTs: OT-1 through OT-7, OT-9, and the loading area. Soil excavation and disposal was recommended at former OT-8 and the fuel pipelines.</p>
February 1998	Soil removal action performed	Three removal actions were conducted to address petroleum contamination related to the former USTs and their associated piping (Tetra Tech May 1999). Soil and free product were removed in the vicinity of former OT-8 and former OT-3. BTEX compounds were determined to be related to leaking USTs from the upgradient Naval Exchange Service Station. The leaking USTs were repaired and the BTEX plumes were being treated by an air sparge/soil vapor extraction system.
August 1998	Hydrogeologic Study at the Tank Farm <i>Tetra Tech February 1999</i>	The Hydrogeologic Study was performed to evaluate the impact of replacing the existing storm sewer system and drainage system on the local groundwater table. The study recommended that a new, shallow storm sewer system be constructed to separate surface water flow from groundwater flow and that the existing drainage system be maintained to help dewater the area.
Approximately September 1999	Tank NN-02 on OT-10 Complex replaced	The 10,000-gallon fiberglass UST (NN-02) was removed and replaced with a 3,000-gallon double wall fiberglass UST (OT-10-3), as documented in the CTDEEP UST Database. No closure report has been identified.



<b>Table A-6</b> <b>Site 23 — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
November 1999	Tank Farm Site Investigation Report Addendum <i>Tetra Tech November 1999</i>	<p>The investigation, performed in summer 1999, further investigated former OT-2 and OT-3 because weathered diesel fuel was detected in the storm sewers; soil was analyzed for BTEX, SVOCs, and TPH. Groundwater was analyzed for BTEX and SVOCs and results were compared to CTDEEP SWPC and Volatilization Criteria. Approximately 1,070 cubic yards of soil impacted by 2-methylnaphthalene and TPH exceeding CTDEEP Industrial Direct Exposure Criteria and Pollutant Mobility Criteria were identified near former OT-3. Acenaphthylene and phenanthrene exceeded screening criteria in groundwater near former OT-2 and former OT-3. Free product was identified in one well as diesel fuel; free product in another well could not be identified.</p> <p>The Tank Farm Site Investigation Report Addendum recommended that the existing air sparge/soil vapor extraction system be assessed to address its effectiveness on removing 2-methylnaphthalene in soil and the free product in groundwater, completion of the storm sewer replacement project, and removal free product during excavation of contaminated soil.</p>
2000	Storm Sewer Rehabilitation completed  Final Closeout Report for Storm Sewer Rehabilitation <i>Foster Wheeler Environmental Corporation May 2001</i>	<p>The Fuel Farm drainage system was rehabilitated in 2000; the original combined groundwater and stormwater system was separated into a deep groundwater and a new shallow stormwater system. The existing deteriorated pipes in the deep groundwater system were relined with cured-in-place plastic pipe and a manhole was converted into a metering pit to measure groundwater flow. The old tank ring-drains (French drains) were not rehabilitated, but their connection with the groundwater collection system was maintained.</p> <p>Contaminated soil and free product were also remediated because excavation was adjacent to contaminated soil in the vicinity of former OT-3 and Tang Avenue. Free product and 1,070 cubic yards of contaminated soil from 6 to 12 feet below ground surface were removed and disposed offsite.</p>
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	<p>The First Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• Postpone preparation of a feasibility study (FS) for the groundwater operable unit (OU) at the Tank Farm until site conditions stabilize and the current sampling and analysis program can determine the trends in groundwater contaminant concentrations. If the results of the monitoring program support that there are no unacceptable risks to human health or the environment, then an FS will not be prepared and the Navy will pursue an NFA Record of Decision (ROD) for the groundwater OU. If the results suggest that further actions are required, then the Navy will prepare an FS for the groundwater OU to develop appropriate remedial alternatives.</li> <li>• Enforce the Standard Operating Procedure — Administrative (SOPA [ADMIN] New London Instruction (NLONINST) 5090.18). (Note: SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>

<p align="center"><b>Table A-6</b> <b>Site 23 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2001	Basewide Groundwater Operable Unit Remedial Investigation Report <i>Tetra Tech December 2001</i>	<p>The Basewide Groundwater Operable Unit Remedial Investigation at Site 23 did not identify any significant risks to receptors from exposure to groundwater. Groundwater sampling results for Site 23 indicated that the water quality is generally good, with only sporadic, low-concentration detections of VOCs, SVOCs, and metals in site monitoring wells.</p> <p>A preliminary evaluation of natural attenuation data indicated that biodegradation and other natural attenuation processes may be acting to reduce organic contaminants to relatively insignificant levels in the Fuel Farm. However, recommendations for monitored natural attenuation alternative were deferred, pending further data collection and additional characterization of groundwater.</p>
January to April 2006	OT-10 Complex Decommissioned <i>CRS Environmental, LLC February 2006, circa June 2006</i>	OT-10 decommissioning activities included pumping, cleaning, and abandoning Tank NN-03 (30,000-gallon) and Tank OT-10-3 (3,000-gallon) in place. The oil/water separator, piping, and sump were also removed
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• The results of the monitoring program and the need for an FS for the groundwater at the Tank Farm should be evaluated. If the results of the monitoring program and evaluation support that there are no unacceptable risks to human health or the environment, an FS should not be prepared and an NFA ROD for the groundwater OU should be prepared.</li> <li>• Continue enforcement of SOPA (ADMIN) NLONINST 5090.18C.</li> </ul>
June 2007 to 2009	Site 23 Underdrain Metering Pit monitored  Work Plan for Site 23 Underdrain Metering Pit Sampling <i>Tetra Tech April 2007</i>	<p>The Site 23 underdrain metering pit was sampled quarterly for two years after construction. All relevant concentrations were less than established Connecticut criteria (SWPC, Residential Volatilization, and storm water discharge permit criteria) (with the exception of some anomalous results, described in the OU 9 ROD), for the four rounds of sampling.</p> <p>Based on results less than criteria, collection and discharge of Site 23 groundwater (including Site 9 groundwater) via the storm sewer system was determined to not pose a significant threat to human health or the environment under the current land use scenario; however, risks would be unacceptable if groundwater at the site was used as a drinking water supply (NAVFAC September 2008). The Year 2 monitoring report recommended no additional monitoring at Site 23 (Environmental Chemical Corporation October 2009).</p>
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	This inventory included 52 Site 23 Environmental Restoration Program wells and 16 Site 23 UST wells; two non-functional Site 23 wells were properly abandoned. Although not part of an active monitoring program, it was recommended that the remaining 25 functional Site 23 wells be maintained until a decision is reached on the selection of a remedial action at this site.
2008	<p>Proposed Plan for Basewide Groundwater OU 9 <i>NAVFAC June 2008</i></p> <p>ROD for Basewide Groundwater OU 9 <i>NAVFAC September 2008</i></p>	OU 9 includes groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23. The selected remedy at Sites 9 and 23 was institutional controls.
November 2009	Land Use Control Remedial Design for Basewide Groundwater OU 9 <i>Tetra Tech November 2009</i>	The OU 9 Land Use Control Remedial Design included groundwater at Sites 9 and 23; see Sections 2.11.2 and 8.5.1.1 of the Fourth Five-Year Review Report for additional information on groundwater land use controls (LUCs) at Sites 9 and 23.

Table A-6 Site 23 — Site History and Background		
Date	Event/Document	Description
June 2010	Remedial Action Completion Report for Basewide Groundwater OU 9 <i>Tetra Tech June 2010</i>	The OU 9 Remedial Action Completion Report documented that institutional controls were in place for groundwater at Sites 9 and 23.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the remedy for Site 23 was protective of human health and the environment. A Site Assessment Screening Evaluation (SASE) was deemed necessary to document full closure of soil at the site. Recommendations are described in Section 8.4 of the Fourth Five-Year Review Report.
April 2012	Oil contamination found during construction at athletic track	Oil contamination was discovered at approximately 5 to 6 feet below ground surface during excavation of a catch basin, adjacent to the southeastern side of former OT-1. Clumps of oily soil and free phase product were observed and oil sheen was observed in groundwater. Construction activities were temporarily stopped until the contractor and the New London Public Works could discuss the discovery with the Environmental Office. Under the provisions of their dig permit, the contractor placed the material back in the excavation, backfilled the area, and construction continued as planned. The CTDEEP was notified, and no further response actions were deemed necessary.
November 2012	Operations and Maintenance Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 8.5.1.2 of the Fourth Five-Year Review Report.
February 2013	Site 9 SASE <i>Resolution Consultants February 2013</i>	See Section 9 of the Fourth Five-Year Review Report for information regarding the Site 9 SASE.
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 23. Additional information can be found in Sections 2.11.1 and 8.5.1.1 of the Fourth Five-Year Review Report.
March 2016	Data Gap Investigation Report <i>Resolution Consultants March 2016</i>	A draft SASE was developed in 2013 using the available soil data to assess residual site risks. Based on United States Environmental Protection Agency review and comments on the draft SASE, the current soil dataset was considered insufficient to determine that the site could be released for unrestricted use/unrestricted exposure. The Data Gap Investigation was performed in April 2015 to collect sufficient soil data to adequately evaluate site risk so that the human health risk assessment can be updated and the SASE can be finalized.
March 2016	Draft SASE <i>Resolution Consultants March 2016</i>	The Draft SASE concluded that most impacts at Site 23 were the result of petroleum releases. The SASE concluded that further delineation of deep subsurface soil impacts (below the water table) is not warranted because subsurface soil is addressed by SUBASENLONINST 5090.25 and there is a LUC for groundwater. The SASE recommended that NFA be considered under Comprehensive Environmental Response, Compensation, and Liability Act for Site 23 soil.

**Notes:**

<sup>(1)</sup> The installation date is unknown; the tanks appeared first on an aerial photograph in April 1996, but were not on an aerial photograph from March 1990. Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-7</b> <b>Site 9 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1940s	Crystal Lake was drained and dredged for the construction of nine concrete underground storage tanks, including Oily Tank (OT)-5, which was used to store fuel oil (Goldberg-Zoino Associates 1991).	
1970s	OT-5 converted to a storage tank for bilge water and other waste solutions as part of an oil/water separator sometime between 1976 and 1981 (Goldberg-Zoino Associates December 1991).	
Approximately 1990	OT-5 abandonment activities began  Letter from Nelson G. Goddard, Public Works Officer, to State of Connecticut, Department of Environmental Protection <i>Navy April 1991</i>	OT-5 was decommissioned and floating product and most of the settled sludge were removed to abandon OT-5 in place. Abandonment was terminated when polychlorinated biphenyls (PCBs) greater than 10 parts per million were discovered in the waste oil sludge at the bottom of the tank.
December 1991	OT-5 Site Characterization  Environmental Services Underground Storage Tank Removal — Waste Oil Tank #5 <i>Goldberg-Zoino Associates December 1991</i>	The Site Characterization identified two areas of contamination in the soil surrounding OT-5: below groundwater (indicating underground storage tank leakage) and above groundwater (indicating surficial spills). Tank contents were identified as floating oil, water, and sludge/sediments.
Mid-1993	OT-5 abandonment activities resume	Most of the tank contents (floating product, sludge, and water) were removed and disposed; floating product and some tank sludge were disposed as Toxic Substances Control Act waste (Brown & Root Environmental, Inc. [B&RE] September 1997). One to two inches of sludge remained on the tank floor which, along with a small amount of rubble debris, could not be removed because of the rapidly rising water level in the tank (Haliburton, NUS August 1995).
Approximately May 1994	OT-5 integrity compromised	Groundwater infiltrated through cracks in the concrete surface, and the tank filled with water by May 1994, possibly earlier (Haliburton, NUS May 1994).
March 1994	Site Characterization Report for Waste Oil Tank 5 <i>Haliburton, NUS May 1994</i>	Four borings were installed through the tank and then converted into temporary monitoring wells during the investigation, performed in March 1994. Tank water and soil above the tank was analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and inorganics; soil samples below the tank and groundwater were analyzed for VOCs, SVOCs, and inorganics; and the concrete top was analyzed for PCBs, toxicity characteristic leaching procedure VOCs, SVOCs, herbicides, pesticides, and inorganics. Arsenic and beryllium exceeded applicable criteria in soil above the tank, total chromium exceeded applicable criteria in soil below the tank, and tetrachloroethene exceeded the Maximum Contaminant Level in one groundwater sample.
September 1994	Removal Action completed Post Removal Action Report for Waste Oil Tank No. 5 <i>Haliburton, NUS August 1995</i>	Oily sludges stored onsite were removed. Post-removal action sampling confirmed that residual waste materials had been properly shipped and disposed and that waste storage vessels had been properly decontaminated.
1995	OT-5 was decontaminated and backfilled <i>OHM Remediation Services Corporation 1996</i>	To accomplish tank closure, the area was dewatered and the tank was cleaned of the remaining PCB sludge and contaminated debris; PCB wipe sampling was performed to confirm proper decontamination. A portion of the tank roof was demolished, the tank was backfilled, and the area was regraded and reseeded.
September 1997	Site Investigation Report for Tank Farm Investigation <i>B&amp;RE September 1997</i>	At OT-5, two additional wells were installed and three soil samples were collected during the installation of the wells and analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and total petroleum hydrocarbons. Soil was evaluated for Industrial/Commercial site use and groundwater was evaluated as GB (groundwater presumed not suitable for human consumption without treatment). Soil and groundwater were determined to have no contaminants of concern (e.g., no contaminants with concentrations greater than the screening levels).

<b>Table A-7</b> <b>Site 9 — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	<p>The First Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• A no further action (NFA) Proposed Plan and Record of Decision (ROD) should be completed for Site 9.</li> <li>• The decision for the groundwater operable unit (OU) should be addressed under Site 23 (Tank Farm).</li> <li>• Enforce Standard Operating Procedure – Administrative (SOPA [ADMIN]) New London Instruction (NLOINST) 5090.18. (Note: SOPA [ADMIN] NLOINST 5090.18 and subsequent revisions are discussed in Section 2.11.1 of the Fourth Five-Year Review Report.)</li> </ul>
December 2001	Basewide Groundwater Operable Unit Remedial Investigation Report <i>Tetra Tech December 2001</i>	The Basewide Groundwater Operable Unit Remedial Investigation at Site 23 (which includes Site 9) was performed to further characterize the nature and extent of groundwater contamination and to quantify the risks to human receptors from groundwater. See Table E-6 for additional information.
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>The Second Five-Year Review stated that the remedy was protective of human health and the environment, and recommended the following:</p> <ul style="list-style-type: none"> <li>• An NFA Proposed Plan and ROD should be completed for Site 9 soil.</li> <li>• The decision for the groundwater OU should be addressed under Site 23 (Tank Farm).</li> <li>• Continue enforcement of SOPA [ADMIN] NLOINST 5090.18.</li> </ul>
September 2007	Monitoring Well Inventory Report and Abandonment Plan <i>Tetra Tech September 2007</i>	This inventory included four Site 9 wells; none of these wells were located. Because these wells were shallow and not part of an active monitoring program, no further action was recommended.
2008	Proposed Plan for Basewide Groundwater OU 9 <i>NAVFAC June 2008</i>  ROD for Basewide Groundwater OU 9 <i>NAVFAC September 2008</i>	OU 9 includes groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23. The selected remedy at Sites 9 and 23 was institutional controls.
November 2009	Land Use Control Remedial Design for Basewide Groundwater OU 9 <i>Tetra Tech November 2009</i>	The OU 9 Land Use Control Remedial Design included groundwater at Sites 9 and 23; see Sections 2.11.2 and 8.5.1.1 of the Fourth Five-Year Review Report for additional information on groundwater land use controls at Sites 9 and 23.
June 2010	Remedial Action Completion Report for Basewide Groundwater OU 9 <i>Tetra Tech June 2010</i>	The OU 9 Remedial Action Completion Report documented that institutional controls were in place for groundwater at Sites 9 and 23.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The Third Five-Year Review stated that the remedy for Site 9 was protective of human health and the environment. A Site Assessment Screening Evaluation (SASE) was deemed necessary to document full closure of soil at the site. Recommendations are described in Section 9.4 of the Fourth Five-Year Review Report.
November 2012	Operations and Maintenance (O&M) Manual Volumes I, VII, and VIII <i>Tetra Tech November 2012</i>	This version, Revision 3, included an updated Introduction (Volume I) to incorporate new volumes (Revision 0) for Site 2B (Volume VII) and Sites 9 and 23 (Volume VIII). Volumes II, III, IV, V, and VI were unchanged. Additional information can be found in Section 2.10 of the Fourth Five-Year Review Report. Results of the inspections are discussed in Section 8.5.1.2 of the Fourth Five-Year Review Report.



Table A-7 Site 9 — Site History and Background		
Date	Event/Document	Description
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides land use controls and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 9. Additional information can be found in Sections 2.11.1 and 8.4 of the Fourth Five-Year Review Report.
February 2013	SASE <i>Resolution Consultants February 2013</i>	The SASE concluded that the depth of impacted soil is not fully defined. However, subsurface soil is addressed by SUBASENLONINST 5090.25 and further delineation was not recommended. The SASE recommended that NFA be considered under Comprehensive Environmental Response, Compensation, and Liability Act for Site 9 soil.

**Notes:**

For additional information regarding the history of the Former Fuel Farm, see Table A-6.  
Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

**Table A-8**  
**Zone 1 (Sites 10 and 11) — Site History and Background**

Date	Event/Document	Description
Early 1940s to late 1980s	Site 10 Fuel Storage Tank and Tank 54-H activities	Site 10 had six concrete underground storage tanks (USTs) placed into service during World War II: three 125,000-gallon tanks (E, F, and G) that stored diesel fuel from 1942 to 1987; two 25,000-gallon tanks (K and L) that stored lubrication and hydraulic oil from 1954 to 1989; and 30,000-gallon Tank 54-H, which was a reclamation tank for the other five tanks. Tanks E, F, G, and 54-H were decommissioned in 1987. Tanks K and L were decommissioned in 1989 and the shells were used to provide secondary containment for newly installed steel tanks (i.e., steel tanks were installed within the concrete shells).
Early 1940s to 2011	Site 11 Power Plant Oil Tanks activities	Multiple tanks were identified at Site 11 associated with the Building 29 Power Plant. Four 170,000-gallon concrete USTs had been in place since World War II and used to store No. 6 fuel oil (Tanks A and B), diesel oil (Tank C), and waste oil from the bilge-water oil recovery system (Tank D). Oil leaks discovered during tank cleaning prompted the tanks to be emptied, repaired, and used as secondary containment for 150,000-gallon USTs installed in the mid-1980s. Those tanks were decommissioned or refurbished between 2010 and 2011.
Early 1940s to mid-1990s	Zone 1 miscellaneous activities	Zone 1 also included Tank J, which held waste oil until 1943, and subsurface oil distribution and utility lines that were abandoned in place in 1996. Tank J adjoined the west boundary of Site 11. Building 89 UST (Z01), installed north (outside) of Site 11 in 1982, stored No. 2 fuel oil until it failed testing and was emptied in 1993 and removed in early 1994.
1979	Oil Contamination of the Groundwater at Subase New London <i>Naval Environmental Support Office 1979</i>	The study, conducted because oil slicks were observed in the Thames River along the waterfront between Pier 10 and Pier 12, included Site 10 and Site 11. The suspected source of the slicks was oil leaching from soil. The investigation concluded that contamination at Site 10 posed no environmental threat and the source of contamination at Site 11 was the heated day-storage tanks and reclamation tank behind the Building 29 Power Plant.
March 1983	Initial Assessment Study (IAS) <i>Envirodyne Engineers, Inc. March 1983</i>	The IAS identified measurable leakage from Site 10 and Site 11 tanks that had migrated to groundwater, steam and fuel pipeline tunnels, and underground vaults. The study concluded a low potential for contributing contaminants to the environment because contamination sources had been filled with concrete and closed to all drainage. The IAS recommended monitoring tank levels to evaluate leakage at Site 10 and replacement of four USTs at Site 11.
November 1987	Site Investigation of Subsurface Oil Contamination <i>Wehran Engineering Corporation November 1987</i>	Sources of heavy oils in the subsurface of Lower Subase were investigated and one area (Site 11) within Zone 1 was found to be contaminated with heavy oil: electrical conduits and manholes along Corvina Road contained a mixture of No. 5 and No. 6 fuel oils.
September 1989	Hydrogeologic Investigation, USTs Oily Tank (OT)-4, OT-7, OT-8, OT-9 and 54-H <i>Fuss &amp; O'Neill, Inc. September 1989</i>	Subsurface soil contamination encountered during construction activities prompted this study of soil and groundwater around Tank 54-H. The investigation concluded petroleum contamination (No. 2 fuel oil, benzene, and xylenes) had impacted groundwater in the area.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services, Inc. August 1992</i>	The Phase I RI included utility manhole inspection and waterfront bulkhead inspection, a soil-gas survey, test boring completion, monitoring well installation, and soil and groundwater sampling. One of four areas of significant petroleum accumulation observed during the manhole inspection was within Zone 1: three manholes west of Building 29. Soil, soil-gas, and groundwater contamination (including volatile organic compounds) detected in Zone 1 were attributed to No. 2 fuel oil and lubricating oil leaks from USTs.
April 1995	Site Characterization Report for OT-10, Building 325, and Building 89 <i>Haliburton NUS Corporation April 1995</i>	This study characterized soil at Building 89, UST Z01. Analytical results indicated soils in the vicinity of UST Z01 contained contaminants below state cleanup levels and groundwater was impacted by a petroleum-related source.

**Table A-8**  
**Zone 1 (Sites 10 and 11) — Site History and Background**

<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
August 1995	Environmental Impact Statement for Seawolf Class Submarine Homeporting <i>Maguire Group Inc. August 1995</i>	This study included sediment, fish, and benthic species in the Thames River within Zone 1 and Zone 2 and around Pier 8 and Pier 10. The report concluded sediments to be dredged were similar to previously dredged material and sediments in the channel tended to be cleaner than those near the pier areas. According to the study, sediments to be dredged were not considered toxic to bottom dwelling ecological receptors but channel sediments near the Lower Subase piers could cause accumulation of organic contaminants in tissues of benthic organisms.
April 1996	Leak Testing Investigation for Fuel Oil Distribution System <i>Heitkamp April 1996</i>	Various fuel oil distribution lines and valves within Lower Subase 1, including Zone 1, were pressure-tested. One section of fuel line in the vicinity of Pier 12 failed the test; replacement of two valves was recommended. All other sections of line and various valves tested within Zone 1 passed pressure testing procedures. Subsequently (in 1996), all portions of subsurface oil distribution lines that passed pressure testing were abandoned in place; one section of pipe near Pier 12 that failed pressure testing was replaced.
March 1997	Existing Data Summery Report for Lower Subase RI and Phase II RI Report <i>Brown &amp; Root Environmental (B&amp;RE) March 1997</i>	The Phase II RI evaluated Site 10 and Site 11 collectively as Zone 1. Total petroleum hydrocarbons (TPH) were identified in groundwater, and TPH and lead were identified in soil. This RI concluded the Lower Subase may have impacted the Thames River due to elevated sediment contamination adjacent to the Lower Subase, and recommended further characterization of TPH and lead in shallow soil and investigation of semivolatile organic compounds in soil (because of the presence of TPH). Also recommended were integrity inspections on active and inactive fuel distribution lines and records review to identify locations of previous leaks. The Phase II RI identified elevated noncarcinogenic human health risks for the construction worker in Zone 1. The Phase II RI included an ecological risk assessment for Zone 1 surface water and sediment, which concluded that the Lower Subase was unlikely to represent a risk to ecological receptors and identified benthic invertebrates as the only potential receptor of concern. This RI recommended further characterization of the Lower Subase.
September 1997	Site Investigation Report for Tank Farm Investigation <i>B&amp;RE September 1997</i>	This investigation included soil along underground (new and old diesel fuel) pipelines from the Crystal Lake Road Tank Farm through Zone 1. TPH was detected in soil along the fuel pipelines in the Lower Subase Area.
January 1999	Lower Subase RI Report <i>Tetra Tech January 1999</i>	This RI was conducted on all zones within the Lower Subase and the Thames River; included the human health risk assessment (HHRA) for consumption of surface water, shellfish, and finfish in Zone 1; and updated the ecological risk assessment to further evaluate risks to benthic invertebrates exposed to Zone 1 sediment. The Lower Subase RI concluded activities at Lower Subase had impacted soil, groundwater, and sediment, and that surface water in the Thames River near the Lower Subase did not appear to differ significantly from upstream or downstream locations. The report recommended further evaluation of soil and groundwater within Zone 1 (Site 10 and Site 11) in a feasibility study (FS).
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	A final remedy had not been selected for Zone 1. The First Five-Year Review concluded that the Lower Subase RI did not indicate imminent threats to human health or the environment, and recommended completion of an FS followed by an appropriate decision document in addition to continued enforcement of Standard Operating Procedure – Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18. SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1.
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	A final remedy had not been selected for Zone 1. The Second Five-Year Review concluded that the Lower Subase RI did not indicate imminent threats to human health or the environment, and recommended completion of the FS and appropriate decision document to select remedial alternative(s) for Zone 1 with continued enforcement of SOPA (ADMIN) NLONINST 5090.18.

<p align="center"><b>Table A-8</b>  <b>Zone 1 (Sites 10 and 11) — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
May 2007	Watershed Contaminated Source Document for Lower Portion of the Thames River <i>Tetra Tech May 2007</i>	This study evaluated sediment from all zones within the Thames River. Polynuclear aromatic hydrocarbons, polychlorinated biphenyls, pesticides, and metals were present in the sediment upstream and downstream of the Lower Subase for which numerous potential sources within the Lower Subase were identified but their contribution amount was not established as to their impact on sediments. The document recommended that sediment cleanup goals selection consider background concentrations.
December 2010	Final Lower Subase FS <i>Tetra Tech December 2010</i>	In this study, volumes of contaminated soil, sediment, and groundwater were calculated and remedial alternatives evaluated. The FS included an updated HHRA to comply with post-Lower Subase RI HHRA guidance/protocol changes by United States Environmental Protection Agency Region 1 and Remediation Standard Regulations changes by Connecticut Department of Energy and Environmental Protection. The FS was issued with the understanding that additional data needed to fill in data gaps would be collected as part of soil and groundwater pre-design investigations (PDIs) and incorporated into an FS Addendum.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	Recommended completion of the Lower Subase Record of Decision (ROD) to select the remedial actions for Site 10 and Site 11 that are protective of human health and the environment, and continued enforcement of SOPA (ADMIN) NLONINST 5090.25, which replaced 5090.18. Details are discussed in Section 10.4.
January 2012	Lower Subase (Operable Unit [OU] 4) Soil and Groundwater PDI Completion Report and FS Addendum <i>Tetra Tech January 2012</i>	Collected additional soil information from Zone 1 to confirm the extent of contamination, contaminants of concern (COCs), and volumes of soil exceeding regulatory criteria (Industrial/Commercial Direct Exposure Criteria and Pollutant Mobility Criteria). Collected additional groundwater samples to confirm the presence and extent of select metals exceeding regulatory criteria in Zone 1. Used additional data to prepare an FS Addendum to incorporate the results of the PDIs; the sections of the FS impacted by PDI data included the HHRA, COCs and medium of concern selection, volumes of contaminated media estimation, and remedial alternative evaluation. Using combined data from the FS and FS Addendum, an updated HHRA was prepared for Zone 1 that concluded soil was a concern but groundwater was not.
2012	OU 4 Proposed Plan <i>NAVFAC March 2012</i>  OU 4 ROD <i>NAVFAC August 2012</i>	The OU 4 ROD documented the selected remedy for Zone 1 (Site 10 and Site 11): land use controls (LUCs), long-term monitoring, and five-year reviews. Details are in Section 10.3.
2012 to 2013	Draft Soil Land Use Control Remedial Design (LUC RD) <i>Resolution Consultants November 2012</i>  Draft Final Soil LUC RD <i>Resolution Consultants February 2013</i>	The LUC RD identified LUC performance objectives, authorized and unauthorized uses, and monitoring/inspection requirements. This document is pending finalization after completion of remedial actions at Zone 4.
April 2013	Subase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 10 and Site 11 until a LUC RD is finalized. Additional information regarding SUBASENLONINST 5090.25 is in Section 2.11.1.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-9</b>  <b>Zone 3 (Site 17) — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1917 to 1950s	Building 31 — Former Battery Overhaul Shop activities	Old diesel submarines containing approximately 100 batteries were routinely serviced in Building 31, with services ranging from charging to complete overhaul. Spent acid from overhauled batteries was accumulated in an offsite tank.
1970s to 1990s	Building 31 — Hazardous/Flammable Materials Warehouse activities	During use as a hazardous/flammable materials warehouse, various materials including acids, bases, and solvents were stored in containers up to 55-gallon in capacity.
November 1987	Site Investigation of Subsurface Oil Contamination <i>Wehran Engineering Corporation November 1987</i>	Oil contamination (No. 6 fuel oil weathered less than a year) was observed in a trench that ran along Argonaut Road from Zone 4 Building 85 to near the northeast corner of Zone 3 Building 78. Trace levels of No. 6 fuel oil were detected in soil samples collected from one Zone 3 soil/monitoring well boring. The report recommended inspection of the fuel lines within the trench followed by cleaning.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services, Inc. August 1992</i>	<p>The Phase I RI included utility manhole inspection and waterfront bulkhead inspection, a soil-gas survey, test boring completion, monitoring well installation, and soil and groundwater sampling. One of four areas of significant petroleum accumulation observed during the manhole inspection was partially located within Zone 3: manhole 73, southwest of Building 31 and northwest of Building 80 on Albacore Road. Possible sources for the accumulation were previous product releases from underground fuel lines or storage tank leaks. The RI indicated no evidence of ongoing release.</p> <p>A shallow (12 to 18 inches) soil-gas survey conducted at Zones 1 through 4 detected low concentrations of volatile organic compounds at the southwest corner of Building 31 and west of Building 79 and Building 80 within Zone 3. The source of the Zone 3 contamination was determined to be Zone 4. Confirmation soil and groundwater samples collected from a monitoring well boring within Zone 3 indicated subsurface soil was contaminated by No. 2 fuel oil/diesel oil and groundwater had not been impacted.</p>
May 1993	Action Memorandum and Remedial Design for Building 31 <i>Haliburton NUS Corporation May 1993</i>	The Building 31 concrete floor was replaced in 1992 at which time a yellow discoloration was discovered in soil beneath the slab. Analysis of soil samples collected from 18 to 60 inches below the slab revealed elevated levels of lead. Surface and subsurface soil and groundwater were investigated further to define the extent of contamination. Soil was primarily contaminated with metals; other contaminants included polynuclear aromatic hydrocarbons (PAHs) and pesticides. The report recommended remediation of lead-contaminated soil to a depth of 1 foot below the water table.



**Table A-9**  
**Zone 3 (Site 17) — Site History and Background**

Date	Event/Document	Description
January 1995	Post-Removal Action Report for Building 31 Lead Remediation <i>Halliburton NUS Corporation January 1995</i>	<p>This report documented a time-critical removal action for lead-contaminated soil above mean high water table. Remedial action thresholds were defined as the Connecticut Department of Energy and Environmental Protection Remediation Standard Regulation of 500 milligrams per kilogram (mg/kg) total lead or 5.0 milligrams per liter in toxicity characteristic leachate procedure extract. Approximately 970 cubic yards of lead-contaminated soil beneath Building 31 was excavated and solidified onsite (by mixing with a stabilizing agent) to reduce leachability of lead from soil to groundwater, and approximately 500 cubic yards in three locations outside Building 31 was excavated and disposed of offsite.</p> <p>Final soil (excavated and solidified) and wipe (concrete) sample results showed excavation walls were not contaminated where the excavation had not reached the mean high water table (maximum excavation depth). The sampled concrete surfaces were either not contaminated or were adequately decontaminated. No further excavation was required for most areas of the site. Residual soil contamination above remedial action thresholds remained below the water table in one of the three removal areas.</p> <p>Albacore Road could not be completely excavated due to Naval Submarine Base New London traffic concerns. The Navy deferred remediation at Albacore Road and installed a non-woven geotextile liner in the excavation to prevent further contamination migration and to allow for easy resumption of future removal actions.</p>
April 1996	Leak Testing Investigation for Fuel Oil Distribution System <i>Heitkamp April 1996</i>	Various fuel oil distribution lines and valves within the Lower Subbase, including Zone 3, were pressure-tested. All portions of the distribution system within Zone 3 passed the leak tests. Subsequently (in 1996), all portions of subsurface oil distribution lines within Zone 3 were abandoned in place.
1997	<p>Site Investigation Report for Tank Farm Investigation <i>Brown &amp; Root Environmental (B&amp;RE) September 1997</i></p> <p>Existing Data Summary Report for Lower Subbase RI and Phase II RI <i>B&amp;RE March 1997</i></p> <p>Phase II RI Report <i>B&amp;RE September 1997</i></p> <p>Work Plan and Sampling and Analysis Plan for Lower Subbase RI <i>B&amp;RE September 1997</i></p>	<p>The investigation of pipelines from the Tank Farm included collecting two soil samples from Zone 3 for total petroleum hydrocarbon (TPH) analysis. TPH concentrations detected in Zone 3 were less than 25 mg/kg. TPH found in soil along the fuel pipelines in other Lower Subbase Area zones indicated the need for further assessment of the pipelines during the Phase II RI.</p> <p>The Phase II RI included six soil samples from four borings analyzed for lead, TPH, and toxicity characteristic leachate procedure metals, and one groundwater sample analyzed for volatile organic compounds, semivolatile organic compounds, metals, and TPH. Lead measured in Thames River sediment along Zone 3 was roughly 30 times less than the maximum shallow soil concentration and were generally the same or slightly above levels detected at other locations in the river. Lead and TPH were the primary contaminants of potential concern for surface and subsurface soil. The Phase II RI concluded the Lower Subbase may have impacted the Thames River due to elevated sediment contamination adjacent to the Lower Subbase. The ecological risk assessment completed for Zone 3 surface water and sediment in the Phase II RI concluded that benthic invertebrates were the only receptor of concern. The Phase II RI recommended further characterization of Zone 3 focusing on evaluating the nature and extent of lead, TPH, and semivolatile organic compounds in Zone 3 soil.</p>

<b>Table A-9</b> <b>Zone 3 (Site 17) — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
January 1999	Lower Subase RI Report <i>Tetra Tech January 1999</i>	This RI was conducted on all zones within the Lower Subase and the Thames River; included a human health risk assessment (HHRA) for Zone 3 surface water, shellfish, and finfish; and updated the ecological risk assessment for Zone 3 to further evaluate risks to benthic invertebrates exposed to Zone 3 sediment. The Lower Subase RI concluded activities at Lower Subase had impacted soil, groundwater, and sediment, and that surface water in the Thames River near the Lower Subase did not appear to differ significantly from upstream or downstream locations. The RI recommended further evaluation of soil and groundwater within Zone 3 (Site 17) in a feasibility study (FS).
August 2000	Interim Removal Action: Lower Subase storm sewer catch basin cleaning	Two storm sewer catch basins in Zone 3 were cleaned using a vacuum truck. The material removed from the catch basins was containerized, tested, and disposed of offsite. The storm sewer lines were not surveyed or repaired during that effort.
2001	Building 31 demolished	Building 31 was demolished, with the foundation and floor slab left in place to act as a cap over lead-contaminated soil. A parking lot was subsequently constructed in this location by placing 3 inches of asphalt over the former floor slab.
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	A final remedy had not been selected for Zone 3. The First Five-Year Review concluded that the Lower Subase RI did not indicate imminent threats to human health or the environment, and recommended completion of an FS followed by an appropriate decision document in addition to continued enforcement of Standard Operating Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18. SOPA [ADMIN] NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1.
2005	Building 78 demolished	Building 78, which adjoined Building 31, was demolished in 2005 and replaced with an asphalt parking lot.
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	A final remedy had not been selected for Zone 3. The Second Five-Year Review concluded that the Lower Subase RI did not indicate imminent threats to human health or the environment, and recommended completion of the FS and appropriate decision document to select remedial alternative(s) for Zone 3 with continued enforcement of SOPA (ADMIN) NLONINST 5090.18.
May 2007	Watershed Contaminated Source Document for Lower Portion of the Thames River <i>Tetra Tech May 2007</i>	This document evaluated sediment from all zones within the Thames River. PAHs, polychlorinated biphenyls, pesticides, and metals are present in the sediment upstream and downstream of the Lower Subase for which numerous potential sources within the Lower Subase were identified but their contribution amount was not established as to their impact on sediments. The report recommended that sediment cleanup goals selection consider background concentrations.
December 2010	Final Lower Subase FS <i>Tetra Tech December 2010</i>	Volumes of contaminated soil, sediment, and groundwater were calculated and remedial alternatives evaluated in the Final Lower Subase FS. The FS included an updated HHRA to comply with post-Lower Subase RI HHRA guidance/protocol changes by United States Environmental Protection Agency Region 1 and Remediation Standard Regulation changes by Connecticut Department of Energy and Environmental Protection. The FS was issued with the understanding that additional data needed to fill in data gaps would be collected as part of soil and groundwater pre-design investigations (PDIs) and incorporated into an FS Addendum.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	The third five-year review recommended completion of the Lower Subase Record of Decision (ROD) to select the remedial actions for Site 17 that are protective of human health and the environment, and continued enforcement of SOPA (ADMIN) NLONINST 5090.25, which replaced 5090.18. Details are discussed in Section 11.4.

<b>Table A-9</b> <b>Zone 3 (Site 17) — Site History and Background</b>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
January 2012	Lower Subbase (Operable Unit [OU] 4) Soil and Groundwater PDI Completion Report and FS Addendum <i>Tetra Tech January 2012</i>	<p>The PDI collected additional soil information from Zone 3 to confirm the extent of contamination, contaminants of concern (COCs), and volumes of soil exceeding regulatory criteria (Industrial/Commercial Direct Exposure Criteria and Pollutant Mobility Criteria). The PDI also collected additional groundwater samples to confirm the presence and extent of lead exceeding regulatory criteria in Zone 3. The additional soil and groundwater data were used to prepare an FS Addendum that incorporated the results of the PDIs; the sections of the FS impacted by PDI data included the HHRA, COCs and medium of concern selection, volumes of contaminated media, and remedial alternative evaluation. Using combined data from the FS and FS Addendum, an updated HHRA was prepared for Zone 3 soil and groundwater. The HHRA concluded that lead in Zone 3 soil was a concern but groundwater was not a concern in any Lower Subbase zone.</p> <p>During completion of the FS Addendum, the boundary between Zones 2 and 3 were altered so that all Zone 2 soil estimated to have lead concentrations greater than residential criteria was moved into Zone 3.</p>
2012	OU 4 Proposed Plan <i>NAVFAC March 2012</i>  OU 4 ROD <i>NAVFAC August 2012</i>	The ROD documented the selected remedy for OU 4 Zone 3, Site 17: land use controls (LUCs), long-term monitoring, and five-year reviews. Details are in Section 11.3.
2012 to 2013	Draft Soil Land Use Control Remedial Design (LUC RD) <i>Resolution Consultants November 2012</i>  Draft Final Soil LUC RD <i>Resolution Consultants February 2013</i>	The LUC RD identified LUC performance objectives, authorized and unauthorized uses, and monitoring/inspection requirements. This document is pending finalization after completion of remedial actions at OU 4 Zone 4.
April 2013	Subbase New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 17 until a LUC RD is finalized. Additional information can be found in Section 2.11.1.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

<p align="center"><b>Table A-10</b>  <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1940s to 1950s	Site 13 (Building 79) activities	Building 79 formerly adjoined an oil contamination area identified in during early investigations of the Lower Subase. This oil contamination is associated with diesel engine repair from the 1940s to the 1950s, which included draining waste oil and solvents into a pit located inside Building 79; use of the pit was discontinued and filled with concrete by 1987. Building 79 was demolished between 2011 and 2013, with the foundation remaining and the surrounding area paved for parking.
1940s to 2000	Site 19 (Former Solvent Storage Area) activities	Equipment cleaning solvents were stored at former Building 316 until circa 2000. The roof and doors of Building 316 were demolished, leaving only the side walls.
1930 to 1960	Former Marine Railway at Pier 1 activities	The north portion of Former Pier 1 was constructed on a solid concrete foundation that extends approximately 175 feet from Controlled Industrial Facility Building 476 into the Thames River and forms the east boundary of the Inner Pier 1 area. The Navy demolished and removed a pile-supported portion of Pier 1 in 2009. Ship maintenance activities (e.g., sandblasting, scraping, painting) may have released metals, polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) to sediment in the Thames River at former Pier 1.
1940 to 1994	Quay Wall history	<p>A wooden platform (pier) and Quay Wall constructed in 1940 underlie Albacore Road in the west part of Zone 4. The current steel bulkhead along the Thames River was erected in 1952, constructed of steel sheet piling and supports. During construction of the bulkhead, the Quay Wall and 4-inch thick wooden platform, supported by 10- to 12-inch square wooden joist and 8-inch timber pilings, were covered with sand and gravel fill, and the area was paved for vehicle access along Albacore Road. Layers of petroleum contamination were identified in soil above the platform and in underlying fill in 1994. The Quay Wall is approximately 4 feet east of the steel bulkhead immediately beneath the paved surface. Fill soil beneath the wooden platform and Quay Wall may periodically wash out and can be replaced with sand poured into a series of manholes along the length of Albacore Road. Natural river deposits of silt and sand underlie the void spaces and sand fill.</p> <p>The area surrounding Pier 4 is underlain by numerous underground utilities and utility access passages. A power plant with four underground storage tanks is located approximately 600 feet northwest of Pier 4. Fuel transfer pipelines, used until the early 1980s, are located approximately 150 feet east of Pier 4. Secondary lines from the main fuel transfer pipelines are located throughout the area northeast of Pier 4 and southeast of the power plant.</p>
February 1979	Oil Contamination of the Groundwater at Subase New London <i>Navy February 1979</i>	This study identified oil contamination in the vicinity of Building 79. Available building maps show a subsurface drain pipe extending from the pit to Albacore Road. Four piezometer borings were installed. Oil and grease content in soils ranged from 500 to 1,600 parts per million (ppm) and oil content in groundwater ranged from 15 ppm to more than 98% (free product). Oil thickness ranged from 10 inches to over 5 feet. Lubricating oil was found in the vicinity of Building 79. This report recommended abandoning the Building 79 waste oil pit and installation of a recovery well system. The waste oil pit was abandoned and filled with concrete. A recovery well system was installed near Building 79 in 1985 and operated for several months but was found to be ineffective and later abandoned.

<p align="center"><b>Table A-10</b>  <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
March 1983	Initial Assessment Study (IAS) <i>Envirodyne Engineers, Inc. March 1983</i>	The IAS included visual investigation and research of site history, which identified Site 13 (Building 79 Waste Oil Pit) as one of 11 sites with hazardous materials. The IAS recommended no further action because the source of contamination (pit) was no longer in use, had been filled with concrete, and was closed to all drainage.
November 1987	Final Site Investigation (SI) Subsurface Oil Contamination Lower Subase <i>Wehran Engineering Corporation November 1987</i>	Two areas within Zone 4 were contaminated with heavy oil. Oil contamination (determined to be No. 6 fuel oil weathered less than a year) was in a trench along Argonaut Road from Building 85 (Zone 4) to near the northeast corner of building 78 (Zone 3). Manholes and the area underneath the supporting platform in the vicinity of Building 79 (Site 13) contained No. 6 fuel oil older than one year and trace levels of waste oil. The SI identified and delineated sources of heavy oils in the subsurface at Lower Subase (including Site 13) by collecting soil samples from soil borings, oil samples from manholes and trenches, and groundwater from monitoring wells. Samples were tested to identify type, degree of weathering, and general concentrations of oil contamination at those sites. Soil, oil, and groundwater samples were analyzed for oil and PCBs. Determined soluble constituents of oil were present throughout the study area: manholes, soil, and groundwater in the vicinity of Building 79 contaminated with No. 6 fuel oil likely caused by old undocumented spills and a No. 6 fuel oil leak in a trench. PCBs were not detected. The SI recommended mopping sludge oil or excavation of oil-laden soils, inspecting the No. 6 fuel oil line, and cleaning the trench.
August 1992	Phase I Remedial Investigation (RI) Report <i>Atlantic Environmental Services, Inc. August 1992</i>	<p>The RI included an inspection of utility manholes and the waterfront bulkhead for evidence of contamination. Also included were a soil-gas survey, test borings, groundwater monitoring well installations, and soil and groundwater sampling and analysis. The investigation identified three areas of concern:</p> <ul style="list-style-type: none"> <li>• Two areas of significant petroleum accumulation: Brown milky oil observed in Manhole 83, west of Building 79, believed to have originated from the former waste oil pit. Thick black oil in an area west of Building 80, on the boundary between Zone 3 and Zone 4.</li> <li>• Large area of low concentrations of volatile organic compounds (VOCs) west of Buildings 79 and 80 in soil-gas survey.</li> <li>• Contaminated soil in the vicinity of Building 79, found to be a mixture of No. 6 fuel oil and waste oil, from a No. 6 fuel oil underground pipeline in the vicinity of Building 78.</li> </ul> <p>The presence of total petroleum hydrocarbons (TPH) in wells located west of Building 79, although oil seeps and sheens have been reported along the bulkhead near Building 79. Many sheens were attributed to creosote leaching from exposed wooden pier and Quay Wall pilings. The RI identified no oil releases along the Thames River and subsurface free product detected in previous studies was not present.</p> <p>The RI included soil and groundwater sampling and analysis at Site 13 for VOCs, total and toxicity characteristic leachate procedure (TCLP) metals, and TPH. The investigation identified the following: groundwater slightly exceeded drinking water standards, the former onsite oil pit in Building 79 was the source of subsurface soil contamination, elevated levels of lead in soil but not groundwater, and low levels of thallium was detected in two wells. The RI included a human health risk assessment (HHRA), which calculated negligible risks for several exposure pathways and recommended proceeding to a feasibility study (FS) with additional data requirements.</p>



Table A-10 Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background		
Date	Event/Document	Description
May 1995	Non-Time-Critical Removal Action (NTCRA) documented in Removal Site Evaluation for Quay Wall <i>Halliburton NUS May 1995</i>	<p>Zones of petroleum contamination were visible in soil immediately above the wooden platform and in the fill below. The petroleum was found in the area around the storm sewer manhole northeast of Pier 4. Globules of floating product were also present in the standing water in the void spaces below the wooden platform. Releases of petroleum products and oily substances were observed in the Thames River in the vicinity of the storm sewer outfall just north of Pier 4 in November 1994. The probable source of releases was the storm sewer manhole near Pier 4 and Building 79. An expandable rubber plug was placed in the storm sewer outfall in November 1994 and the storm sewer pipe leading to the outfall was filled with sand in late December 1994. The measure appeared to have eliminated migration of petroleum product from that outlet, because no visible release of petroleum product had been observed in the Thames River near the outlet.</p> <p>The Zone 4 Quay Wall study area situated on the Thames River between Piers 4 and 6, southwest of building 79. In November 1994, 2,300 gallons of oily wastewater and roughly 40 drums of various sizes of absorbent pads contaminated with product were generated during cleanup activities. Five product recovery wells were installed with 16,000 gallons of oil/water pumped during four removal events; less than 5 percent (800 gallons) of the liquid was petroleum product. Soil samples analyzed for VOCs, semivolatile organic compounds (SVOCs), TCLP metals, PCBs, TPH, and cyanide. Lead and arsenic were detected above Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs); VOCs, SVOCs, and pesticides were detected below CTDEEP RSRs. PCBs were not detected and TPH detections in all soil were below CTDEEP standards. Lead was the only remaining contaminant of concern (COC) and direct exposure was not considered likely to occur except during construction activities; therefore, no further removal action was recommended but further lead studies were needed.</p>
April 1996	Leak Testing Investigation for Fuel Oil Distribution System <i>Heitkamp April 1996</i>	Various fuel oil distribution lines and valves within the Lower Subbase, including Zone 4, were pressure-tested. Valves 19 and 20 on the Building 332 North Line and 17 and 18 on Building 332 South Line did not seal tight and were subsequently replaced. All other sections of line and various valves tested within Zone 4 passed pressure testing procedures and were abandoned in place in 1996.
September 1997	Site Investigation Report for Tank Farm Investigation <i>Brown and Root Environmental (B&amp;RE) September 1997</i>	This study investigated underground (new and old diesel) pipelines from the fuel loading dock (Pier 1), throughout a portion of Zone 4, and from the gate valve (Building 332) to tanks within the tank farm along Crystal Lake Road. Included six samples within Zone 4 for TPH analysis. TPH concentrations detected in five samples were below 50 milligrams per kilogram (mg/kg); one sample near the southwest corner of Building 504 exceeded 2,500 mg/kg believed to have originated from a pipeline leak. The report recommended additional integrity inspections to determine location(s) of leaks on active and inactive product lines and a records review to identify previous leaks based on results of line inspections and tightness tests.

<p align="center"><b>Table A-10</b>  <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
March 1997	<p>Phase II RI Report  <i>B&amp;RE March 1997</i></p> <p>Existing Data Summary Investigation for Lower Subbase RI  <i>B&amp;RE March 1997</i></p>	<p>The Phase II RI included seven soil samples from five borings analyzed for lead, TPH, and TCLP metals and groundwater samples from eight wells analyzed for VOCs, SVOCs, metals, and TPH. Elevated levels of TPH (up to 11,800 mg/kg) and lead (up to 10,600 mg/kg) were detected in Zone 4 soil, particularly near Site 13 and the Quay Wall. Possible sources of contamination were again identified as the Building 79 waste oil pit and fuel oil distribution system in the area. The Phase II RI recommended further characterization of the Lower Subbase in a separate RI that emphasized evaluation of the nature and extent of lead, TPH, and SVOCs in soil; and a focused data collection effort to provide information relevant to an FS.</p> <p>Accumulated data from existing studies, including the Phase II RI, to identify potential data gaps needed to be filled during the Lower Subbase RI. For Zone 4, the report identified the need for:</p> <ul style="list-style-type: none"> <li>• Determining mobility of lead in shallow and deep soil using synthetic precipitate leachate procedure analysis.</li> <li>• Quantifying the amount of lead entering the Thames River.</li> <li>• Evaluating ecological impacts in the Thames River.</li> <li>• Records review and sampling associated with Building 316 (southeast portion of Zone 4).</li> <li>• Sediment sampling in the Thames River in the vicinity of Zone 4.</li> <li>• Evaluation, repair, and/or cleanout of fuel oil distribution lines, utility ducts, and storm sewers.</li> </ul>
1999	<p>Work Plan and Sampling and Analysis Plan for Lower Subbase RI  <i>B&amp;RE September 1997</i></p> <p>Lower Subbase RI Report  <i>Tetra Tech January 1999</i></p>	<p>This RI was conducted on all zones within the Lower Subbase and the Thames River and included an HHRA and updated ecological risk assessment (ERA) for Zone 4. The RI concluded that activities at Lower Subbase had impacted soil, groundwater, and sediment, and that surface water in the Thames River near the Lower Subbase did not appear to differ significantly from upstream or downstream locations. Recommended further evaluation of soil and groundwater in Zone 4 in an FS and a data-gap investigation for sediment in Zone 4. The results of the data-gap investigation should be combined with the results of the RI to determine risk in Zone 4 sediment and appropriate remedial alternatives evaluated in an FS.</p>
2000	Pier 1 Marine Railway Investigation <i>Science Applications International Corporation 2000</i>	<p>Pier 1 area sediment analyzed for metals, PAHs, PCBs, and pesticides in 1999 after evidence of marine vessel overhaul activities was discovered during draining the railway for a building construction project. The study evaluated whether chemicals from those activities had been released and transported to sediment in the Thames River. Results of this small-scale study indicated that concentrations of PCBs, metals, and PAHs in sediment exceeded benchmark values and that concentrations of these chemicals in Pier 1 decreased from north to south away from the new building location.</p>
December 2001	First Five-Year Review <i>Naval Facilities Engineering Command (NAVFAC) December 2001</i>	<p>A final remedy had not been selected for Zone 4. The First Five-Year Review concluded that the Lower Subbase RI did not indicate imminent threats to human health or the environment, and recommended completion of an FS followed by an appropriate decision document in addition to continued enforcement of Standard Operating Procedure — Administrative (SOPA) [ADMIN] New London Instruction (NLONINST) 5090.18. SOPA (ADMIN) NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1.</p>

<p align="center"><b>Table A-10</b>  <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
2003	Thames River Rapid Sediment Characterization Pilot Study <i>Battelle September 2003</i>  Final Screening-Level ERA and Refinement for Zones 4 and 7 <i>Battelle and Neptune October 2004</i>	The pilot study was conducted to evaluate the potential for unacceptable ecological risk in three locations including Zone 4 and Pier 1. Sediment samples were analyzed using in-situ screening techniques for metals, PCBs, and PAHs with confirmation laboratory analysis. Results were used to develop data quality objectives and a screening-level ERA.
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	A final remedy had not been selected for Zone 4. The Second Five-Year Review concluded that the Lower Subbase RI did not indicate imminent threats to human health or the environment, and recommended completion of the FS and appropriate decision document to select remedial alternative(s) for Zone 4 with continued enforcement of SOPA (ADMIN) NLONINST 5090.18.
March 2008	Thames River Validation Study <i>Battelle and Neptune March 2008</i>	This study evaluated sediment from all zones within the Thames River. The report concluded sediment in Zone 4 posed low-level risks to piscivorous birds and sediment in Zone 4 and Outer Pier 1 posed unacceptable risks to invertebrates. The study recommended evaluation of Zone 4 sediment in an FS and an Inner Pier 1 sediment in an Engineering Evaluation/Cost Analysis.
October 2009	Thames River Sediment Sampling at Zone 4, Pier 1, and Outer Pier 1 <i>Tetra Tech October 2009</i>	Sediment samples analyzed for PCBs, metals, PAHs, and pesticides. Sediment in Zone 4 and Pier 1 exceeded Effects Range Median-Quotients (ERM-Q) and PCB preliminary Remedial Goals (RGs). Average ERM-Q and PCB concentrations increase with depth, which indicated clean sediment deposition is occurring. Recommended reviewing preliminary RGs to determine if they are appropriate and determining if additional sampling was necessary to delineate the vertical and horizontal extent of contamination. After remedial technologies were re-evaluated and resolved, the report recommended finalizing the FS.
November 2009	Engineering Evaluation/Cost Analysis and Action Memorandum for Inner and Outer Pier 1 <i>Tetra Tech November 2009</i>	Removal action boundaries were established for contaminated sediment in Inner and Outer Pier 1 (the whole of Inner Pier 1 and a portion of Outer Pier 1). A small area of contamination in the vicinity of Outer Pier 1 was left to be addressed in the FS.
May 2010	NTCRA Completion Report for Sediment Removal at Pier 1 Inner and Outer Areas <i>Tetra Tech May 2010</i>	The specific removal action objective for Inner and Outer Pier 1 was to minimize the potential migration of, and mitigate the risk to ecological receptors posed by, COCs in Inner and Outer Pier 1 sediment. Former Pier 1 was subdivided into two subareas (Inner and Outer) based on contaminant distribution. Phase I of the NTCRA was completed in March 2010, which included dredging most of the contaminated sediment from Pier 1 Inner Area and removal of all contaminated sediment from the Pier 1 Outer Area (except for the area to be included in the FS) through mechanical dredging. Confirmation sediment samples were analyzed for PCBs, pesticides, metals, and PAHs. Confirmation samples collected from the Inner Pier 1 Area confirmed some contaminated sediment remained but structures encountered prevented removal of all sediment from the Inner Pier Area. The Navy determined a second phase would be needed to remove all contaminated sediment from Inner Pier 1 using hydraulic dredging. A small area of contaminated sediment that comprises the Outer Pier 1 portion included with Zone 4 not included in the NTCRA was subsequently evaluated in the Lower Subbase FS and FS Addendum, described below.

<p align="center"><b>Table A-10</b>  <b>Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2010	Final Lower Subase FS <i>Tetra Tech December 2010</i>	Volumes of contaminated soil, sediment, and groundwater were calculated and remedial alternatives evaluated. The FS includes an updated HHRA was completed to comply with post-Lower Subase RI HHRA guidance/protocol changes by United States Environmental Protection Agency Region 1 and RSR changes by CTDEEP. The FS was issued with the understanding that additional data needed to fill in data gaps would be collected as part of soil and groundwater pre-design investigations (PDIs) and incorporated into an FS Addendum.
2011	Final Removal Action Design for Pier 1 Inner Area <i>Tetra Tech April 2011</i>  Draft Work Plan for Pier 1 Sediment Removal Action Phase 2 <i>AGVIQ-CH2M HILL Constructors, Inc. Joint Venture III (AGVIQ) 2011</i>	These design and work plans outlined the second phase of the NTCRA in Inner Pier 1 (removing remaining contaminated sediment using hydraulic dredging) and included a contingency measure for removing additional Outer Pier 1 sediment that may have migrated from Inner to Outer Pier 1. Once completed, all contaminated sediment would be removed from the Pier 1 area, except for the Outer Pier 1 area evaluated in the FS and FS Addendum.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	Recommended completion of the Lower Subase Record of Decision (ROD) to select the remedial actions for Zone 4 (Site 13 and Site 19) and Outer Pier 1 that are protective of human health and the environment, and continued enforcement of SOPA (ADMIN) NLOINST 5090.25, which replaced 5090.18. Details are discussed in Section 12.4.
January 2012	Lower Subase (Operable Unit [OU] 4) Soil and Groundwater PDI Completion Report and FS Addendum <i>Tetra Tech January 2012</i>	The PDI including Zone 4 soil and groundwater. The study included collecting additional soil information from Zone 4 to confirm the extent of contamination, COCs, and volumes of soil exceeding regulatory criteria (Industrial/Commercial Direct Exposure Criteria and Pollutant Mobility Criteria). Additional groundwater samples were also collected to confirm the presence and extent of select metals (i.e., arsenic, copper, and lead) exceeding regulatory criteria in Zone 4. The additional data were used to prepare an FS Addendum to incorporate the results of the PDIs; the sections of the FS impacted by PDI data included the HHRA, COC and medium of concern selection, volumes of contaminated media, and remedial alternative evaluation. Using combined data from the FS and FS Addendum, an updated HHRA was prepared for Zone 4 soil and groundwater. The HHRA concluded that PAHs and lead in Zone 4 soil are a concern for human health but groundwater is not a concern in any Lower Subase zone. Unacceptable ecological risks were also identified for metals, PAHs, pesticides, and PCBs in Zone 4 and Outer Pier 1 sediment.
2012	OU 4 Proposed Plan <i>NAVFAC March 2012</i>  OU 4 ROD <i>NAVFAC August 2012</i>	The ROD selected the following remedy for soil: excavation and offsite disposal, land use controls (LUCs), long-term monitoring, and five-year reviews.  The ROD selected the following remedy for sediment: dredging, dewatering, and offsite disposal; monitoring during and after construction; LUCs; long-term monitoring; and five-year reviews.
2012 to 2013	Draft Soil Land Use Control Remedial Design (LUC RD) <i>Resolution Consultants November 2012</i>  Draft Final Soil LUC RD <i>Resolution Consultants February 2013</i>	The Soil LUC RD identified LUC performance objectives, authorized and unauthorized uses, and monitoring/inspection requirements by restricting residential land use and development; restricting disturbance of contaminated soil/ and maintaining a protective cover lay to provide Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk-based engineered controls. This document is pending finalization after completion of remedial actions at Zone 4.

Table A-10 Zone 4 (Sites 13 and 19) and Outer Pier 1 — Site History and Background		
Date	Event/Document	Description
2012 to 2013	Draft Sediment LUC RD <i>Resolution Consultants October 2012</i>  Draft Final Sediment LUC RD <i>Resolution Consultants January 2013</i>	The Sediment LUC RD identified specific actions needed to implement, operate, maintain, inspect, and enforce the following LUC components of the remedy: prohibiting disturbance of sediment over 13,500-square-foot area in Outer Pier 1 and adjacent to the Quay Wall and existing pier structure in Zone 4; maintaining the protective cover over Outer Pier 1; controlling remaining contaminated sediment under the Quay Wall and existing pier structure; and establishing a "Safety Zone" or "No Anchor Zone" around the Outer Pier 1 capped area to avoid damage as a result of maintenance dredging activities and to repair such damage if it occurs.
April 2013	Submarine Base New London Instruction (SUBASENLONINST) 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) NLONINST 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media (soil and sediment) at Site 13, Site 19, and Outer Pier 1 until a LUC RD is finalized. Additional information can be found in Section 2.11.1.
2014	Final Remedial Action Work Plan, OU 4 Zones 4 and 7 Soil <i>AGVIQ June 2014</i>  60 Percent Design Report for CERCLA Soil, Lower Subbase, OU 4 <i>Resolution Consultants November 2014</i>	This Work Plan and Design Report detailed the specific actions to be conducted as part of implementing the remedy for soil at Zone 4 selected in the OU 4 ROD, which included excavation and disposal of contaminated soil and asphalt pavement.
June 2014	Removal Action Completion Report Pier 1 Inner Area Sediment Removal Action Phase 2 <i>AGVIQ June 2014</i>	The NTCRA consisted of dredging, dewatering, stabilizing, and offsite transportation and disposal of approximately 376 cubic yards of residual contaminated sediment.
November 2014	60 Percent Design Report for CERCLA Sediment, Lower Subbase, OU 4 <i>Resolution Consultants November 2014</i>	This report detailed the specific actions to be conducted as part of implementing the selected remedy for sediment at Zone 4 (within the Thames River between former Pier 1 and Pier 6) and Outer Pier 1 (small area of contaminated sediment that could not be removed during the NTCRA). Details of the selected remedy are in Section 12.3.
May to December 2014	Soil excavation activities performed	Soil excavation activities were performed, as detailed in the 60 Percent Design Report and Remedial Action Work Plan, from May to December 2015. Further details regarding the completed remedial construction activities are discussed in Section 12.3.4.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.



**Table A-11**  
**Zone 7 (Sites 21 and 25) — Site History and Background**

Date	Event/Document	Description
1918 to present	Various Zone 7 Structures historical uses and activities	<p>The north portions of existing Buildings 40, 88, and 153 are within the south boundary of Zone 7. Three structures were constructed between 1918 and 1944 that remain in use within Zone 7:</p> <ul style="list-style-type: none"> <li>• Building 173 has remained an electrical substation since construction.</li> <li>• Building 106, originally used as a photo lab and electronics shop, is currently used for storage.</li> <li>• Building 157, originally a periscope shop, is now an optical shop.</li> </ul>
	Site 21 (Berth 16) operations	<p>Berth 16 had a 250-gallon diesel fuel underground storage tank (UST), polychlorinated biphenyl (PCB)-containing transformers, and underground diesel fuel lines.</p> <ul style="list-style-type: none"> <li>• The UST, formerly outside the north wall of Building 157, was connected to a diesel fuel transfer line that extended along Pier 15, east of Building 173. The tank powered an emergency generator for a sewer lift station. A former septic tank with leach field, the location of which have not been identified, served Building 173.</li> <li>• The transformers, which formerly contained approximately 140 gallons of PCB-containing dielectric fluid, were located in an outdoor covered electrical vault (Vault 31) at Building 157. The transformers were replaced with non-PCB-containing transformers and a secondary containment was constructed around the transformer vault.</li> <li>• Underground diesel fuel lines serviced Berth 16 as late as 1954 and were subsequently abandoned; the method of abandonment is unknown. Underground diesel fuel lines do not extend further north than Pier 13.</li> </ul>
1944 to 1963	Site 25 Former Classified Materials Incinerator operations	Between 1944 and 1963, the incinerator burned classified material and other non-salvageable wastes generated within the Lower Subase. Residual ash was disposed of in one of three landfill locations within Naval Submarine Base New London (NSB NLON). The incinerator was located within former Building 97, both of which were demolished in 1979. Building 478 was constructed after the incinerator was demolished in 1979 and has been used as a maintenance shop.
1989	Geotechnical Investigation	A geotechnical investigation was conducted in 1989 prior to replacement of the Zone 4 Quay Wall, as documented in the Final Site Inspection (SI) Report, Pier 33 and Berth 16/Former Incinerator, discussed below. No. 2 fuel oil was detected in subsurface soil at Berth 16, with total petroleum hydrocarbon (TPH) detected at 1,200 milligrams per kilogram (mg/kg). A soil sample collected from a trench dug north of Building 157 contained 490 mg/kg TPH and 1.1 mg/kg trichloroethene, and exhibited lead in leachate (245 milligrams per liter via the toxicity characteristic leachate procedure [TCLP]). Based on discovery of TPH contamination, the Berth 16/Former Incinerator was added to the Installation Restoration Program.
September 1994	Environmental Assessment for Pier 17 Replacement <i>Maguire Group Inc. September 1994</i>	Surface water (elutriate), sediment, and benthic species sampling conducted in the vicinity of Pier 15 and 17 (which included the Thames River near Pier 16) identified polynuclear aromatic hydrocarbons (PAHs) and metals as the major contaminants detected in sediment. Concentrations of metals and PAHs detected in upper sediment strata were higher than in lower strata. Pesticides and PCBs were detected in low levels in the upper sediment strata. Mercury and nickel exceeded marine United States Environmental Protection Agency water quality criteria. The assessment concluded that the proposed activities would have short-term effects on Thames River water quality, no effects on navigation, and minimal effects on fish and benthic species.

<p style="text-align: center;"><b>Table A-11</b>  <b>Zone 7 (Sites 21 and 25) — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
February 1995	Final SI Report, Pier 33 and Berth 16/Former Incinerator <i>Atlantic Environmental Services February 1995</i>	The SI included soil-gas surveys, a utility inspection, soil borings, monitoring well installation, and soil, sediment, and groundwater sampling. Berth 16 (although not located in the formal boundaries of the Lower Subbase) and the Former Classified Materials Incinerator were investigated. Soil, sediment, and groundwater samples were analyzed for TPH, TCLP metals, and dioxins. Petroleum products and metals were the contaminants of concern (COCs) identified in soil; volatile organic compound, pesticide, and PCB concentrations detected were not considered significant. A detection of dioxin in one soil sample was attributed to the presence of incinerator ash. Elevated lead was detected at three locations. The COCs for groundwater were metals, likely from fill material (construction debris and ash). Lead was the only contaminant that exceeded an action level in groundwater; PAHs were detected at low levels as a result of soils containing fuel-oil residues. The report recommended a remedial investigation (RI) for Berth 16.
April 1995	Preliminary Assessment, Supplement to Initial Assessment Study <i>Naval Facilities Engineering Command (NAVFAC) April 1995</i>	This assessment included a visual investigation and site history research of the transformer at Building 157, Vault 31. Oil was observed on a concrete pad surface with the potential for PCBs. No further cleanup action was recommended under the NSB NLON spill contingency plan.
March 1997	Existing Data Summary Report for Lower Subbase RI <i>Brown and Root Environmental (B&amp;RE) March 1997</i>	<p>This report evaluated the adequacy of existing data and concluded activities and contamination at the Lower Subbase had impacted the Thames River but had minimal impact on groundwater. USTs and leaking fuel lines resulted in potential contaminant sources throughout the Lower Subbase. An ecological risk assessment (ERA) indicated PAHs and metals were the primary COCs for the Thames River, which is the only potential ecological habitat near the Lower Subbase. The ERA concluded that the Lower Subbase represented a minimal potential risk to ecological receptors.</p> <p>The report reiterated recommendations provided in the SI Report with some modifications: additional characterization of the Thames River in the vicinity of the Lower Subbase; identification, removal, and monitoring sources of contamination in the Lower Subbase (including removal and disposal of contaminated sediments); identification and repair of fuel line leaks; and additional characterization at all contaminant zones in the Lower Subbase. The recommended additional characterization included further investigation of soil and groundwater containing petroleum constituents, contamination in catch basins, lead in subsurface soils (including soils with TCLP lead exceeding 150 micrograms per liter) and groundwater, and the extent of ash disposal.</p>

<p align="center"><b>Table A-11</b>  <b>Zone 7 (Sites 21 and 25) — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
1999	<p>Work Plan and Sampling and Analysis Plan for Lower Subbase RI  <i>B&amp;RE September 1997</i></p> <p>Lower Subbase RI Report  <i>Tetra Tech January 1999</i></p>	<p>The Lower Subbase RI was conducted on all zones within the Lower Subbase and the Thames River but did not include Site 25 or transformers at Building 157. Previous (Phase I and Phase II) RIs conducted at other Lower Subbase areas did not include Zone 7. This RI included a human health risk assessment (HHRA) for Zone 7 surface water, shellfish, and finfish and an ERA for sediment. The ERA concluded that Zone 7 was one of two (with Zone 4) that posed unacceptable risk to benthic invertebrates exposed to sediment; primary risk drivers were PAHs and metals.</p> <p>Lead was detected in shallow and deep soils; the highest concentrations were detected along the west side of Building 456 and east side of Building 157, respectively. Lead concentrations in Zone 7 were higher than other Lower Subbase zones. Lead was detected in groundwater samples, with higher concentrations in unfiltered samples. The Lower Subbase RI suggested the potential that inorganic compounds (mainly lead) were migrating from soil to groundwater; the source of lead contamination in groundwater was the unsaturated soil of Zone 7. The Thames River showed some potential evidence of cross-contamination from PAHs and inorganic compounds but lead was not a COC in the Thames River.</p> <p>TPH was detected in two locations (northwest corner and south third of Zone 7), more widespread and at higher concentrations in shallow soil than in deep soil. PAHs were detected in Zone 7 shallow and deep soils. Fuel lines formerly within Zone 7 had been decommissioned, eliminating the historical source of petroleum contamination which had not migrated (at elevated levels) to groundwater.</p> <p>The Lower Subbase RI concluded activities at Lower Subbase had impacted soil, groundwater, and sediment, and that surface water in the Thames River near the Lower Subbase did not appear to differ significantly from upstream or downstream locations. The RI recommended further evaluation of soil and groundwater within Zone 7 in a feasibility study (FS) and a data gap investigation for sediment in Zone 7 to be combined with Lower Subbase RI results to determine risk in Zone 7 sediment for evaluating appropriate remedial alternatives.</p>
August 2000	Lower Subbase storm sewer catch basin cleaning	Five storm sewer catch basins in Zone 7 were cleaned using a vacuum truck. The material removed from the catch basins was containerized, tested, and disposed of offsite. The storm sewer lines were not surveyed or repaired during that effort.
December 2001	First Five-Year Review <i>NAVFAC December 2001</i>	During the five-year review site inspection, issues with the condition of some monitoring wells was noted. A final remedy had not been selected for Zone 7. The First Five-Year Review concluded that the Lower Subbase RI did not indicate imminent threats to human health or the environment, and recommended completion of an FS followed by an appropriate decision document in addition to continued enforcement of Standard Operating Procedure — Administrative (SOPA [ADMIN]) New London Instruction (NLONINST) 5090.18 and rehabilitation or abandonment of damaged wells. SOPA (ADMIN) NLONINST 5090.18 and subsequent revisions are discussed in Section 2.11.1.
2003 to 2004	<p>Thames River Rapid Sediment Characterization Pilot Study Report  <i>Battelle September 2003</i></p> <p>Final Screening-Level ERA and Refinement for Zones 4 and 7  <i>Battelle and Neptune October 2004</i></p>	<p>Zone 7 Thames River sediment was sampled and analyzed for PCBs, metals, and PAHs. Elevated levels of chemical constituents remained in the dredged area footprint within Zone 7. The report recommended developing data quality objectives and a screening level ERA.</p> <p>The recommended ERA was performed with data from the Lower Subbase RI and indicated potential risk to benthic invertebrates and piscivorous birds exposed to sediment in Zone 7.</p>

**Table A-11**  
**Zone 7 (Sites 21 and 25) — Site History and Background**

<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
December 2006	Second Five-Year Review <i>NAVFAC December 2006</i>	<p>A final remedy had not been selected for Zone 7. The Second Five-Year Review concluded that the Lower Subase RI did not indicate imminent threats to human health or the environment, and recommended completion of the FS and appropriate decision document to select remedial alternative(s) for Zone 7 with continued enforcement of SOPA (ADMIN) NLONINST 5090.18.</p> <p>During the five-year review site inspection, an extension of Building 157 was being constructed, which resulted in soil excavation and stockpiling for offsite disposal. The five-year review identified monitoring wells with missing covers that provided an open conduit from the ground surface to groundwater, and recommended rehabilitation or abandonment of those wells.</p>
May 2007	Watershed Contaminated Source Document for Lower Portion of the Thames River <i>Tetra Tech May 2007</i>	This study evaluated sediment from all zones within the Thames River. PAHs, PCBs, pesticides, and metals were present in the sediment upstream and downstream of the Lower Subase for which numerous potential sources within the Lower Subase were identified but their contribution amount was not established as to their impact on sediments. This report also concluded risks from Zone 7 sediment were acceptable and recommended no further evaluation.
March 2008	Thames River Validation Study <i>Battelle March 2008</i>	Included the most recent ERA performed for Zone 7 sediment to further evaluate risks to benthic invertebrates and piscivorous birds exposed to Zone 7 sediment and update the screening level ERA conducted during the Lower Subase RI. The Validation Study included fish tissue sampling and analysis for metals, and sediment sampling and analysis for PCBs, metals, PAHs, pesticides, and toxicity bioassays. Risks from sediment in Zone 7 were found to be acceptable and fish tissue results did not differ considerably between the reference area and Pier 1 fish. The report recommended no further evaluation of Zone 7 sediment.
December 2010	Final Lower Subase FS <i>Tetra Tech December 2010</i>	Volumes of contaminated soil, sediment, and groundwater were calculated and remedial alternatives evaluated in the FS. The FS included an updated HHRA completed to comply with post-Lower Subase RI HHRA guidance/protocol changes by United States Environmental Protection Agency Region 1 and the Connecticut Department of Energy and Environmental Protection Remediation Standard Requirements. The FS was issued with the understanding that additional data needed to fill data gaps would be collected as part of soil and groundwater pre-design investigations (PDIs) and incorporated into an FS Addendum.
December 2011	Third Five-Year Review <i>NAVFAC December 2011</i>	During the five-year review site inspection, an excavation was noted inside Zone 7 boundaries near Site 21, outside the southeast corner of Building 106. The stockpiled soil from the excavation had not been placed on a plastic liner and was not protected from weather by a cover. Recommended completion of the Lower Subase Record of Decision (ROD) to select the remedial actions for Site 21 and Site 25 protective of human health and the environment, and strengthened enforcement of SOPA (ADMIN) NLONINST 5090.25 until a final remedy was selected and implemented.

<p align="center"><b>Table A-11</b>  <b>Zone 7 (Sites 21 and 25) — Site History and Background</b></p>		
<b>Date</b>	<b>Event/Document</b>	<b>Description</b>
January 2012	Lower Subase (Operable Unit [OU] 4) Soil and Groundwater PDI Completion Report and FS Addendum <i>Tetra Tech January 2012</i>	The PDI collected additional soil information from Zone 7 to confirm the extent of contamination, COCs, and volumes of soil exceeding regulatory criteria (Industrial/Commercial Direct Exposure Criteria and Pollutant Mobility Criteria). The PDI also provided additional stratigraphic information regarding ash and cinders and synthetic precipitate leachate results for antimony and lead within Zone 7. The PDI also included collecting additional groundwater samples to confirm the presence and extent of arsenic, copper, and lead contamination in Zone 7. The additional data gathered during the PDI was used to prepare an FS Addendum; the sections of the FS impacted by PDI data included the HHRA, COC and medium of concern selection, volumes of contaminated media, and remedial alternative evaluation. Using combined data from the FS and FS Addendum, an updated HHRA was prepared for Zone 7 soil and groundwater. The HHRA concluded that antimony and lead in Zone 7 soil were a concern but groundwater was not a concern in any Lower Subase zone.
2012	OU 4 Proposed Plan <i>NAVFAC March 2012</i>  OU 4 ROD <i>NAVFAC August 2012</i>	The OU 4 ROD documented the selected remedy for Zone 7 (Site 21 and Site 25): land use controls (LUCs), long-term monitoring, and Five-Year Reviews. Details are in Section 13.3.
2012 to 2013	Draft Soil Land Use Control Remedial Design (LUC RD) <i>Resolution Consultants November 2012</i>  Draft Final Soil LUC RD <i>Resolution Consultants February 2013</i>	The LUC RD identified LUC performance objectives, authorized and unauthorized uses, and monitoring/inspection requirements. This document is pending finalization after completion of remedial actions at Zone 4.
April 2013	SUBASENLONINST 5090.25 <i>Navy April 2013</i>	SUBASENLONINST 5090.25 cancelled SOPA (ADMIN) 5090.25. This Navy-instituted instruction provides LUCs and restricts site activities to minimize unauthorized and unplanned exposure to contaminated media at Site 21 and Site 25 until a LUC RD is finalized. Additional information can be found in Section 2.11.1.
2014	Final Remedial Action Work Plan, OU 4 Zones 4 and 7 Soil <i>AGVIQ-CH2M HILL Constructors, Inc. (AGVIQ) Joint Venture III June 2014</i>  60 Percent Design Report for Comprehensive Environmental Response, Compensation, and Liability Act Soil, Lower Subase, OU 4 <i>Resolution Consultants November 2014</i>	This Work Plan and Design Report detailed the specific actions to be conducted as part of implementing the storm sewer upgrades and engineered control installation portions of the Zone 7 soil remedy selected in the OU 4 ROD. Details are in Section 12.3.4. Prior to the design report, approximately 86 feet of the 170 linear feet of storm sewer line identified for upgrades in the ROD had been replaced by NSB NLON as part of routine maintenance.
July 2015	Engineered Controls and Storm Sewer Upgrades performed  Draft Construction Completion Report <i>AGVIQ May 2016</i>	Engineered controls and storm sewer upgrades were performed, as detailed in the 60 Percent Design Report and Remedial Action Work Plan, from April to July 2015 and are documented in the Draft Construction Completion Report. Further details regarding the completed remedial construction activities are discussed in Section 13.3.4.

**Note:**

Full citations for all references can be found in Section 14 of the Fourth Five-Year Review Report.

**Appendix B**  
**Site Inspection Photographs**



Appendix B  
Five-Year Review Site Visit Photographs  
14 October 2015  
Naval Submarine Base New London



**2A-1**  
***Site 2A – Area A Landfill***  
*Deployed Parking Area*  
Typical sealed and unsealed cracks



**2A-2**  
***Site 2A – Area A Landfill***  
*Deployed Parking Area*  
Typical sealed and unsealed cracks, with vegetation

**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**2A-3**  
***Site 2A – Area A Landfill***  
*Deployed Parking Area*  
Typical cracks



**2A-4**  
***Site 2A – Area A Landfill***  
*Deployed Parking Area*  
Cracks with vegetation located near a landfill gas vent



**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**2A-5**  
***Site 2A – Area A Landfill***  
***Thresher Avenue Gate***

Example of signage posted in compliance with Volume III of the Operations and Maintenance Manual



**2A-6**  
***Site 2A – Area A Landfill***  
***Thresher Avenue Gate***

Gate conditions and erosion due to heavy equipment use

Appendix B  
Five-Year Review Site Visit Photographs  
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**2A-7**

***Site 2A – Area A Landfill***

*Deployed Parking Area at Drainage Channel B*

Typical sealed cracks at slope



**2A-8**

***Site 2A – Area A Landfill***

*Drainage Channel B*

Recently repaved drainage channel with some standing water (to the right of the culvert)



**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**2A-9**  
***Site 2A – Area A Landfill***  
***Crane Test Pad***  
Current conditions with minor standing water



**2A-10**  
***Site 2A – Area A Landfill***  
***Storage (Plateau) Area***  
Typical storage conditions following proper storage procedures

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**2A-11**

***Site 2A – Area A Landfill***

***Storage (Plateau) Area***

Sealed cracks, typical storage conditions following proper storage procedures



**2A-12**

***Site 2A – Area A Landfill***

***Storage (Plateau) Area***

Small cracks, typical storage conditions following proper storage procedures



Appendix B  
Five-Year Review Site Visit Photographs  
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**2A-13**  
***Site 2A – Area A Landfill***  
***Drainage Channel A***  
Vehicles parked on and near channel slope



**2A-14**  
***Site 2A – Area A Landfill***  
***Drainage Channel A***  
Vehicles parked on and near channel slope

Appendix B  
Five-Year Review Site Visit Photographs  
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**2A-15**  
***Site 2A – Area A Landfill***  
***Drainage Channel A***  
Drainage conditions indicating need for repaving



**2A-16**  
***Site 2A – Area A Landfill***  
***Slope Adjacent to Site 2B – Area A Wetland***  
Typical conditions



Appendix B  
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**2B-1**  
***Site 2B – Area A Wetland***  
Current restoration conditions



**2B-2**  
***Site 2B – Area A Wetland***  
Current restoration conditions

Appendix B  
Five-Year Review Site Visit Photographs  
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Naval Submarine Base New London



3-1

**Site 3 – Area A Downstream Watercourses/OBDA**  
*Concrete-Encapsulated Soil*  
Site conditions with leaf litter



3-2

**Site 3 – Area A Downstream Watercourses/OBDA**  
*Wetland Restoration Area*  
Vegetation conditions – potential invasive species



Appendix B  
Five-Year Review Site Visit Photographs  
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Naval Submarine Base New London



**6-1**

***Site 6 – Former DRMO***  
*Drainage Channel and Drop Inlet*  
Vegetation and leaf litter



**6-2**

***Site 6 – Former DRMO***  
*Cap Area*  
Trailer tie-downs (rebar) potentially through cap

Appendix B  
Five-Year Review Site Visit Photographs  
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Naval Submarine Base New London



**8-1**

***Site 8 – Goss Cove Landfill***

*Cap Area*

Typical condition of sealed cracks



**8-2**

***Site 8 – Goss Cove Landfill***

*Cap Area*

Conditions of AST that was subject to additional investigation



**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**8-3**

***Site 8 – Goss Cove Landfill***

*Cap Area*

Storm sewer repair, final conditions



**8-4**

***Site 8 – Goss Cove Landfill***

*Cap Area*

Gun and missile displays

**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**Naval Submarine Base New London**



**8-5**

***Site 8 – Goss Cove Landfill***

***Cap Area***

**Missile display with paver settlement**



**8-6**

***Site 8 – Goss Cove Landfill***

***Cap Area***

**Gun display with paver settlement**

Appendix B  
Five-Year Review Site Visit Photographs  
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Naval Submarine Base New London



**8-7**

***Site 8 – Goss Cove Landfill***

*Cap Area*

Gun display with paver settlement



**9/23-1**

***Former Fuel Farm***

*Above-ground Storage Tank Area near Site 9 – OT-5*

Site conditions



Appendix B  
Five-Year Review Site Visit Photographs  
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Naval Submarine Base New London



**9/23-2**  
***Former Fuel Farm***  
*Roadway and Athletic Fields*  
Site conditions



**OU4-1**  
***Lower Base – OU 4***  
*Zone 7*  
Concrete cover placed behind Building 456.

**Appendix B**  
**Five-Year Review Site Visit Photographs**  
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**Naval Submarine Base New London**



**OU4-2**

***Lower Base – OU 4***

***Zone 4***

Storm sewer rehabilitation, final conditions



**OU4-3**

***Lower Base – OU 4***

***Zone 7***

Storm sewer rehabilitation, final conditions

Appendix B  
Five-Year Review Site Visit Photographs  
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**OU4-4**  
***Lower Base – OU 4***  
*Zone 7*  
Storm sewer rehabilitation, final conditions



**Appendix C**  
**Site Inspection Checklists**

**Fourth Five-Year Review Site Visit Checklist  
for  
CERCLA Sites at Naval Submarine Base New London**

I. SITE INFORMATION			
<b>Site Name:</b> Site 2A - Area A Landfill	<b>Date of inspection:</b> 14 October 2015		
<b>Location and Region:</b> New London County, Connecticut	<b>U.S. EPA ID:</b> CTD980906515		
<b>Agency, office, or company leading the five-year review:</b> NAVFAC Mid-Atlantic/U.S. EPA Region 1	<b>Weather/temperature:</b> Sunny, 60s		
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <input checked="" type="checkbox"/> Landfill cover/containment  <input checked="" type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input type="checkbox"/> Groundwater pump and treatment  <input type="checkbox"/> Surface water collection and treatment  <input checked="" type="checkbox"/> Other </div> <div style="width: 50%;"> <input type="checkbox"/> Monitored natural attenuation  <input type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls </div> </div> <p><u>Inspecting landfill gas vents and perimeter channels. Long-term monitoring of groundwater and surface water.</u></p>			
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached    See Report			
II. INTERVIEWS			
1.	<b>O&amp;M site manager</b>	<u>Tracey McKenzie</u> Name	<u>NSB NLON ER Manager</u> Title <u>10/14/15</u> Date Interviewed <input checked="" type="checkbox"/> at site <input checked="" type="checkbox"/> at office <input type="checkbox"/> by phone    Phone no. <u>(860) 694-5649</u> Problems, suggestions: <input type="checkbox"/> Report attached <u>Ms. McKenzie indicated that she recently had equipment towed from the landfill cap and spends much time ensuring that storage requirements are met. She informed the group that there is a protocol (SUBASENLON Alpha Area Storage Permit) and yearly meetings between interested parties at NSB NLON to discuss requirements and procedures to be followed for proper storage.</u>
2.	<b>O&amp;M staff</b>	<u>H&amp;S Environmental</u> Name	<u>O&amp;M Contractor</u> Title <u>May 2015</u> Date Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone    Phone no. <u>(508) 366-7442</u> Problems, suggestions: <input type="checkbox"/> Report attached <u>Information from the most recent O&amp;M inspection (performed in May 2015) was used to supplement this inspection form.</u>
3.	<b>Local regulatory authorities and response agencies</b> (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.		
Agency <u>U.S. EPA Region 1</u> Contact <u>Kymberlee Keckler</u> <u>RPM</u> <u>10/14/15</u> <u>(617) 918-1385</u> Name    Title    Date    Phone no. Problems; suggestions: <input type="checkbox"/> Report attached <u>During the site visit, Ms. Keckler indicated that Site 2A was in much better condition than it was during previous inspections.</u>			
Agency <u>CTDEEP</u> Contact <u>Kenneth Feathers</u> <u>RPM</u> <u>10/14/15</u> <u>(860) 424-3770</u> Name    Title    Date    Phone no. Problems; suggestions: <input type="checkbox"/> Report attached <u>No comment received.</u>			

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks: <u>Inspections are performed annually. The O&amp;M Manual, drawings, maintenance logs, and inspection reports are maintained in the Navy's NIRIS environmental records management system; maintenance activities are captured in the annual O&amp;M reports generated by the O&amp;M Contractor and were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks: <u>Groundwater monitoring is performed annually. Round 27 groundwater monitoring was conducted in April 2014 with a final report anticipated in 2016. Round 28 sampling was completed in April 2015 with a draft report anticipated in 2016. Round 29 will occur in spring 2016. The annual groundwater monitoring reports are maintained in the Navy's NIRIS environmental records management system; the groundwater monitoring reports were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
IV. O&M			
1.	<b>O&amp;M Organization</b> <input type="checkbox"/> State in-house <input type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house <input type="checkbox"/> Contractor for State <input type="checkbox"/> Contractor for PRP <input checked="" type="checkbox"/> Contractor for Federal Facility Remarks: <u>Sovereign performed groundwater monitoring, landfill cap inspections, and site maintenance in 2011. H&amp;S performed groundwater monitoring, landfill cap inspections, and site maintenance from 2012 through 2015.</u>		<input type="checkbox"/> Other

V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A				
A. Fencing				
1.	<b>Fencing damaged</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Gates secured <input type="checkbox"/> N/A Remarks: <u>Fencing was recently repaired and appears to be in good condition. The gate to the Deployed Parking Area is open and the gate to the main storage area is closed.</u>			
B. Other Access Restrictions				
1.	<b>Signs and other security measures</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A Remarks: <u>Proper signage observed at all three gates.</u>			
C. Land Use Controls (LUCs)				
1.	<b>Implementation and enforcement</b> <div style="display: flex; justify-content: space-between;"> <span>Site conditions imply LUCs properly implemented</span> <span><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No    <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Site conditions imply LUCs being fully enforced</span> <span><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No    <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Type of monitoring</span> <span><u>Site inspection</u></span> </div> <div style="display: flex; justify-content: space-between;"> <span>Frequency</span> <span><u>Quarterly</u></span> </div> <div style="display: flex; justify-content: space-between;"> <span>Responsible party/agency</span> <span><u>NSB NLON</u></span> </div> <div style="display: flex; justify-content: space-between;"> <div style="display: flex; align-items: center;"> <span>Contact</span> <div style="margin-left: 10px;"> <u>Tracey McKenzie</u> Name               </div> </div> <div style="margin-left: 10px;"> <u>NSB NLON ER Manager</u> Title             </div> <div style="margin-left: 10px;"> <u>10/14/15</u> Date             </div> <div style="margin-left: 10px;"> <u>(860) 694-5649</u> Phone no.             </div> </div> <div style="display: flex; justify-content: space-between;"> <span>LUC Certification is up-to-date</span> <span><input type="checkbox"/> Yes    <input checked="" type="checkbox"/> No    <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>LUC Certifications are verified by the Navy</span> <span><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No    <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Specific requirements in deed or decision documents have been met</span> <span><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No    <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Violations have been reported</span> <span><input type="checkbox"/> Yes    <input type="checkbox"/> No    <input checked="" type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Other problems or suggestions:</span> <span><input type="checkbox"/> Report attached</span> </div> <div style="font-size: small;">           Remarks: <u>Per SUBASENLONINST 5090.25 (April 2013) contractors shall contact the Environmental Division prior to storing or operating heavy equipment/materials on Site 2A. Ground disturbing activities must be approved by the Environmental Division prior to commencement of the activities. Per the OU 9 LUC RD, groundwater cannot be extracted or used for potable purposes or other purposes that may result in unacceptable risks, groundwater must be handled appropriately during construction activities, and the monitoring network must be maintained. Site conditions indicate these LUCs are being followed.</u> </div>			
2.	<b>Adequacy</b> <input checked="" type="checkbox"/> LUCs are adequate <input type="checkbox"/> LUCs are inadequate <input type="checkbox"/> N/A Remarks: <u>Equipment should continue to be stored properly and LUCs followed. Based on site conditions, SUBASENLONINST 5090.25 and the OU 9 LUC RD appear adequate.</u>			
D. General				
1.	<b>Vandalism/trespassing</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No vandalism evident			
2.	<b>Land use changes onsite</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A			
3.	<b>Land use changes offsite</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A			
VI. GENERAL SITE CONDITIONS				
A. Roads <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A				
1.	<b>Roads damaged</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A			
B. Other Site Conditions				
Remarks: _____				

VII. LANDFILL COVER CONDITIONS			
<b>A. Landfill Surface</b>			
1.	<b>Settlement</b> (Low spots)	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Settlement not evident
2.	<b>Cracks</b> Lengths up to over 100+’ Widths up to 1 to 2” Depths up to 3” Remarks: <u>Old cracks previously sealed have re-opened and new cracks observed. The largest cracks are located in the Deployed Parking Area and along the edge of Channel A at the southern side of the landfill, where vehicles are parked near the edge and should be moved away from the edge to minimize further cracking. Vegetation observed growing through some cracks. See photos #2A-1 through 2A-3, 2A-7, 2A-11, 2A-13, and 2A-14 in Appendix B.</u>	<input checked="" type="checkbox"/> Location shown on site map	<input type="checkbox"/> Cracking not evident
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
4.	<b>Holes</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b> <input type="checkbox"/> Grass <input type="checkbox"/> Trees/Shrubs <input type="checkbox"/> Cover properly established Remarks: <u>Some old growth and Phragmites noted. Vegetated areas are in good condition.</u>		<input checked="" type="checkbox"/> No signs of stress
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> <input type="checkbox"/> N/A Remarks: <u>Gabion baskets and riprap on the north side of landfill cap are in good condition with some minor vegetative growth and the chain link securing rip rap is in place (see photo #2A-16 in Appendix B). Crane test pad appears to be in good condition.</u>		
7.	<b>Bulges</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b> <input checked="" type="checkbox"/> Wet areas <input checked="" type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade Remarks: <u>Some minor ponding observed on the crane test pad (see photo #2A-9 in Appendix B).</u>	<input type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map	Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____
9.	<b>Slope Instability</b> <input type="checkbox"/> Slides Areal extent _____ Remarks: <u>Crack on the southeast slope of the landfill near the Deployed Parking Area and crack on the south slope of the landfill along Channel A may be indicators of future slope stability problems.</u>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of slope instability
<b>B. Benches</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>C. Letdown Channels</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>D. Cover Penetrations</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Gas Vents</b> <input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks: <u>Vegetation was observed growing near and around gas vents (see photo #2A-4 in Appendix B), all vents are protected and in good condition.</u>	<input type="checkbox"/> Active <input checked="" type="checkbox"/> Functioning	<input checked="" type="checkbox"/> Passive <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition
2.	<b>Gas Monitoring Probes</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Good condition



3.	<b>Monitoring Wells</b> (within surface area of landfill) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance Remarks: <u>Only one monitoring well is located within the landfill cap, 2LOW1D. It is recommended that this well be labeled.</u>
4.	<b>Leachate Extraction Wells</b> <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance
5.	<b>Settlement Monuments</b> <input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <input checked="" type="checkbox"/> N/A
<b>E. Gas Collection and Treatment</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>F. Cover Drainage Layer</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>G. Detention/Sedimentation Ponds</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>H. Retaining Walls</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>I. Perimeter Ditches/Offsite Discharge</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Siltation</b> <input checked="" type="checkbox"/> Siltation evident <input type="checkbox"/> Siltation not evident Remarks: <u>Siltation evident in drainage channel C.</u>
2.	<b>Vegetative Growth</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Vegetation does not impede flow Remarks: <u>No significant vegetation growth in perimeter ditches/channels.</u>
3.	<b>Erosion</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident Areal extent <u>~25,000 square feet</u> Depth <u>surficial</u> Remarks: <u>Some erosion noted along slope by storage area gate (see photo #2A-6 in Appendix B); attributed to recent paving event (heavy equipment) and rain.</u>
4.	<b>Discharge Structure</b> <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Culverts appear clean and unobstructed.</u>
5.	<b>Other Conditions</b> Remarks: <u>During the site visit, there was concern over the profile of Channel A around Station 19+00 to 24+00 and indication that in that location the channel was more "U" shaped than the current profile (see photo #2A-15 in Appendix B). However, upon reviewing the as-builts, the current channel profile is consistent with the channel as originally constructed. However, some standing water in the ditches/channels that were recently paved indicates repaving may be necessary (see photo #2A-8 in Appendix B). Ms. McKenzie indicated she would have the contractor repair the profile of the drainage ditches/channels.</u>
<b>J. Monitoring Wells (outside of landfill cover)</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input checked="" type="checkbox"/> Needs Maintenance Remarks: <u>Unused monitoring wells should be abandoned. Several idle wells could not be located; these wells should be located using GPS and inspected. Minor maintenance was performed on select wells in summer 2015.</u>	
<b>K. Staff Gauges (outside of landfill cover)</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input checked="" type="checkbox"/> Needs Maintenance Remarks: <u>Staff gauges in wetland should be secured.</u>	
<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	

<b>X. OTHER REMEDIES</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>XI. OVERALL OBSERVATIONS</b>
<b>A. Implementation of the Remedy</b>
<p>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.).</p> <p><u>The landfill cap is in good condition (see photos #2A-10 and 2A-12 in Appendix B) and successfully reduces infiltration of precipitation through the landfill, and human and ecological receptors from exposure to contaminated soil, and prevents contaminant migration.</u></p>
<b>B. Adequacy of O&amp;M</b>
<p>Describe issues and observations related to the implementation and scope of O&amp;M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.</p> <p><u>O&amp;M has been completed at the site since the cap was constructed. Repairs to cracks in the pavement and removal of sediment and vegetation from the channels, culverts, and rip rap are ongoing. Cracking continues to occur in some locations; the larger cracks should be evaluated and additional repair activities considered (in addition to crack sealing).</u></p>
<b>C. Early Indicators of Potential Remedy Problems</b>
<p>Describe issues and observations such as unexpected changes in the cost or scope of O&amp;M or a high frequency of unscheduled repairs, which suggest that the protectiveness of the remedy may be compromised in the future.</p> <p><u>Sealing asphalt cracks and clearing channels should continue as cracking and debris/vegetation in channels are recurring problems. The cracks are believed to be caused by normal seasonal expansion and contraction of the asphalt, but they can also be caused by improper storage of equipment/materials, heavy use of area by vehicles/trucks, snow removal equipment storage, and use as a temporary contractor lay down area. Improper storage has been reduced substantially, but it is recommended the site is inspected regularly to discourage improper use of the area (for example, by painting a line and stenciling "No Load Zone" or "No Parking Zone" on the southern edge of the cap, near drainage channel A and on the southeastern to northwestern perimeter, adjacent to the wetland) similar to that on the northern edge of the cap.</u></p> <p><u>The asphalt surface should continue to be maintained to allow vehicles and equipment to be moved around without damaging any of the underlying cap components. Overall O&amp;M of the cap system has improved since the last five-year review inspection in 2011.</u></p>
<b>D. Opportunities for Optimization</b>
<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p><u>Idle wells should be evaluated for abandonment.</u></p>

**Fourth Five-Year Review Site Visit Checklist  
for  
CERCLA Sites at Naval Submarine Base New London**

I. SITE INFORMATION			
<b>Site name:</b> Site 2B - Area A Wetland	<b>Date of inspection:</b> 14 October 2015		
<b>Location and Region:</b> New London County, Connecticut	<b>U.S. EPA ID:</b> CTD980906515		
<b>Agency, office, or company leading the five-year review:</b> NAVFAC Mid-Atlantic/U.S. EPA Region 1	<b>Weather/temperature:</b> Sunny, 60s		
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <input type="checkbox"/> Landfill cover/containment  <input type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input type="checkbox"/> Groundwater pump and treatment  <input type="checkbox"/> Other </div> <div style="width: 50%;"> <input type="checkbox"/> Monitored natural attenuation  <input type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls  <input type="checkbox"/> Surface water collection and treatment </div> </div>			
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached    (See Report)			
II. INTERVIEWS			
1.	<b>O&amp;M site manager</b>	<u>Tracey McKenzie</u> Name Title	<u>NSB NLON ER Manager</u> Title Date
		Interviewed <input checked="" type="checkbox"/> at site <input checked="" type="checkbox"/> at office <input type="checkbox"/> by phone    Phone no. <u>(860) 694-5649</u> Problems, suggestions: <input type="checkbox"/> Report attached <u>Ms. McKenzie indicated that the site was recently sprayed for Phragmites.</u>	
2.	<b>O&amp;M staff</b>	<u>Resolution Consultants</u> Name Title	<u>O&amp;M Contractor</u> Title Date
		Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone    Phone no. <u>(508) 366-7442</u> Problems, suggestions: <input type="checkbox"/> Report attached <u>Information from the most recent O&amp;M inspection (performed November 2015) was used to supplement this inspection form.</u>	
3.	<b>Post-Construction Inspection Contractor</b>	<u>CB&amp;I</u> Name Title	<u>Inspection Contractor</u> Title Date
		Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone    Phone no. _____ Problems, suggestions: <input type="checkbox"/> Report attached <u>Information from the most recent available post-construction inspections (performed June and September 2014) were used to supplement this inspection form.</u>	
4.	<b>Local regulatory authorities and response agencies</b> (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.		
	Agency <u>U.S. EPA Region 1</u> Contact <u>Kymberlee Keckler</u> <u>RPM</u> <u>10/14/15</u> <u>(617) 918-1385</u> Name    Title    Date    Phone no. Problems; suggestions: <input type="checkbox"/> Report attached <u>No comment received.</u>		
	Agency <u>CTDEEP</u> Contact <u>Kenneth Feathers</u> <u>RPM</u> <u>10/14/15</u> <u>(860) 424-3770</u> Name    Title    Date    Phone no. Problems; suggestions: <input type="checkbox"/> Report attached <u>No comment received.</u>		

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks: <u>Inspections are performed annually. The O&amp;M Manual, drawings, maintenance logs, and inspection reports are maintained in the Navy's NIRIS environmental records management system; maintenance activities are captured in the annual O&amp;M reports generated by the O&amp;M Contractor and were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
IV. O&M			
1.	<b>O&amp;M Organization</b> <input type="checkbox"/> State in-house <input type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for State <input type="checkbox"/> Contractor for PRP <input checked="" type="checkbox"/> Contractor for Federal Facility	<input type="checkbox"/> Other Remarks: <u>Resolution Consultants performed O&amp;M inspections at Site 2B in 2015; H&amp;S will begin performing O&amp;M inspections at Site 2B in 2016. CBI performed post-construction monitoring at Site 2B from 2013 through 2015.</u>
V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
A. Fencing			
1.	<b>Fencing damaged</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Gates secured <input checked="" type="checkbox"/> N/A
B. Other Access Restrictions			
1.	<b>Signs and other security measures</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A

C. Land Use Controls (LUCs)					
1.	<b>Implementation and enforcement</b> Site conditions imply LUCs properly implemented <span style="float: right;"><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</span> Site conditions imply LUCs being fully enforced <span style="float: right;"><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</span>  Type of monitoring <u>Site inspection</u> Frequency <u>Quarterly</u> Responsible party/agency <u>NSB NLON</u> Contact <u>Tracey McKenzie</u> <u>NSB NLON ER Manager</u> <u>10/14/15</u> <u>(860) 694-5649</u> <div style="display: flex; justify-content: space-between; margin-top: -10px;"> <span>Name</span> <span>Title</span> <span>Date</span> <span>Phone no.</span> </div> LUC Certification is up-to-date <span style="float: right;"><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A</span> LUC Certifications are verified by the Navy <span style="float: right;"><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</span>  Specific requirements in deed or decision documents have been met <span style="float: right;"><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</span> Violations have been reported <span style="float: right;"><input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A</span> Other problems or suggestions: <input type="checkbox"/> Report attached Remarks: <u>Per the Site 2B LUC RD, residential use of the site is prohibited. Per the OU 9 LUC RD, groundwater cannot be extracted or used for potable purposes or other purposes that may result in unacceptable risks, groundwater must be handled appropriately during construction activities, and monitoring locations at Site 2B that are part of the Site 2A monitoring network must be maintained. Site conditions indicate these LUCs are being followed.</u>				
2.	<b>Adequacy</b> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> LUCs are adequate</span> <span style="margin-left: 20px;"><input type="checkbox"/> LUCs are inadequate</span> <span style="float: right;"><input type="checkbox"/> N/A</span> Remarks: <u>Based on site conditions, Site 2B LUC RD and OU 9 LUC RD appear adequate.</u>				
D. General					
1.	<b>Vandalism/trespassing</b> <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> No vandalism evident</span>				
2.	<b>Land use changes onsite</b> <span style="margin-left: 20px;"><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A</span>				
3.	<b>Land use changes offsite</b> <span style="margin-left: 20px;"><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A</span>				
VI. GENERAL SITE CONDITIONS					
A. Roads <span style="float: right;"><input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A</span>					
1.	<b>Roads damaged</b> <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Roads adequate</span> <span style="float: right;"><input type="checkbox"/> N/A</span>				
B. Other Site Conditions					
Remarks: _____					
VII. AREA CONDITIONS					
A. Surface					
1.	<b>Settlement</b> (Low spots) <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Settlement not evident</span>				
2.	<b>Cracks</b> <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Cracking not evident</span>				
3.	<b>Erosion</b> <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Erosion not evident</span>				
4.	<b>Holes</b> <span style="margin-left: 20px;"><input type="checkbox"/> Location shown on site map</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Holes not evident</span>				
5.	<b>Vegetative Cover</b> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Grass</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Cover properly established</span> <span style="float: right;"><input type="checkbox"/> No signs of stress</span> <span style="margin-left: 20px;"><input checked="" type="checkbox"/> Trees/Shrubs</span> Remarks: <u>The <i>Phragmites</i> and other invasive species in the wetland were recently cut/treated.</u>				



6.	<b>Alternative Cover (armored rock, concrete, etc.)</b>	<input checked="" type="checkbox"/> N/A
7.	<b>Bulges</b>	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b>	<input checked="" type="checkbox"/> Wet areas/water damage not evident
9.	<b>Slope Instability</b>	<input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No evidence of slope instability
<b>B. Benches</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>C. Letdown Channels</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>D. Cover Penetrations</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>F. Area Drainage</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b>	<input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Outlet pipes to Site 3 appear to drain freely.</u>
2.	<b>Outlet Rock Inspected</b>	<input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks: <u>Outlet flows to shotcrete/natural channel in Site 3.</u>
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>H. Retaining Walls</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>I. Perimeter Ditches/Offsite Discharge</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	<b>Siltation</b>	<input type="checkbox"/> Siltation evident <input checked="" type="checkbox"/> Siltation not evident
2.	<b>Vegetative Growth</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Vegetation does not impede flow
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Erosion not evident
4.	<b>Discharge Structure</b>	<input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Functioning.</u>
<b>J. Monitoring Wells</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
		<input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance Remarks: <u>Unused monitoring wells should be abandoned.</u>
<b>K. Staff Gauges</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
		<input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input checked="" type="checkbox"/> Needs Maintenance Remarks: <u>Staff gauges in wetland should be secured.</u>
<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
<b>X. OTHER REMEDIES</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A

XI. OVERALL OBSERVATIONS	
<b>A. Implementation of the Remedy</b>	<p>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.).</p> <p><u>Contaminated sediments have been remediated and the wetland has been properly restored (see photo #2B-1 and #2B-2 in Appendix B). Years 1 through 3 of post-construction monitoring has been completed by CB&amp;I (2013, 2014, and 2015). Continue to monitor Phragmites in Area 3-2 because it is lower in elevation than what was shown in the restoration plan.</u></p>
<b>B. Adequacy of O&amp;M</b>	<p>Describe issues and observations related to the implementation and scope of O&amp;M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.</p> <p><u>O&amp;M inspections were not performed in 2013 or 2014, as required by the O&amp;M Manual. Resolution Consultants performed the 2015 inspection and, moving forward, inspections will be performed by H&amp;S. Recent treating and cutting program was successful in removing most (approximately 16 acres) of the <i>Phragmites</i> and other invasive species in the wetland.</u></p>
<b>C. Early Indicators of Potential Remedy Problems</b>	<p>Describe issues and observations such as unexpected changes in the cost or scope of O&amp;M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.</p> <p><u>None noted.</u></p>
<b>D. Opportunities for Optimization</b>	<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p><u>Idle wells should be evaluated for abandonment.</u></p> <p><u>Introduce weevils to control mile-a minute which has been observed proliferating on the upland island and along the western edge of the wetland.</u></p> <p><u>NSB NLON is procuring funding under Navy Natural and Cultural Resources to design and implement a wetland enhancement/restoration plan at Site 2B. This plan would address invasive species and create a more diverse habitat and vegetation structure.</u></p>

# Fourth Five-Year Review Site Visit Checklist for CERCLA Sites at Naval Submarine Base New London

I. SITE INFORMATION			
<b>Site name:</b> Site 3 - Area A Downstream Watercourses/ OBDA	<b>Date of inspection:</b> 14 October 2015		
<b>Location and Region:</b> New London County, Connecticut	<b>U.S. EPA ID:</b> CTD980906515		
<b>Agency, office, or company leading the five-year review:</b> NAVFAC Mid-Atlantic/U.S. EPA Region I	<b>Weather/temperature:</b> Sunny, 60s		
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <input type="checkbox"/> Landfill cover/containment  <input checked="" type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input type="checkbox"/> Groundwater pump and treatment  <input type="checkbox"/> Surface water collection and treatment  <input checked="" type="checkbox"/> Other </div> <div style="width: 50%;"> <input type="checkbox"/> Monitored natural attenuation  <input type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls </div> </div> <p><u>Continue groundwater monitoring until remedial goals are met.</u></p>			
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached    See Report			
II. INTERVIEWS			
1.	<b>O&amp;M site manager</b> <div style="display: flex; justify-content: space-between;"> <span>Name</span> <span>Title</span> <span>Date</span> </div>	<u>Tracey McKenzie</u> <u>NSB NLON ER Manager</u> <u>10/14/15</u>	<div style="display: flex; justify-content: space-between;"> <span>Interviewed</span> <span><input checked="" type="checkbox"/> at site    <input checked="" type="checkbox"/> at office</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Problems, suggestions:</span> <span><input type="checkbox"/> Report attached</span> </div> <p><u>Ms. McKenzie had no comments on Site 3.</u></p>
2.	<b>O&amp;M staff</b> <div style="display: flex; justify-content: space-between;"> <span>Name</span> <span>Title</span> <span>Date</span> </div>	<u>H&amp;S Environmental</u> <u>O&amp;M Contractor</u> <u>May 2015</u>	<div style="display: flex; justify-content: space-between;"> <span>Interviewed</span> <span><input type="checkbox"/> at site    <input type="checkbox"/> at office</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Problems, suggestions:</span> <span><input type="checkbox"/> Report attached</span> </div> <p><u>Information from the most recent O&amp;M inspection (completed in May 2015) was used to supplement this inspection form.</u></p>
3.	<b>Local regulatory authorities and response agencies</b> (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.		
<div style="margin-bottom: 20px;"> Agency <u>U.S. EPA Region 1</u>  Contact <u>Kymberlee Keckler</u>    <u>RPM</u>    <u>10/14/15</u>    <u>(617) 918-1385</u>  <div style="display: flex; justify-content: space-between; font-size: small;"> <span>Name</span> <span>Title</span> <span>Date</span> <span>Phone no.</span> </div> Problems; suggestions: <input type="checkbox"/> Report attached  <u>During the site visit, Ms. Keckler suggested a review of the invasive species plan for Site 3 (see photo #3-2 of Appendix B) to make sure the site is in compliance.</u> </div> <div> Agency <u>CTDEEP</u>  Contact <u>Kenneth Feathers</u>    <u>RPM</u>    <u>10/14/15</u>    <u>(860) 424-3770</u>  <div style="display: flex; justify-content: space-between; font-size: small;"> <span>Name</span> <span>Title</span> <span>Date</span> <span>Phone no.</span> </div> Problems; suggestions: <input type="checkbox"/> Report attached  <u>No comment received.</u> </div>			

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks: <u>Inspections are performed annually. The O&amp;M Manual, drawings, maintenance logs, and inspection reports are maintained in the Navy's NIRIS environmental records management system; maintenance activities are captured in the annual O&amp;M reports generated by the O&amp;M Contractor and were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: <u>Groundwater monitoring is performed annually. Round 16 groundwater monitoring was conducted in April 2014 with a final report anticipated in 2016. Round 17 sampling was completed in April 2015 with a draft report anticipated in 2016. Round 18 will occur in spring 2016. The annual groundwater monitoring reports are maintained in the Navy's NIRIS environmental records management system; the groundwater monitoring reports were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>		
8.	<b>Leachate Extraction Records</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b>	<input type="checkbox"/> Readily available <input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
IV. O&M			
1.	<b>O&amp;M Organization</b> <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> State in-house  <input type="checkbox"/> PRP in-house  <input type="checkbox"/> Federal Facility in-house             </div> <div> <input type="checkbox"/> Contractor for State  <input type="checkbox"/> Contractor for PRP  <input checked="" type="checkbox"/> Contractor for Federal Facility             </div> <div> <input type="checkbox"/> Other             </div> </div> Remarks: <u>Sovereign performed groundwater monitoring, site inspections, and site maintenance in 2011. H&amp;S performed groundwater monitoring, site inspections, and site maintenance from 2012 through 2015.</u>		
V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
A. Fencing			
1.	<b>Fencing damaged</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Gates secured <input checked="" type="checkbox"/> N/A Remarks: <u>There is no fencing at the concrete-encapsulated soil.</u>		

B. Other Access Restrictions				
1.	<b>Signs and other security measures</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A	
Remarks: <u>Access to Site 3 is through fencing at Site 2A, Site 3, and Site 7.</u>				
C. Land Use Controls (LUCs)				
1.	<b>Implementation and enforcement</b>			
	Site conditions imply LUCs properly implemented	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Site conditions imply LUCs being fully enforced	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Type of monitoring	<u>Site inspection</u>		
	Frequency	<u>Quarterly</u>		
	Responsible party/agency	<u>NSB NLON</u>		
	Contact	<u>Tracey McKenzie</u>	<u>NSB NLON ER Manager</u>	<u>10/14/15</u>
	Name	Title	Date	Phone no.
	LUC Certification is up-to-date	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> N/A
	LUC Certifications are verified by the Navy	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Specific requirements in deed or decision documents have been met	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
	Other problems or suggestions: <input type="checkbox"/> Report attached			
	Remarks: <u>Per SUBASENLONINST 5090.25 (April 2013), ground disturbing activities must be approved by the Environmental Division prior to commencement of the activities. Per the OU 9 LUC RD, groundwater cannot be extracted or used for potable purposes or other purposes that may result in unacceptable risks, groundwater must be handled appropriately during construction activities, and there is a building restriction for 100 feet around monitoring well 2DMW29S. Site conditions indicate these LUCs are being followed.</u>			
2.	<b>Adequacy</b>			
	<input checked="" type="checkbox"/> LUCs are adequate	<input type="checkbox"/> LUCs are inadequate		<input type="checkbox"/> N/A
	Remarks: <u>Based on site conditions, SUBASENLONINST 5090.25 and the OU 9 LUC RD appear adequate.</u>			
D. General				
1.	<b>Vandalism/trespassing</b>			
	<input type="checkbox"/> Location shown on site map		<input checked="" type="checkbox"/> No vandalism evident	
2.	<b>Land use changes onsite</b>			
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A			
3.	<b>Land use changes offsite</b>			
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A			
VI. GENERAL SITE CONDITIONS				
<b>A. Roads</b>				
		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
<b>B. Other Site Conditions</b>				
Remarks: _____				
VII. CONCRETE COVER OVER CONTAMINATED SOIL CONDITIONS				
<b>A. Surface</b>				
1.	<b>Settlement</b> (Low spots)			
	<input type="checkbox"/> Location shown on site map		<input checked="" type="checkbox"/> Settlement not evident	
2.	<b>Cracks</b>			
	<input type="checkbox"/> Location shown on site map		<input checked="" type="checkbox"/> Cracking not evident	
3.	<b>Erosion</b>			
	<input type="checkbox"/> Location shown on site map		<input checked="" type="checkbox"/> Erosion not evident	



4.	<b>Holes</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b>	<input checked="" type="checkbox"/> Grass <input checked="" type="checkbox"/> Trees/Shrubs	<input checked="" type="checkbox"/> Cover properly established <input checked="" type="checkbox"/> No signs of stress
Remarks: <u>Leaf litter noted near and above the concrete-encapsulated soil. Rooted vegetation not noted over the concrete cover.</u>			
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b>	<input type="checkbox"/> N/A	
Remarks: <u>Concrete is in good condition.</u>			
7.	<b>Bulges</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b>	<input checked="" type="checkbox"/> Wet areas/water damage not evident	
9.	<b>Slope Instability</b>	<input type="checkbox"/> Slides	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No evidence of slope instability
<b>B. Benches</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>C. Letdown Channels</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>D. Cover Penetrations</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>F. Area Drainage</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b>	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A
Remarks: <u>No deficiencies observed.</u>			
2.	<b>Outlet Rock Inspected</b>	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>H. Retaining Walls</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>I. Perimeter Ditches/Offsite Discharge</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>J. Monitoring Wells (outside of concrete encapsulated area)</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
<input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition Remarks: <u>Unused monitoring wells should be abandoned. Minor maintenance required on select wells was performed in late summer 2015.</u>			
<b>VIII. VERTICAL BARRIER WALLS</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>X. OTHER REMEDIES</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>XI. OVERALL OBSERVATIONS</b>			
<b>A. Implementation of the Remedy</b>			
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.).  <u>The concrete-encapsulated soil was found to be in good condition. The center of the downstream channel has a rill that is a few inches wide and that runs down the middle of a portion of the channel that was likely created before the shotcrete was completely hardened. The cap over the steep portion of the channel, downgradient of the culverts, is currently stable and prevents erosion. A rust colored hue blankets the shotcrete (likely caused by naturally-occurring iron in the water flowing from the culvert), but it does not seem to have an effect on the function of the shotcrete.</u>			

<b>B. Adequacy of O&amp;M</b>
<p>Describe issues and observations related to the implementation and scope of O&amp;M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.</p> <p><u>O&amp;M has been completed at the site since the concrete-encapsulated soil was constructed.</u></p>
<b>C. Early Indicators of Potential Remedy Problems</b>
<p>Describe issues and observations such as unexpected changes in the cost or scope of O&amp;M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.</p> <p><u>None noted.</u></p>
<b>D. Opportunities for Optimization</b>
<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p><u>The groundwater monitoring program at Site 3 should be reviewed. Based on the last seven years of monitoring results being below remedial goals, Site 3 is a candidate for cessation of groundwater monitoring. Idle wells should be evaluated for abandonment.</u></p> <p><u>NSB NLON obtained Natural and Cultural Resources funding to assist in invasive species management on NSB NLON. Herbicide treatment and cutting of invasive species occurred in 2015 and 2016; funding has been secured for 2017 invasive species management.</u></p>

**Fourth Five-Year Review Site Visit Checklist  
for  
CERCLA Sites at Naval Submarine Base New London**

I. SITE INFORMATION			
Site name: Site 6 – Former DRMO		Date of inspection: 14 October 2015	
Location and Region: New London County, Connecticut		U.S. EPA ID: CTD980906515	
Agency, office, or company leading the five-year review: NAVFAC Mid-Atlantic/U.S. EPA Region 1		Weather/temperature: Sunny, 60s	
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <input checked="" type="checkbox"/> Landfill cover/containment  <input checked="" type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input type="checkbox"/> Groundwater pump and treatment  <input checked="" type="checkbox"/> Other  <u>Long-term groundwater monitoring.</u> </div> <div style="width: 50%;"> <input type="checkbox"/> Monitored natural attenuation  <input type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls  <input type="checkbox"/> Surface water collection and treatment           </div> </div>			
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached    See Report			
II. INTERVIEWS			
1.	<b>O&amp;M site manager</b> Interviewed <input checked="" type="checkbox"/> at site Problems, suggestions: <u>Ms. McKenzie indicated that she frequently visits the site to ensure that equipment storage is being performed properly.</u>	<u>Tracey McKenzie</u> Name <input checked="" type="checkbox"/> at office <input type="checkbox"/> Report attached	<u>NSB NLON ER Manager</u> Title <input type="checkbox"/> by phone    Phone no. <u>(860) 694-5649</u> <u>10/14/15</u> Date
2.	<b>O&amp;M staff</b> Interviewed <input type="checkbox"/> at site Problems, suggestions: <u>Information from the most recent O&amp;M inspection (performed May 2015) was used to supplement this inspection form.</u>	<u>H&amp;S Environmental</u> Name <input type="checkbox"/> at office <input type="checkbox"/> Report attached	<u>O&amp;M Contractor</u> Title <input type="checkbox"/> by phone    Phone no. <u>(508) 366-7442</u> <u>May 2015</u> Date
3.	<b>Local regulatory authorities and response agencies</b> (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.		
	Agency <u>U.S. EPA Region 1</u> Contact <u>Kymberlee Keckler</u> Name Problems; suggestions: <input type="checkbox"/> Report attached <u>No comment received.</u>	<u>RPM</u> Title	<u>10/14/15</u> Date <u>(617) 918-1385</u> Phone no.
	Agency <u>CTDEEP</u> Contact <u>Kenneth Feathers</u> Name Problems; suggestions: <input type="checkbox"/> Report attached <u>No comment received.</u>	<u>RPM</u> Title	<u>10/14/15</u> Date <u>(860) 424-3770</u> Phone no.

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks: <u>Inspections are performed annually. The O&amp;M Manual, drawings, maintenance logs, and inspection reports are maintained in the Navy's NIRIS environmental records management system; maintenance activities are captured in the annual O&amp;M reports generated by the O&amp;M Contractor and were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks: <u>Groundwater monitoring is performed biennially (once every two years). Round 23 groundwater monitoring was conducted in April 2014 with a final report anticipated in 2016. Round 24 will occur in spring 2016. The biennial groundwater monitoring reports are maintained in the Navy's NIRIS environmental records management system; the groundwater monitoring reports were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks: <u>The site no longer has controlled access.</u>	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
IV. O&M			
1.	<b>O&amp;M Organization</b> <input type="checkbox"/> State in-house <input type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for State <input type="checkbox"/> Contractor for PRP <input checked="" type="checkbox"/> Contractor for Federal Facility	<input type="checkbox"/> Other
Remarks: <u>Sovereign performed groundwater monitoring, landfill cap inspections, and site maintenance in 2011. H&amp;S performed groundwater monitoring, landfill cap inspections, and site maintenance from 2012 through 2015.</u>			





VII. LANDFILL COVER CONDITIONS			
<b>A. Landfill Surface</b>			
1.	<b>Settlement</b> (Low spots) Areal extent ~ 1 square foot Remarks: <u>Divot/indentation observed in edge of cap due to concrete block placement. Some minor settlement observed elsewhere.</u>	<input type="checkbox"/> Location shown on site map Depth <u>~0.5-1" divot</u>	<input type="checkbox"/> Settlement not evident
2.	<b>Cracks</b> Remarks: <u>Minor cracks noted; some with grasses growing through. Sealed cracks are in good condition.</u>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Cracking not evident
3.	<b>Erosion</b> Remarks: <u>Some sediment building up on edge of cap along river; but cap itself is not eroding.</u>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
4.	<b>Holes</b> Areal extent _____ Remarks: <u>Two penetrations were observed at southwest corner of the cap by trailer tie-downs (rebar) that is ~36" in length. One is in the cap limits, the other is on the edge and may be outside of cap limits (see photo #6-2 in Appendix B).</u>	<input type="checkbox"/> Location shown on site map Depth <u>36"</u>	<input type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b>	<input type="checkbox"/> Grass <input type="checkbox"/> Trees/Shrubs	<input type="checkbox"/> Cover properly established <input checked="" type="checkbox"/> N/A <input type="checkbox"/> No signs of stress
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> <input checked="" type="checkbox"/> N/A		
7.	<b>Bulges</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b> <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade Remarks: <u>Wet areas were not noted on the cap. Some wet areas and ponding onsite outside of the cap area.</u>	<input checked="" type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Location shown on site map	Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____
9.	<b>Slope Instability</b> <input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No evidence of slope instability	
<b>B. Benches</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>C. Letdown Channels</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
<b>D. Cover Penetrations</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Gas Vents</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Active <input type="checkbox"/> Functioning	<input type="checkbox"/> Passive <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition
2.	<b>Gas Monitoring Probes</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Good condition
3.	<b>Monitoring Wells</b> (within surface area of landfill) <input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration Remarks: <u>Minor well maintenance was performed in summer 2015.</u>	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition

4.	<b>Leachate Extraction Wells</b>	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
			<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance	
5.	<b>Settlement Monuments</b>	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed	<input checked="" type="checkbox"/> N/A		
<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>F. Cover Drainage Layer</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>H. Retaining Walls</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>I. Perimeter Ditches/Offsite Discharge</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A			
1.	<b>Siltation</b>	<input type="checkbox"/> Siltation evident	<input type="checkbox"/> Siltation not evident			
	Remarks: <u>No significant siltation noted.</u>					
2.	<b>Vegetative Growth</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A			
	<input checked="" type="checkbox"/> Vegetation does not impede flow					
	Remarks: <u>No significant vegetative growth noted. Some recent, minor leaf fall near the drop inlet (see photo #6-1 in Appendix B).</u>					
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident			
4.	<b>Discharge Structure</b>	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A			
	Remarks: <u>Could not inspect culvert discharge in the rip rap because of fence. Navy indicated they have not noted issues when stormwater sampling (culvert discharge is visible during low tide).</u>					
<b>J. Monitoring Wells (outside of landfill cover)</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A			
	<input checked="" type="checkbox"/> Properly secured/locked	<input checked="" type="checkbox"/> Functioning	<input checked="" type="checkbox"/> Routinely sampled	<input checked="" type="checkbox"/> Good condition		
	<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance			
	Remarks: <u>Unused monitoring wells should be abandoned. Minor well maintenance was performed in summer 2015.</u>					
<b>VIII. VERTICAL BARRIER WALLS</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>X. OTHER REMEDIES</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A			
<b>XI. OVERALL OBSERVATIONS</b>						
<b>A. Implementation of the Remedy</b>						
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.).						
<u>Assuming the penetration by the trailer tie downs is minimal, the landfill cap is in good condition and successfully reduces infiltration of precipitation through the landfill, prevents human and ecological receptors from exposure to contaminated soil, and prevents contaminant migration.</u>						
<b>B. Adequacy of O&amp;M</b>						
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.						
<u>O&amp;M has been completed at the site since the cap was constructed. Proper storage procedures should be followed, cracks should be repaired as needed, and a man gate may be installed to facilitate inspection of the culvert discharge pending Environmental Division discussions with safety and security personnel indicate that doing so will not pose a safety or security risk.</u>						

**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.

Penetration of the cap by the trailer tie downs (rebar) indicate the SUBASENLONINST 5090.25 is not being properly followed at Site 6. Further action is required to ensure proper enforcement (e.g., painting a line showing the landfill cap boundary, storage permits).

**D. Opportunities for Optimization**

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Groundwater monitoring at Site 6 could be further reduced, possibly to once every five years, based on the last two rounds of monitoring results being below monitoring criteria. Idle wells should be evaluated for abandonment.

Environmental Division should talk with the NSB NLON Executive Officer about Site 6 Storage Permit request similar to the one developed for Site 2A.

# Fourth Five-Year Review Site Visit Checklist for CERCLA Sites at Naval Submarine Base New London

I. SITE INFORMATION			
<b>Site name:</b> Site 8 - Goss Cove Landfill	<b>Date of inspection:</b> 14 October 2015		
<b>Location and Region:</b> New London County, Connecticut	<b>U.S. EPA ID:</b> CTD98096515		
<b>Agency, office, or company leading the five-year review:</b> NAVFAC Mid-Atlantic/U.S. EPA Region 1	<b>Weather/temperature:</b> Sunny, 60s		
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <input checked="" type="checkbox"/> Landfill cover/containment  <input checked="" type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input type="checkbox"/> Groundwater pump and treatment  <input type="checkbox"/> Surface water collection and treatment  <input checked="" type="checkbox"/> Other </div> <div style="width: 50%;"> <input type="checkbox"/> Monitored natural attenuation  <input type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls </div> </div> <p><u>Groundwater monitoring program to determine adequacy of low-permeability landfill cap. Landfill gas vents, and storm drain structures.</u></p>			
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached    See Report			
II. INTERVIEWS			
<div style="display: flex; justify-content: space-between;"> <div>1.    <b>O&amp;M site manager</b></div> <div><u>Tracey McKenzie</u></div> <div><u>NSB NLON IR Manager</u></div> <div><u>10/14/15</u></div> </div> <div style="display: flex; justify-content: space-between; font-size: small;"> <div>Name</div> <div>Title</div> <div>Date</div> </div> <div style="display: flex; justify-content: space-between;"> <div> Interviewed    <input checked="" type="checkbox"/> at site    <input checked="" type="checkbox"/> at office    <input type="checkbox"/> by phone    Phone no. <u>(860) 694-3976</u>  Problems, suggestions:    <input type="checkbox"/> Report attached  <u>Ms. McKenzie indicated that she submitted a work request to repair the pavers for the gun display four years ago, but there has been no action by the Public Works Department.</u> </div> </div>			
<div style="display: flex; justify-content: space-between;"> <div>2.    <b>O&amp;M staff</b></div> <div><u>H&amp;S Environmental</u></div> <div><u>O&amp;M Contractor</u></div> <div><u>May 2015</u></div> </div> <div style="display: flex; justify-content: space-between; font-size: small;"> <div>Name</div> <div>Title</div> <div>Date</div> </div> <div style="display: flex; justify-content: space-between;"> <div> Interviewed    <input type="checkbox"/> at site    <input type="checkbox"/> at office    <input type="checkbox"/> by phone    Phone no. <u>(508) 366-7442</u>  Problems, suggestions:    <input type="checkbox"/> Report attached  <u>Information from the most recent O&amp;M inspection (performed May 2015) was used to supplement this inspection form.</u> </div> </div>			
<div>3.    <b>Local regulatory authorities and response agencies</b> (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.</div> <div style="margin-top: 10px;"> Agency <u>U.S. EPA Region 1</u>  Contact <u>Kymberlee Keckler</u>    <u>RPM</u>    <u>10/14/15</u>    <u>(617) 918-1385</u>  <div style="display: flex; justify-content: space-between; font-size: small;"> <div>Name</div> <div>Title</div> <div>Date</div> <div>Phone no.</div> </div> Problems; suggestions: <input type="checkbox"/> Report attached  <u>No comment received.</u> </div> <div style="margin-top: 10px;"> Agency <u>CTDEEP</u>  Contact <u>Kenneth Feathers</u>    <u>RPM</u>    <u>10/14/15</u>    <u>(860) 424-3770</u>  <div style="display: flex; justify-content: space-between; font-size: small;"> <div>Name</div> <div>Title</div> <div>Date</div> <div>Phone no.</div> </div> Problems; suggestions: <input type="checkbox"/> Report attached  <u>No comment received.</u> </div>			

III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks: <u>Inspections are performed annually. The O&amp;M Manual, drawings, maintenance logs, and inspection reports are maintained in the Navy's NIRIS environmental records management system; maintenance activities are captured in the annual O&amp;M reports generated by the O&amp;M Contractor and were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks: <u>Groundwater monitoring is performed annually. Round 26 groundwater monitoring was conducted in April 2014 with a final report anticipated in 2016. Round 27 sampling was completed in April 2015 with a draft report anticipated in 2016. Round 28 will occur in spring 2016. The annual groundwater monitoring reports are maintained in the Navy's NIRIS environmental records management system; the groundwater monitoring reports were reviewed as part of preparation of the Fourth Five-Year Review Report.</u>	<input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks: <u>Public Access to site while museum is open to the public.</u>	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
IV. O&M			
1.	<b>O&amp;M Organization</b> <input type="checkbox"/> State in-house <input type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for State <input type="checkbox"/> Contractor for PRP <input checked="" type="checkbox"/> Contractor for Federal Facility	<input type="checkbox"/> Other Remarks: <u>Sovereign performed groundwater monitoring, landfill cap inspections, and site maintenance in 2011. H&amp;S performed groundwater monitoring, landfill cap inspections, and site maintenance from 2012 through 2015.</u>



V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
A. Fencing			
1.	<b>Fencing damaged</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Gates secured <input type="checkbox"/> N/A Remarks: <u>Fencing appears to be in good condition.</u>		
B. Other Access Restrictions			
1.	<b>Signs and other security measures</b> <input checked="" type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A Remarks: <u>The site is open to the public (Nautilus Museum). The gates are locked when museum is closed (overnight). The gate to the storage area on the north side of the site (near well 8MW5S) was locked during the inspection.</u>		
C. Land Use Controls (LUCs)			
1.	<b>Implementation and enforcement</b> Site conditions imply LUCs properly implemented <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Site conditions imply LUCs being fully enforced <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A  Type of monitoring <u>Site inspection</u> Frequency <u>Quarterly</u> Responsible party/agency <u>NSB NLON</u> Contact <u>Tracey McKenzie</u> <u>NSB NLON ER Manager</u> <u>10/14/15</u> <u>(860) 694-5649</u> <div style="display: flex; justify-content: space-between; margin-top: -10px;"> <span>Name</span> <span>Title</span> <span>Date</span> <span>Phone no.</span> </div> LUC Certification is up-to-date <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A LUC Certifications are verified by the Navy <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A  Specific requirements in deed or decision documents have been met <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Violations have been reported <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A Other problems or suggestions: <input type="checkbox"/> Report attached Remarks: <u>Per SUBASENLONINST 5090.25 (April 2013) contractors shall contact the Environmental Division prior to storing or operating heavy equipment/materials on Site 8. Ground disturbing activities must be approved by the Environmental Division prior to commencement of the activities. Site conditions indicate this Instruction is being followed.</u>		
2.	<b>Adequacy</b> <input checked="" type="checkbox"/> LUCs are adequate <input type="checkbox"/> LUCs are inadequate <input type="checkbox"/> N/A Remarks: <u>Equipment should continue to be stored properly and LUCs followed. Based on site conditions, SUBASENLONINST 5090.25 appears adequate.</u>		
D. General			
1.	<b>Vandalism/trespassing</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No vandalism evident		
2.	<b>Land use changes on site</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A		
3.	<b>Land use changes off site</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A Remarks: <u>While not a land use change, recent cleanup under CTDEEP RSRs of the Former Fusconi's dry cleaner site has occurred and the Town of Groton and state DOT will be constructing a new intersection where Military Road meets Crystal Lake Road, in front of the museum entrance and to the main entrance of NSB NLON.</u>		
VI. GENERAL SITE CONDITIONS			
A. Roads <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	<b>Roads damaged</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A		

B. Other Site Conditions			
Remarks: _____			
VII. LANDFILL COVER CONDITIONS			
A. Landfill Surface			
1.	<b>Settlement</b> (Low spots) Areal extent <u>around displays</u>	<input checked="" type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Depth <u>significant; at least 4" in places but has not increased since the last five-year review period; appears to be stabilized.</u>	<input type="checkbox"/> Settlement not evident <input type="checkbox"/> Depth <u>significant; at least 4" in places but has not increased since the last five-year review period; appears to be stabilized.</u>
Remarks: <u>Settlement is evident near the gun display. Settlement is of the pavers, not the display themselves and does not appear to be progressing further (based on site inspections). The displays were placed on engineering concrete foundations during the remedial action. As such, settlement of pavers is deemed superficial (see photos #8-4 through #8-7 in Appendix B).</u>			
2.	<b>Cracks</b> Remarks: <u>Minor cracks were noted throughout, most are sealed. No issues associated with the cracks were noted.</u>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Cracking not evident	<input type="checkbox"/> Cracking not evident
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Erosion not evident	<input checked="" type="checkbox"/> Erosion not evident
4.	<b>Holes</b>	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Holes not evident	<input checked="" type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b> <input checked="" type="checkbox"/> Grass <input type="checkbox"/> Cover properly established <input type="checkbox"/> No signs of stress <input checked="" type="checkbox"/> Trees/Shrubs	Remarks: <u>Vegetated areas are in good condition. During the inspection, there was some concern raised about the trees located along the entrance road to the museum. (Concern due to tree type and suitability—e.g., root structure—for placement on the cap.) After the inspection, the trees were confirmed to be a Winter King Hawthorne and were installed on the cap as designed in the landfill landscape plan.</u>	
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> Remarks: <u>Pavers are in good condition except under the gun display.</u>	<input checked="" type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A	<input type="checkbox"/> N/A
7.	<b>Bulges</b>	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Bulges not evident	<input checked="" type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b> <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade	<input checked="" type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____	<input checked="" type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Location shown on site map    Areal extent _____
9.	<b>Slope Instability</b> <input type="checkbox"/> Slides	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No evidence of slope instability	<input checked="" type="checkbox"/> No evidence of slope instability
<b>B. Benches</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	<input checked="" type="checkbox"/> N/A
<b>C. Letdown Channels</b>		<input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	<input checked="" type="checkbox"/> N/A
<b>D. Cover Penetrations</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	<input type="checkbox"/> N/A
1.	<b>Gas Vents</b> <input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Active <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Passive <input type="checkbox"/> Needs Maintenance	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition
Remarks: <u>Some vegetation noted near Gas Vent "M"; vents are secured and in good condition.</u>			
2.	<b>Gas Monitoring Probes</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Evidence of leakage at penetration	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Needs Maintenance	<input type="checkbox"/> Good condition

3.	<b>Monitoring Wells</b> (within surface area of landfill) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input checked="" type="checkbox"/> Needs Maintenance Remarks: <u>Some monitoring wells require maintenance (bolts replaced). Minor well maintenance was performed in summer 2015.</u>
4.	<b>Leachate Extraction Wells</b> <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance
5.	<b>Settlement Monuments</b> <input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <input checked="" type="checkbox"/> N/A
<b>E. Gas Collection and Treatment</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>F. Cover Drainage Layer</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Outlet Pipes Inspected</b> <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Yard drains are in good condition with little to no accumulated sediment at the drains. Video inspection was performed in 2013 as part of routine maintenance.</u>
2.	<b>Outlet Rock Inspected</b> <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Video inspection was performed in 2013.</u>
<b>G. Detention/Sedimentation Ponds</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>H. Retaining Walls</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>I. Perimeter Ditches/Offsite Discharge</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Siltation</b> <input checked="" type="checkbox"/> Siltation evident <input type="checkbox"/> Siltation not evident Remarks: <u>Catch basins have small amounts of accumulated sediment (0 to 4").</u>
2.	<b>Vegetative Growth</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input type="checkbox"/> Vegetation does not impede flow Remarks: <u>Catch basins have minimal vegetation.</u>
3.	<b>Erosion</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Erosion not evident Remarks: <u>No erosion noted in the catch basins.</u>
4.	<b>Discharge Structure</b> <input checked="" type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks: <u>Catch basins are in good condition.</u>
<b>J. Monitoring Wells (outside of landfill cover)</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance Remarks: <u>Minor well maintenance was performed in summer 2015.</u>	
<b>VIII. VERTICAL BARRIER WALLS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
<b>X. OTHER REMEDIES</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	

XI. OVERALL OBSERVATIONS	
A. Implementation of the Remedy	
<p>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.).</p> <p><u>The landfill cap is in good condition and successfully reduces infiltration of precipitation through the landfill, and human and ecological receptors from exposure to contaminated soil, and prevents contaminant migration (see photos #8-1 through 8-3). O&amp;M issues are not affecting the remedy. Settlement of the pavers around the gun display appears to have stopped and has been determined to be superficial, as described above. The Environmental Division will submit another work request to repair the pavers.</u></p>	
B. Adequacy of O&M	
<p>Describe issues and observations related to the implementation and scope of O&amp;M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.</p> <p><u>O&amp;M has been completed at the site since the cap was constructed. Cracks in the asphalt should be filled during the next annual O&amp;M repair event in 2016 and the superficial settlement of the gun display pavers should be repaired once funding requests are fulfilled. Some other O&amp;M repairs (curbing, etc.) are needed. Overall, the site is in good condition.</u></p>	
C. Early Indicators of Potential Remedy Problems	
<p>Describe issues and observations such as unexpected changes in the cost or scope of O&amp;M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.</p> <p><u>None noted.</u></p>	
D. Opportunities for Optimization	
<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p><u>Idle wells should be evaluated for abandonment.</u></p>	

**Appendix D**  
**Public Notice**



Ad Number: d00676613  
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Size: B&W  
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Client Name: AECOM  
Advertiser: AECOM  
Section/Page/Zone: Region/D006/  
Description: United States Navy 5 year review re

TRUMP CAMPAIGNS IN CONNECTICUT



Republican presidential candidate Donald Trump speaks during a campaign rally at Sacred Heart University on Saturday in Fairfield.

EVAN VUCCI/AP PHOTO

Man pleads guilty to role in murder-for-hire plot

**Boston** (AP) — A Massachusetts man has pleaded guilty to his role in a murder-for-hire plot. Massachusetts U.S. Attorney Carmen Ortiz says 52-year-old Everett resident Joseph Burke pleaded guilty Friday in federal court in Boston to using facilities of interstate commerce in commission

of a murder-for-hire.

Prosecutors say the murder plot was developed through a series of meetings between Burke and an undercover federal agent. Burke told the agent that he needed money and was willing to commit murder.

Burke eventually agreed to

kill a man the agent said was “causing problems.” Burke and the agent met several times to discuss logistics of the murder. Burke said he would shoot the man in the head.

Scheduling is sentenced for Nov. 15. Burke is expected to be sentenced to 90 months in prison.

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PUBLIC MEETING  
NAVAL SUBMARINE BASE NEW LONDON  
FIVE YEAR REVIEW  
AND  
RESTORATION ADVISORY BOARD (RAB)  
MEETING

Wednesday, August 31, 2016

US NAVY Submarine Force Museum,  
US Naval Submarine Base New London,  
One Crystal Lake Road, Groton, CT  
Meeting begins at 7:00 pm

The local press and public are invited to attend these meetings and questions from the public are welcome. You can meet fellow citizens and representatives from the Navy, the U.S. Environmental Protection Agency, and the Connecticut Department of Energy and Environmental Protection, and you can help plan studies and restorations of cleanup sites.

For additional information please contact Ms. Tracey McKenzie at 860.694.5649.

WEEKAPAUG INN  
WEEKAPAUG, RHODE ISLAND

THURSDAY NIGHT CLAMBAKES  
AUGUST 18, 25

Lobster, seafood and barbeque favorites await you and your family at our classic New England clambake every Thursday throughout the summer.

Seatings from 5:30 to 8:00 p.m.; \$85/ adult, \$40/ child ages 4 to 12,  
children ages 3 and under complimentary (plus tax and gratuity);  
includes house beer, wine, soda and valet parking

AMERICAN SONGBOOK: LOVE SONGS  
ON THE POND WITH CHRIS JASON  
AUGUST 26

With more than 15 years of experience performing the works of Frank Sinatra, Chris Jason will delight your ears as he pays tribute to an American icon.

Find your spot on the lawn and enjoy the show.  
8:00 to 9:30 p.m.; \$45/ adult, \$20/ child ages 4 to 12,  
children ages 3 and under are complimentary (plus tax and gratuity);  
includes entertainment and a dessert buffet

RESERVATIONS 855.709.6394 WWW.WEEKAPAUGINN.COM



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OCEAN HOUSE  
WATCH HILL, RHODE ISLAND

Coming Up at Ocean House

LOBSTER BOILS & BBQS  
AUGUST 19 & SEPTEMBER 3

Our favorite summertime tradition continues throughout the summer. Enjoy the freshest seafood from local waters, classic BBQ fare and live music by the sea.  
Seatings from 6:00 to 9:00 p.m.; \$110/ adult, \$55/ child  
ages 4 to 12, children ages 3 and under are free (plus tax and gratuity);  
includes house beer, wine, soda and valet parking

DINNER AND DISNEY TUNES  
AUGUST 28

Pack up your wands and wings for a whimsical evening of music and magic. Sure to create lasting childhood memories, this event includes visits from some of the Disney characters themselves, musical performances of your favorite Disney tunes and a delicious dinner buffet.  
6:00 to 8:00 p.m.; \$45/ person, \$25/ child ages 4 to 12,  
children ages 3 and under are free (plus tax and gratuity)

RESERVATIONS 877.511.8862 WWW.OCEANHOUSEEVENTS.COM

THE UNITED STATES NAVY  
ANNOUNCES  
NOTICE OF AVAILABILITY  
FOURTH FIVE-YEAR REVIEW REPORT  
NAVAL SUBMARINE BASE NEW LONDON  
GROTON, CONNECTICUT

The United States Navy (Navy) in coordination with the U.S. Environmental Protection Agency (U.S. EPA) and the Connecticut Department of Energy and Environmental Protection (CTDEEP) has completed the **Fourth Five-Year Review Report** for Environmental Restoration (ER) activities at Naval Submarine Base New London (NSB NLON).

This report was prepared by the Navy as part of the ER Program for the Department of the Navy, following U.S. EPA guidelines under the Comprehensive Environmental Response, Compensation, and Liability Act. The Navy conducted the five-year review with the evaluation of pending, completed, and ongoing remedial actions implemented at ER sites at NSB NLON. The review of seven operable units where remedial activities have been initiated since December 1996, and site-related contaminants that remain at levels above those that would allow for unrestricted use, were included in this five-year review report.

The Draft Fourth Five-Year Review Report is available in hardcopy for public review at the following repositories:

Groton Public Library Bill Library  
(860) 441-6750 (860) 464-9912  
52 Newtown Road 718 Colonel Ledyard Highway  
Groton, Connecticut 06340 Ledyard, Connecticut 06399

For more information, please call Mr. Christopher Zendan, the NSB NLON Public Affairs Officer, at (860) 694-5980 or contact Ms. Nicole Cowand, Naval Facilities Engineering Command, Mid-Atlantic, 9324 Virginia Avenue, Building Z144, Norfolk, VA 23511.





**FIVE-YEAR REVIEW PUBLIC MEETING  
AND RESTORATION ADVISORY BOARD (RAB) MEETING  
SIGN-IN SHEET**

**August 31, 2016 7:00 PM**

Naval Submarine Base New London, Groton, Connecticut

Name (Printed)	Organization/Affiliation	E-Mail Address	Phone Number
1. Nicole Cowand	NAVFAC Midlant	nicole.cowand@navy.mil	757-341-2009
2. Tracey McKenzie	SUBASE NAVFAC MIDLANT PWD EV	tracey.p.mckenzie@navy.mil	860-694-5649
3. Alexandra Stark	Resolution Consultants	astark@ensafe.com	860-920-5172
4. Rob McCarthy	Resolution Consultants	Rmccarthy@ensafe.com	860-665-1140
5. Ken Feathers	CT Dept Energy & Env Prot	kenneth.feathers@ct.gov	860-424-3770
6. Marian Galbraith	City of Groton	Mayor@cityofgroton-ct.gov	860-446-4101
7. CHRIS ZENAW	SUBASE PAD	CHRIS.ZENAW@NAVY.MIL	860-694-5980
8. PAUL WHITESCARVER	SUBASE CO	paul.whitescarver@NAVY.MIL	860-694-3400
9. Kymberlee Keckler	USEPA	keckler.kymberlee@epa.gov	617.918.1385
10. RICH MERRILL	PLW EY	rich.merrill@navy.mil	(860)694-5140
11. REGINALD PRESTON	SUB FORCE MUSEUM	reginald.a.preston@navy.mil	860-694-4226
12. JOEL STRAUS	NAVFAC MEDLANT	joel.straus@navy.mil	860 694 4480
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## **MEETING AGENDA**

### **PUBLIC MEETING AND RESTORATION ADVISORY BOARD**

Naval Submarine Base New London, Groton, Connecticut

**7:00 PM AUGUST 31, 2016**

Submarine Force Library and Museum  
1 Crystal Lake Road, Groton, CT

### **CALL TO ORDER**

### **WELCOME AND INTRODUCTIONS**

*Michael Brown, SUBASENLON Environmental Division Manager*

*Captain Paul A. Whitescarver, Commanding Officer SUBASENLON*

### **FIVE YEAR REVIEW PUBLIC MEETING**

1. Background
  - a. Process
  - b. Sites Included
2. Site Summaries
  - a. Remedial Action
  - b. Ongoing Activities
3. Issues and Recommendations

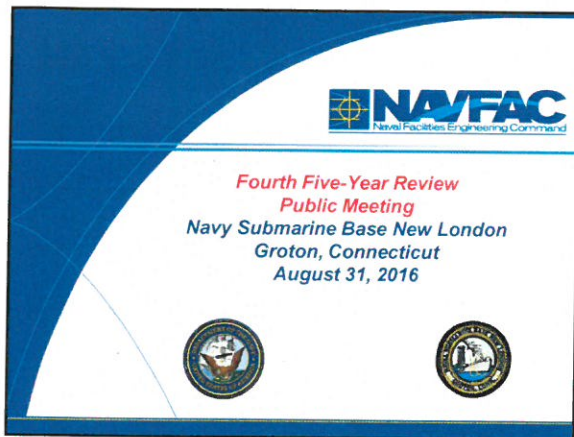
### **RESTORATION ADVISORY BOARD MEETING**

1. CERCLA Process, Construction Completion
  - a. Land use Controls (LUCs) and Remedial Action Completion Reports (RACRs)
  - b. Construction Completion
2. OU4 Soil Remediation
  - a. Remedial Action Status
3. OU4 Sediment Remediation
  - a. Remedial Design Status
  - b. Remedial Action Planning

Submarine Base New London Team Members  
Tracey McKenzie, PWD New London  
Nicole Cowand, NAVFAC Mid Atlantic, North IPT  
Rob McCarthy, Resolution Consultants  
Matthew Panciera, Resolution Consultants  
Alexandra Stark, Resolution Consultants  
Ed Dullaghan, AGVIQ Environmental Services  
Kymberlee Keckler, EPA Region I  
Ken Feathers, CT DEEP

**ADJOURN**





Presentation begins - 7<sup>05</sup> pm

given by - Alexandra Stark, Resolution Consultants


### Fourth Five-Year Review

- Authority for Conducting the Five-Year Review
  - This five-year review was prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section §121(c), as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan in Title 40 Code of Federal Regulations §300.430(f)(4)(ii).
  - The Navy is the lead agency responsible for this five-year review at NSB NLON, working with the United States Environmental Protection Agency (U.S. EPA) Region 1 and the Connecticut Department of Energy and Environmental Protection (CTDEEP) under a Federal Facility Agreement (FFA) (U.S. EPA October 1994).

### Fourth Five-Year Review

- Five-Year Review History
  - This is the Fourth Five-Year Review for NSB NLON
    - Statutory review required because hazardous substances, pollutants, and contaminants remain above levels that allow for unlimited use/unrestricted exposure (UU/UE).
  - The triggering action for the first five-year review was initiation of remedial action at Site 2A — Area A Landfill (OU 1), which began in December 1996.
  - Previous Reviews:
    - First Five-Year Review – December 2001
    - Second Five-Year Review – December 2006
    - Third Five-Year Review – December 2011

## Fourth Five-Year Review



- Purpose
  - Five-year reviews evaluate whether the completed remedies at a CERCLA site are protective of human health and the environment.
  - When the remedy is under construction, it evaluates whether:
    - Immediate threats have been addressed.
    - The remedy is expected to be protective when completed.
  - Five-year reviews answer three key questions:
    - Is the remedy functioning as intended by the decision documents?
    - Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
    - Has any other information come to light that could call into question the protectiveness of the remedy?
  - A five-year review identifies deficiencies and recommends steps to correct them.

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## Fourth Five-Year Review



- Approach
  - Policy and Guidance
    - Chief of Naval Operations Letter 5090 N453 Ser/11U158119 Policy for Conducting Five-Year Reviews (7 June 2011)
    - U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P Comprehensive Five-Year Review Guidance (U.S. EPA June 2001)
    - OSWER Directive 9355.7-18 Recommended Evaluation of Institutional Controls: Supplement to the Comprehensive Five-Year Review Guidance (U.S. EPA June 2011)
    - OSWER Directive 9200.2-111 Clarifying the Use of Protectiveness Determinations for CERCLA Five-Year Reviews (U.S. EPA September 2012)
    - NAVFAC Toolkit for Preparing Five-Year Reviews (NAVFAC April 2013)

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## Fourth Five-Year Review



- Approach
  - Tasks
    - Document Review
    - Site Inspection – performed 14 October 2015
    - Interviews and Community Involvement
    - Technical Assessment
    - Recommendations and Corrective Actions
    - Protectiveness Statements

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### Fourth Five-Year Review



- Sites Included in this Five-Year Review
  - 13 of 24 CERCLA sites evaluated during this five-year review
    - Site 2A, Site 2B, Site 3, Site 6, Site 8, Site 23, Site 9, Sites 10 and 11 (Zone 1); Site 17 (Zone 3); Sites 13 and 19 and Outer Pier 1 (Zone 4), and Sites 21 and 25 (Zone 7).
  - 11 CERCLA sites were not evaluated during this five-year review due to No Further Action RODs or unlimited use/unrestricted exposure (UU/UE) due to remedy completion.
    - Site 1, Site 4, Site 5, Site 7, Site 14, Site 15, Site 16, Site 18, Site 20, Site 22, Site 24 (Zone 6), and Zone 2.

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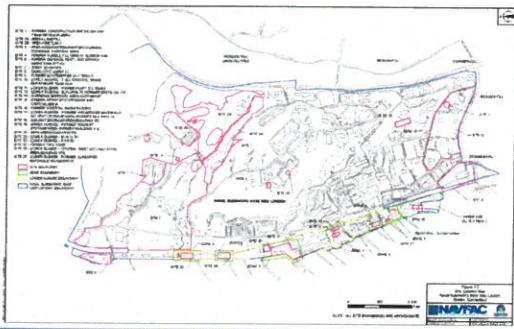
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### Fourth Five-Year Review





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### Fourth Five-Year Review



Site 2A – Area A Landfill – Operable Units 1 and 9

- Current NSB NLON Use: Alpha Lot (storage area)

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### Fourth Five-Year Review



**Site 2A – Area A Landfill – Operable Units 1 and 9**

- Former Landfill: Accepted NSB NLON wastes including: residues from the former base incinerator, refuse, and debris
- COCs: VOCs, SVOCs/PAHs, PCBs, dioxins, pesticides, and metals
- Operable Unit 1 – Source Control
  - Remedy (1996-1997): Cap installation (Subtitle C Landfill), access restrictions, site grading, stormwater management, groundwater and surface water monitoring
- Operable Unit 9 – Groundwater
  - Remedy (2008): Institutional controls and continuation of monitoring described above
- LTM Activities: Groundwater and surface water monitoring, O&M inspections, LUC certifications

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### Fourth Five-Year Review



**Site 2B – Area A Wetland – Operable Units 12 and 9**

- Current NSB NLON Use: None (wetland)

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### Fourth Five-Year Review



**Site 2B – Area A Wetland – Operable Units 12 and 9**

- Source of Contamination: surface releases such as pre-cap runoff from the Area A Landfill (Site 2A) and placement of pesticide bricks within the wetland
- Operable Unit 12 – Sediment
  - COCs: Total PAHs, Total DDT (includes 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD), and Total Aroclors
  - Remedy (2012-2013): Excavation, restoration, seeding, post-construction restoration monitoring, LUCs
- Operable Unit 9 – Groundwater
  - Remedy (2008): Institutional controls and continuation of Site 2A monitoring
- LTM Activities: Groundwater and surface water monitoring (with Site 2A monitoring), restoration inspections, O&M inspections, LUC certifications

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### Fourth Five-Year Review



Site 3 – Area A Downstream Watercourses/Overbank Disposal Area – Operable Units 3 and 9

- Current NSB NLON Use: Recreational Area (encapsulated soil is a heavily wooded, unused area)

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### Fourth Five-Year Review



Site 3 – Area A Downstream Watercourses/Overbank Disposal Area – Operable Units 3 and 9

- Operable Unit 3 – Soil and Sediment
  - Sources of Contamination: Historical application of pesticides to surface water bodies and contaminant migration from placing Thames River dredge spoils at upland sites
  - COCs: pesticides and metals
  - Remedy (1999-2000): Removal, treatment, and discharge of standing water from ponds and streams, dredging/excavating and offsite disposal of contaminated sediment and soil, placing clean soil backfill in dredged sediment areas, post-construction restoration monitoring
  - Explanation of Significant Difference was issued for pipes and soil unable to be removed during the soil/sediment remedy which required concrete encapsulation, LUCs, O&M inspections, and LUC certifications

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### Fourth Five-Year Review



Site 3 – Area A Downstream Watercourses/Overbank Disposal Area – Operable Units 3 and 9

- Operable Unit 9 – Groundwater
  - Suspected Source of Contamination: Migration from upgradient sites
  - COCs: TCE and vinyl chloride
  - Remedy (2005): Institutional controls and monitoring
- LTM Activities (Soil, Sediment, and Groundwater): Groundwater monitoring, O&M inspections, LUC certifications

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### Fourth Five-Year Review



**Site 6 – Former Defense Reutilization and Marketing Office – Operable Unit 2**

- Current NSB NLON Use: Storage area

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### Fourth Five-Year Review



**Site 6 – Former Defense Reutilization and Marketing Office – Operable Unit 2**

- Former Landfill: Accepted NSB NLON wastes including residues from the former base incinerator, refuse, and debris
- COCs: PCBs, PAHs, dioxins, inorganics
- TCRA (1994-1995): Excavation of contaminated soils and installation of a geosynthetic clay liner cap
- Remedy: Institutional controls and monitoring
- LTM Activities: Groundwater monitoring, O&M inspections, LUC certifications (once LUC RD complete)

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### Fourth Five-Year Review



**Site 8 – Goss Cove Landfill – Operable Unit 5**

- Current NSB NLON Use: Submarine Force Library and Museum and parking lot

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Fourth Five-Year Review

Site 8 – Goss Cove Landfill – Operable Unit 5

- Former Landfill: Accepted NSB NLON wastes including residues from former base incinerator, refuse, and debris
- COCs: PAHs, PCBs, metals, and pesticides
- Remedy (2000-2001): Containment via engineered control cap, land use controls, groundwater monitoring
- LTM Activities: Groundwater monitoring, O&M inspections, LUC certifications (once LUC RD complete)

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Fourth Five-Year Review

Site 23 – Former Fuel Farm – Operable Unit 9

- Current NSB NLON Use: Recreational area and fuel storage

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Fourth Five-Year Review

Site 23 – Former Fuel Farm – Operable Unit 9

- Source of Contamination: Former use as a petroleum tank farm; soil was investigated and remediated under RCRA Subtitle I
- Groundwater COCs: PCE, naphthalene, lead, total arsenic, PAHs, and hexachlorobenzene
- Groundwater Remedy: Institutional controls
- LTM Activities: O&M inspections, LUC certifications

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### Fourth Five-Year Review



**Site 9 – Former Wastewater Oily Tank OT-5 – Operable Unit 9**

- Current NSB NLON Use: Military dog training area



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### Fourth Five-Year Review



**Site 9 – Former Wastewater Oily Tank OT-5 – Operable Unit 9**

- Source of Contamination: Oily Tank 5 – initially used to store No. 6 fuel oil but converted to store bilge water and other waste solutions
- Site 9 is located within Site 23
- Groundwater COCs: PCE, naphthalene, lead, total arsenic, PAHs, and hexachlorobenzene
- Groundwater Remedy: Institutional controls
- LTM Activities: O&M inspections, LUC certifications

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### Fourth Five-Year Review



**Operable Unit 4 – Lower Subase**

- Current NSB NLON Use: Submarine docking, maintenance, repair, and overhaul

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### Fourth Five-Year Review



Sites 10 and 11 – Zone 1 – Operable Unit 4

- Suspected Sources of Contamination: Leaks of petroleum products from USTs and subsurface fuel oil distribution lines
- COCs: CPAHs and metals
- TPH above CTDEEP RSRs in soil and groundwater and a thin layer of light non-aqueous phase liquid is being addressed under a separate CTDEEP regulatory program
- Remedy (ongoing): NFA for sediment, groundwater, and surface water; CERCLA risk-based engineering controls, LUCs, and long-term monitoring for soil
- LTM Activities: Groundwater monitoring, O&M inspections, LUC certifications (to be implemented FY 2017)

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### Fourth Five-Year Review



Site 17 – Zone 3 – Operable Unit 4

- Suspected Sources of Contamination: Releases of lead from Former Battery Overhaul Shop, leaks of petroleum products from USTs and fuel distribution lines, steam, condensate, and electrical lines which may have acted as conduits to transport chemicals
- COCs: benzo(a)anthracene and lead
- Remedy (ongoing): NFA for sediment, groundwater, and surface water; CERCLA risk-based engineering controls, CTDEEP RSR engineered controls, LUCs, and long-term monitoring for soil
- LTM Activities: Groundwater monitoring, O&M inspections, LUC certifications (to be implemented FY 2017)

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### Fourth Five-Year Review



Sites 13 and 19 and Outer Pier 1 – Zone 4 – Operable Unit 4

- Soil
  - Suspected Sources of Contamination: Releases of petroleum, waste oil, and solvents from the former waste oil pit at former Building 79 (Site 13), releases of lead from Former Battery Overhaul Shop (Zone 3), releases of solvents stored in former Building 316 (Site 19), leaks of petroleum products from USTs and fuel distribution lines, steam, condensate, and electrical lines which may have acted as conduits to transport chemicals
  - COCs: PAHs and lead
  - Remedy (ongoing): Excavation, CERCLA risk-based engineering controls, LUCs, and long-term monitoring

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### Fourth Five-Year Review



Sites 13 and 19 and Outer Pier 1 – Zone 4 – Operable Unit 4

- Sediment**
  - Suspected Sources of Contamination: Releases from Zone 4 and Lower Subbase, Former Pier 1 marine railway activities (sandblasting, paint scraping, and ship maintenance), releases from the Building 79 waste pit discharge
  - COCs: metals, PAHs, pesticides, and PCBs
  - Remedy (ongoing): dredging, Outer Pier 1 engineering controls, LUCs, and long-term monitoring
- LTM Activities (Soil and Sediment):** Groundwater monitoring, O&M inspections, LUC certifications (to be implemented FY 2017)

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### Fourth Five-Year Review



Sites 21 and 25 – Zone 7 – Operable Unit 4

- Suspected Sources of Contamination:** Former incinerator at Site 25, former PCB-containing transformers at Vault 31 (Building 157), leaks of petroleum products from diesel fuel UST and fuel distribution lines associated with Berth 16, historical uses (including submarine battery maintenance), construction debris, and incinerator ash and cinders, former Dumpster Washing Area (in present day location of Building 456), steam, condensate, and electrical lines which may have acted as conduits to transport chemicals
- COCs: PAHs and metals
- Remedy (ongoing):** NFA for sediment groundwater and surface water, storm sewer upgrades, CERCLA risk-based engineering controls, CTDEEP RSR engineered controls, LUCs, and long-term monitoring or soil
- LTM Activities:** Groundwater monitoring, O&M inspections, LUC certifications (to be implemented FY 2017)

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### Fourth Five-Year Review



**Interviews**

- Formal interviews were not conducted, however, the following personnel were contacted to provide comment and input on site status, condition, and results of the site inspection (this information was incorporated into the site inspection checklists):
  - Nicole Cowand, Navy Remedial Project Manager
  - Tracey McKenzie, Environmental Restoration Navy NSB NLON
  - Kymberlee Keckler, U.S. EPA Region 1 Remedial Project Manager
  - Kenneth Feathers, CTDEEP Remedial Project Manager

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### Fourth Five-Year Review



Site Inspection – 14 October 2015

- All sites were inspected; the following items were noted and incorporated into their respective Issues/Recommendations Tables:
  - Site 2A – persistent cracks with vegetation growth and vehicles parked along slope of Channel A
  - Site 6 – rebar penetration in cap surface, no longer a sign-in desk, inspections of the culvert discharge are difficult due to site fencing

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### Fourth Five-Year Review



Site Inspection – 14 October 2015

Cracks at Site 2A

Vehicles parked on drainage channel slope at Site 2A

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### Fourth Five-Year Review



Site Inspection – 14 October 2015



Trailer tie down at Site 6

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### Fourth Five-Year Review

**Issues and Recommendations**

- **Protectiveness Not Affected**
  - Emerging Contaminants
    - 1,4-dioxane – preliminary evaluation performed during this FYR, further evaluation to be further reviewed in FY 2017
    - PFOAs/PFOSS – preliminary evaluation to be performed FY 2017
  - Annual LUC certifications should be performed
  - O&M procedures should be reviewed to ensure timely reporting
  - Review of LTM data to assess any exceedances
  - O&M Manual Update
    - Reflect new ARARs and optimization of groundwater monitoring (reduction in frequency and/or COCs)
  - Monitoring wells slated for abandonment last FYR have not yet been abandoned
    - Abandonment will occur after the need for emerging contaminant investigation(s) is evaluated

Question - Chris Zendan: what makes emerging contaminants "emerging"

AS - they are "new"; not originally evaluated in ROD

CZ - so closed sites could be reopened due to emerging contaminants

AS - Yes.

### Fourth Five-Year Review


**Issues and Recommendations**

- **Protectiveness Not Affected (continued)**
  - LUC RDs have not been finalized (Sites 2A, 3, 6, and 8)
  - RACRs have not been finalized (Sites 2A, 3, 6, and 8)
  - SUBASENLONINST 5090.25 needs to be revised to prohibit industrial use of groundwater and address vapor intrusion concerns at Site 8 and OU4
  - OU 9 LUC RD needs to be revised to prevent potable use of groundwater and address vapor intrusion concerns at Site 9/23
  - Site 3 - Letter prohibiting construction around 2DMW29S may no longer be required based on groundwater concentrations below RGs
  - There is no groundwater monitoring program at Site 9/23; an evaluation will be performed to determine if one is needed
  - SASE at Site 9 determined NFA for soil above the water table and Draft SASE for Site 23 recommended NFA for soil
    - Path to closure for these two sites needed


### Fourth Five-Year Review

**Issues and Recommendations**

- **Protectiveness Issues**
  - Site 6 cap penetrations from trailer tie downs
    - Indicates SUBASENLONINST 5090.25 is not being properly enforced
    - May have damaged the cap
- **Corrective Actions**
  - Investigate penetration (completed)
  - Repair (once tie downs are removed)
  - Finalize Site 6 LUC RD
  - Implement a Storage Permit as part of LUC RD



### Fourth Five-Year Review



- **Protectiveness Summary**
  - All remedies are currently protective of human health and the environment.
    - Two deficiencies at Site 6 (related to the rebar penetration) were identified during the Fourth Five-Year Review which affect future protectiveness.
    - Addressing future protectiveness issues at Site 6 will ensure all remedies are protective of human health and the environment (current, and future).
    - These protectiveness issues will be addressed by 31 July 2017.
  - The Fourth Five-Year Review Report will be finalized and submitted by 20 December 2016.

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### Fourth Five-Year Review



- Public Notice of the Fourth Five-Year Review Report was provided in *The Day* on August 14, 2016.

**THE UNITED STATES NAVY**  
**BRIDGEPORT**  
**NOTICE OF AVAILABILITY**  
**FOURTH FIVE YEAR REVIEW REPORT**  
**NAVAL SUBMARINE BASE NEW LONDON**  
**GROTON, CONNECTICUT**

The United States Navy (USN) is in compliance with the U.S. Environmental Protection Agency (EPA) and the Connecticut Department of Energy and Environmental Protection (CTDEEP) for the submission of a Fourth Five-Year Review Report for Environmental Restoration (ER) activities at Naval Submarine Base Groton, Connecticut.

The report was prepared by the Navy as part of the ER Program for the Department of the Navy, following U.S. EPA guidelines under the Comprehensive Environmental Response, Compensation, and Liability Act. The report contained the Navy's assessment of the remediation of existing, completed, and ongoing remedial actions implemented at USNSB in 1995-2015. The review of these activities and other remedial activities have been submitted to the CTDEEP for review and approval. The review of these activities and other remedial activities have been submitted to the CTDEEP for review and approval. The review of these activities and other remedial activities have been submitted to the CTDEEP for review and approval.

The Draft Fourth Five Year Review Report is available in hardcopy for public review at the following locations:

Groton Public Library	60 Library
1901 1st St	06340 and 06122
US Navy Base	131 Colonel Ledyard Highway
Groton, Connecticut 06340	Ledyard, Connecticut 06339

For more information, please call the Commander, USNSB, Mr. Mike Miller, Public Affairs Officer at (860) 426-0000 or contact the Naval Command, Naval Facilities Engineering Command, 1600 Wilson, 2222 Taylor Avenue, Building 2244, Norfolk, VA 23511.

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### Fourth Five-Year Review



- The report is available for review in the Public Repositories:
  - Groton Public Library  
52 Newtown Road  
Groton, CT 06340  
860-441-6750
  - Bill Library  
718 Colonel Ledyard Highway  
Ledyard, CT 06339  
860-464-9912
- The report is also available for download on the Administrative Record

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**Appendix E**  
**Dioxin Information**

**Table E-1**  
**Comparison of Dixoin Regional Screening Levels**  
**Naval Submarine Base New London, Groton, Connecticut**

Analyte	Chemical Abstract Number	Resident Soil (mg/kg)	Industrial Soil (mg/kg)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
<b>Dioxins</b>					
Hexachlorodibenzo-p-dioxin, Mixture	Not Applicable	1.00E-04	4.70E-04	1.70E-05	Not Available
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	4.80E-06	2.20E-05	5.90E-08	1.50E-05
<b>Furans</b>					
Dibenzofuran	132-64-9	7.30E+00	1.00E+02	1.50E-02	Not Available

Source: Regional Screening Levels (RSLs) - Generic Tables (November 2015)  
[http://www.epa.gov/sites/production/files/2015-12/documents/master\\_sl\\_table\\_01run\\_nov2015.pdf](http://www.epa.gov/sites/production/files/2015-12/documents/master_sl_table_01run_nov2015.pdf)

**Notes:**

mg/kg milligrams per kilogram  
MCL Maximum contaminant level  
SSL Soil screening level

**Appendix F**  
**Monitoring Criteria**

**Table F-1**  
**Groundwater Comparison Criteria and Background Groundwater Concentrations for Site 2A**  
**Naval Submarine Base New London, Groton, Connecticut**

Constituent	Evaluated Criteria		Selected Criterion
	Background Concentration <sup>(1)</sup>	CTDEEP WQS Aquatic Life <sup>(2)</sup>	
Semivolatile Organic Compounds and Polynuclear Aromatic Hydrocarbons (µg/L)			
Benzo(a)anthracene	NA	4.7 <sup>(3)</sup>	4.7 <sup>(4)</sup>
Benzo(a)pyrene	NA	0.06 <sup>(3)</sup>	0.06 (0.1) <sup>(4,5)</sup>
Benzo(b)fluoranthene	NA	2.6 <sup>(3)</sup>	2.6 <sup>(4)</sup>
Benzo(k)fluoranthene	NA	NC	2.6 <sup>(6)</sup>
Bis-2-Ethylhexyl phthalate	NA	1 <sup>(3)</sup>	1 (5) <sup>(4,5)</sup>
Phenanthrene	NA	2.3 <sup>(3)</sup>	2.3 <sup>(4)</sup>
Metals (µg/L)			
Arsenic	1.92	150 <sup>(7,8)</sup>	150 <sup>(9,10,11)</sup>
Cadmium	NA	0.125 <sup>(7,8)</sup>	0.125 <sup>(9,11)</sup>
Chromium (trivalent/hexavalent)	49.9 (total)	42 <sup>(7,8)</sup> /11 <sup>(7)</sup>	49.9 <sup>(9,11)</sup> /11 <sup>(9)</sup>
Copper	107	4.8 <sup>(7,8)</sup>	107 <sup>(9)</sup>
Lead	6.63	1.2 <sup>(7,8)</sup>	6.63 <sup>(9)</sup>
Zinc	131	65 <sup>(7,8)</sup>	131 <sup>(9)</sup>

**Notes:**

Source: Table 2-11 of the Operations and Maintenance Manual, Volume II - Groundwater Monitoring Plan (Tetra Tech July 2011).

CTDEEP WQS Connecticut Department of Energy and Environmental Protection Water Quality Standards

ug/L micrograms per liter

NA Not Available

NC No CTDEEP 2009 proposed or 2011 promulgated criteria

(1) Total background concentration from Basewide Groundwater Operable Unit Remedial Investigation (Tetra Tech September 2002).

(2) Criterion for freshwater at a continuous (chronic) concentration.

(3) Proposed CTDEEP Revisions to Connecticut WQS, Groundwater Quality Standards, Issued for Public Comment on 22 December 2009.

(4) There is no promulgated CTDEEP aquatic life WQS for this parameter; therefore, the 2009 proposed criterion is to be considered (TBC).

(5) Because the criterion is below the detection limit, the goal will be to meet the detection limit. The TBC criterion is provided outside the parentheses and the detection limit is provided inside the parentheses.

(6) CTDEEP 2009 proposed chronic aquatic life Water Quality Criterion for benzo(b)fluoranthene selected as surrogate TBC criterion for benzo(k)fluoranthene.

(7) CTDEEP Revisions to Connecticut WQS, Groundwater Quality Standards, Effective 25 February 2011.

(8) Criterion is a function of hardness. The default criterion provided corresponds to a hardness of 50 milligrams per liter (Reference: Technical Supporting Information for Proposed Revisions to the Connecticut WQS: Ambient Water Quality Criteria, 28 January 2010).

(9) Criterion should be compared to total concentration.

(10) Resolution of Monitoring Criteria Issues for Site 2A – Area A Landfill, Rev 2 Issue: 27 April 2011 (Tetra Tech April 2011).

(11) If the the criterion is exceeded, adjustment of criteria to account for hardness could be considered with further input from CTDEEP.

**Table F-2**  
**Surface Water Comparison Criteria and Background Groundwater Concentrations for Site 2A**  
**Naval Submarine Base New London, Groton, Connecticut**

Constituent	CTDEEP WQS	Selected Criterion
	Aquatic Life <sup>(2)</sup>	
Semivolatile Organic Compounds and Polynuclear Aromatic Hydrocarbons (µg/L)		
Benzo(a)anthracene	4.7 <sup>(2)</sup>	4.7 <sup>(3)</sup>
Benzo(a)pyrene	0.06 <sup>(2)</sup>	0.06 (0.1) <sup>(3,4)</sup>
Benzo(b)fluoranthene	2.6 <sup>(2)</sup>	2.6 <sup>(3)</sup>
Benzo(k)fluoranthene	NC	2.6 <sup>(5)</sup>
Bis-2-Ethylhexyl phthalate	1 <sup>(2)</sup>	1 (5) <sup>(3,4)</sup>
Phenanthrene	2.3 <sup>(2)</sup>	2.3 <sup>(3)</sup>
Metals (µg/L)		
Arsenic	150 <sup>(6,7)</sup>	150 <sup>(8,9,10)</sup>
Cadmium	0.125 <sup>(6,7)</sup>	0.125 <sup>(8,10)</sup>
Chromium (trivalent/hexavalent)	42 <sup>(6,7)</sup> /11 <sup>(6)</sup>	42 <sup>(8,10)</sup> /11 <sup>(8)</sup>
Copper	4.8 <sup>(6,7)</sup>	4.8 <sup>(8,10)</sup>
Lead	1.2 <sup>(6,7)</sup>	1.2 <sup>(8,10)</sup>
Zinc	65 <sup>(6,7)</sup>	65 <sup>(8,10)</sup>

**Notes:**

- Source: Table 2012 of the Operations and Maintenance Manual, Volume II - Groundwater Monitoring Plan (Tetra Tech July 2011).
- CTDEEP WQS Connecticut Department of Energy and Environmental Protection Water Quality Standards
- ug/L micrograms per liter
- NC No CTDEEP 2009 proposed or 2011 promulgated criteria
- (1) Criterion for freshwater at a continuous (chronic) concentration.
- (2) Proposed CTDEEP Revisions to Connecticut WQS, Groundwater Quality Standards, Issued for Public Comment on 22 December 2009.
- (3) There is no promulgated CTDEEP aquatic life WQS for this parameter; therefore, the 2009 proposed criterion is to be considered (TBC).
- (4) Because the criterion is below the detection limit, the goal will be to meet the detection limit. The TBC criterion is provided outside the parentheses and the detection limit is provided inside the parentheses.
- (5) CTDEEP 2009 proposed chronic aquatic life Water Quality Criterion for benzo(b)fluoranthene selected as surrogate TBC criterion for benzo(k)fluoranthene.
- (6) CTDEEP Revisions to Connecticut WQS, Groundwater Quality Standards, Effective 25 February 2011.
- (7) Criterion is a function of hardness. The default criterion provided corresponds to a hardness of 50 milligrams per liter (Reference: Technical Supporting Information for Proposed Revisions to the Connecticut WQS: Ambient Water Quality Criteria, 28 January 2010).
- (8) Criterion should be compared to dissolved concentration.
- (9) Resolution of Monitoring Criteria Issues for Site 2A – Area A Landfill, Rev 2 Issue: 27 April 2011 (Tetra Tech April 2011).
- (10) If the the criterion is exceeded, adjustment of criteria to account for hardness could be considered with further input from CTDEEP.



**Table F-3**  
**Monitoring Criteria and Background Groundwater Concentrations for Site 6**  
**Naval Submarine Base New London, Groton, Connecticut**

Chemical of Concern	Evaluated Primary Monitoring Criteria				Selected Criterion <sup>(5)</sup>
	Background Concentration <sup>(1)</sup>	Site-Specific SWPC <sup>(2)</sup>	CTDEEP SWPC <sup>(3)</sup>	CTDEEP Volatilization <sup>(4)</sup>	
Volatile Organic Compounds (µg/L)					
1,1,2,2-Tetrachloroethane	NA	400	110	54	54
1,2-Dichloroethane	NA	3,700	2,970	68	68
1,2-Dichloroethene (total)	NA	1,000,000	NA	24,000 <sup>(6)</sup>	24,000 <sup>(6)</sup>
Trichloroethene	NA	3,000	2,340	67	67
Vinyl chloride	NA	240	15,750	52	52
Semivolatile Organic Compounds and Polynuclear Aromatic Hydrocarbons (µg/L)					
Benzo(a)anthracene	NA	1.8	0.3	NA	1.8
Benzo(a)pyrene	NA	1.8	0.3	NA	1.8
Benzo(b)fluoranthene	NA	1.8	0.3	NA	1.8
Benzo(k)fluoranthene	NA	1.8	0.3	NA	1.8
Benzoic acid	NA	224,000,000 <sup>(7)</sup>	NA	NA	224,000,000 <sup>(7)</sup>
bis(2-Ethylhexyl) phthalate	NA	220	59	NA	220
Fluoranthene	NA	128	3,700	NA	3,700
Fluorene	NA	4,920	140,000	NA	140,000
Naphthalene	NA	2,051,300	NA	NA	2,051,300
Phenanthrene	NA	4,917	0.3	NA	4,917
Pyrene	NA	4,917	110,000	NA	110,000
Metals (µg/L)					
Arsenic	1.92	10(8)	4	NA	10 <sup>(9)</sup>
Barium	227	22,000 <sup>(7)</sup>	NA	NA	22,000 <sup>(7,9)</sup>
Cadmium	NA	12.5	6	NA	12.5 <sup>(9)</sup>
Chromium (hexavalent)	49.9 <sup>(10)</sup>	1,100	110	NA	1,100 <sup>(9)</sup>
Copper	107	310	48	NA	310 <sup>(9)</sup>
Lead	6.63	120	13	NA	120 <sup>(9)</sup>
Silver	NA	102	12	NA	102 <sup>(9)</sup>
Zinc	131	6,500	123	NA	6,500 <sup>(9)</sup>

**Notes:**

Source: Table 2-26 the Operations and Maintenance Manual, Volume II - Groundwater Monitoring Plan (Tetra Tech July 2011).

SWPC Surface Water Protection Criteria  
CTDEEP Connecticut Department of Energy and Environmental Protection  
µg/L micrograms per liter  
NA Not Available

- (1) Total metals background concentration from Basewide Groundwater Operable Unit Remedial Investigation (Tetra Tech September 2002).
- (2) Calculated SWPC for substances in groundwater, using a site-specific dilution factor (see Appendix II-G of the Operations and Maintenance Manual).
- (3) SWPC for substances in groundwater (CTDEEP 2007).
- (4) Industrial/commercial Volatilization Criteria for groundwater (CTDEEP 2007)
- (5) Criterion selected for comparison against groundwater concentrations.
- (6) Total of criterion for cis-1,2-dichloroethene and trans-1,2-dichloroethene.
- (7) 2011 promulgated Water Quality Standards do not include criterion for this parameter; therefore, 2009 proposed criterion is to be considered (TBC).
- (8) CTDEEP Promulgated Alternative SWPC (3 February 2009 email).
- (9) Criteria should be compared to total concentration.
- (10) Background concentration for total chromium.

**Table F-4**  
**Monitoring Criteria and Background Groundwater Concentrations for Site 8**  
**Naval Submarine Base New London, Groton, Connecticut**

Chemical of Concern	Evaluated Primary Monitoring Criteria				Selected Criterion <sup>(5)</sup>
	Background Concentration <sup>(1)</sup>	Site-Specific SWPC <sup>(2)</sup>	CTDEEP SWPC <sup>(3)</sup>	CTDEEP Volatilization <sup>(4)</sup>	
Volatile Organic Compounds (µg/L)					
Methylene chloride	--	59,000	48,000	2,200	2,200
Tetrachloroethene	--	330	88	810	330
Xylenes	--	2,700 <sup>(6)</sup>	NA	48,000	2,700 <sup>(6)</sup>
Semivolatile Organic Compounds and Polynuclear Aromatic Hydrocarbons (µg/L)					
Benzo(a)anthracene	--	1.8	0.3	NA	1.8
Benzo(a)pyrene	--	1.8	0.3	NA	1.8
Benzo(b)fluoranthene	--	1.8	0.3	NA	1.8
Benzo(g,h,i)perylene	--	492	NA	NA	492
Benzo(k)fluoranthene	--	1.8	0.3	NA	1.8
bis(2-Ethylhexyl) phthalate	--	220	59	NA	220
Carbazole	--	300 <sup>(6)</sup>	NA	NA	300 <sup>(6)</sup>
Chrysene	--	1.8	NA	NA	1.8
Dibenzo(a,h)anthracene	--	1.0	NA	NA	1.0
Fluoranthene	--	128	3,700	NA	3,700
Indeno(1,2,3-cd)pyrene	--	1.8	NA	NA	1.8
Phenanthrene	--	4,917	0.3	NA	4,917
Pyrene	--	4,917	110,000	NA	110,000
Metals (µg/L)					
Antimony	2.90	64,000	86,000	NA	86,000 <sup>(7)</sup>
Arsenic	1.92	10 <sup>(8)</sup>	4	NA	10 <sup>(7)</sup>
Beryllium	NA	13	4	NA	13 <sup>(7)</sup>
Cadmium	NA	12.5	6	NA	12.5 <sup>(7)</sup>
Copper	107	310	48	NA	310 <sup>(7)</sup>
Lead	6.63	120	13	NA	120 <sup>(7)</sup>
Mercury	NA	5.1	0.4	NA	5.1 <sup>(7)</sup>
Nickel	32.2	820	880	NA	880 <sup>(7)</sup>
Vanadium	10.2	4,400 <sup>(6)</sup>	NA	NA	4,400 <sup>(6,7)</sup>
Zinc	131	6,500	123	NA	6,500 <sup>(7)</sup>

**Notes:**

Source: Table 2-35 the Operations and Maintenance Manual, Volume II - Groundwater Monitoring Plan (Tetra Tech July 2011).

SWPC Surface Water Protection Criteria

CTDEEP Connecticut Department of Energy and Environmental Protection

ug/L micrograms per liter

NA Not Available

(1) Total inorganic background concentration from Basewide Groundwater Operable Unit Remedial Investigation (Tetra Tech September 2002).

(2) SWPC for substances in groundwater using a site-specific dilution factor (see Appendix II-G of the Operations and Maintenance Manual)).

(3) SWPC for substances in groundwater (CTDEEP 2007).

(4) Industrial/Commercial Volatilization Criteria for groundwater (CTDEEP 2007).

(5) Criterion selected for comparison against groundwater concentrations.

(6) 2011 promulgated Water Quality Standards do not include a criterion for this parameter; therefore, the 2009 proposed criterion is to be considered.

(7) Criteria should be compared to total concentration.

(8) CTDEEP Promulgated Alternative SWPC (February 3, 2009 email).